Rail Baltica

Co-funded by the European Union

Economic Assessment of the Rail Baltica Project: Phase 1 Cost-Benefit Analysis

December 2024

(v1.1.1)

RailBaltica.org

1 Table of Contents

1 TABLE OF CONTENTS 3
2 LIST OF ABBREVIATIONS AND GLOSSARY 8
3 EXECUTIVE SUMMARY 11
4 ECONOMIC APPRAISAL INTRODUCTION 13
4.1 Purpose of the Economic Appraisal 13
4.2 Structure of the Economic Appraisal 14
4.3 Methodology and Reference Framework 16
5 PROJECT CONTEXT 18
5.1 Project Definition 18
5.2 The Baltic Sea Region 20
5.3 Macroeconomic Overview 23
5.3.1 Population Decline 24
5.3.2 GDP Growth 24
5.3.3 Inflation 25
5.3.4 Construction Market Capacity 26
5.4 Geopolitical Overview and Effects of the War in Ukraine 27
5.4.1 Geopolitical Overview 27
5.4.2 Effects of the War in Ukraine 28
5.5 Transportation Market 30
5.5.1 Passenger 31
5.5.2 Freight 32
5.6 Value Proposition of Rail Baltica Phase 1 35
5.6.1 Passenger 35
5.6.2 Freight 48
5.7 Stakeholder Mapping 54
5.7.1 Project Stakeholders 55
5.7.2 The Broader Audience 58
5.8 Regulatory & Compliance 59
6 OBJECTIVES 61
6.1 Operational and Financial Objectives 61
6.2 Socio–Economic Objectives 64
6.2.1 Direct Socio-Economic Objectives 65
6.2.2 Wider Socio-Economic Objectives 68
7 PROJECT SPECIFICATION 71
7.1 Project Governance 71
7.2 Geographic Scope 72

7.3 Connectivity to Adjacent Transport Infrastructure 74
7.4 Technical Design 77
7.5 Timeline and Phased Delivery Implications 79
8 ASSUMPTIONS 83
8.1 Core Assumptions 83
8.1.1 Price Levels 83
8.1.2 Financial Discount Rate 83
8.1.3 Social Discount Rate 84
8.1.4 Useful Economic Life and Reference Period 86
8.1.5 Residual Value 86
8.1.6 Geographic Scope and Catchment Area 86
8.2 Operational Assumptions 92
8.3 Financial Assumptions 93
8.4 Socio-Economic Assumptions 96
8.5 Transport Mode Characteristics 98
8.6 Environmental Assumptions 106
9 TRAFFIC DEMAND FORECASTING 110
9.1 Objective of Traffic Flow Modeling 110
9.2 Modeling Approach 111
9.3 Validation of the RBM Demand Model 112
9.4 Model Inputs and Assumptions 113
9.4.1 Macroeconomic Environment 113
9.4.2 Infrastructure Network 115
9.4.3 Rail Baltica Services 115
9.4.4 Microeconomic Assumptions 117
9.5 Output Analysis 118
9.5.1 Passenger Demand 119
9.5.2 Freight 124
10 FINANCIAL ANALYSIS 133
10.1 Infrastructure Manager Financial Analysis 133
10.1.1 Track Access Charge Calculation 135
10.1.2 Asset Renewal & Maintenance 140
10.1.3 Train Services 143
10.2 Capital Expenditure 144
10.2.1 Capital Expenditure for RB Phase 1 145
10.2.2 Mainline Capital Expenditures 149
10.2.3 PTO Capital Expenditures 150
10.2.4 Global Project Activities Capital Expenditures 151
10.2.5 Country Comparison 151

10.2.6 CAPEX Phasing ... 152
10.2.7 Benefits and Risks of Single-track ... 154

10.3 Passenger Carrier Financial Analysis ... 156
10.3.1 High-Speed Carrier ... 157
10.3.2 Night Carrier ... 158
10.3.3 Regional Carrier ... 159

10.4 Freight Carrier Financial Analysis ... 160
10.4.1 Unitised Freight ... 161
10.4.2 Non-Unitised Freight ... 162

10.5 Electricity Resale Analysis ... 163

10.6 Facilities Financial Analysis ... 164
10.6.1 Passenger Stations Financial Analysis ... 164
10.6.2 Freight Terminals Financial Analysis ... 165

10.7 Country-Level Financial Analysis ... 166
10.7.1 Estonia ... 166
10.7.2 Latvia ... 169
10.7.3 Lithuania ... 171

10.8 Financial Analysis Results ... 173
10.8.1 Financial Net Present Value ... 173
10.8.2 Financial Rate of Return ... 177

10.9 Financing Plan ... 177
10.9.1 Introduction ... 177
10.9.2 Key Financing Sources ... 177
10.9.3 Financial Sustainability Analysis ... 182
10.9.4 Financing of the Construction and Operational Phases ... 185
10.9.5 Financing Sensitivity Analysis ... 189
10.9.6 Conclusions ... 192

10.10 Sensitivity Analysis ... 193
10.10.1 Sensitivity of Drivers ... 193
10.10.2 Passenger TAC ... 196

11 SOCIO-ECONOMIC ANALYSIS ... 197

11.1 Methodology Overview ... 197

11.2 Socio-Economic Impact Summary (NPV) ... 198

11.3 Socio-Economic Impact Components ... 199
11.3.1 Transport Value Chain Impact ... 199
11.3.2 Passenger Impacts ... 202
11.3.3 Freight Shipper Impact ... 210
11.3.4 Environmental Impacts ... 214
11.3.5 Labor Market Impacts ... 222

11.4 Socio-Economic Impact Analysis Results and Sensitivity Analysis ... 223

12 CONCLUSION OF ECONOMIC VIABILITY AND KEY PERFORMANCE INDICATORS ... 225

13 PHASE 1 EXTENDED SCENARIO 227
13.1 Extended Scenario Scope Definition 227
13.1.1 CAPEX Changes 227
13.1.2 Service Concept Changes 232
13.2 Traffic Demand 233
13.2.1 Passenger Traffic 233
13.2.2 Freight Traffic 235
13.3 Financial Analysis 236
13.3.1 Main Operations 238
13.3.2 Other Operations 239
13.3.3 Financial sustainability 239
13.4 Socio-Economic Analysis 240
13.5 Conclusion 242
13.5.1 Impact of Earlier Operational Start of RB1 244
13.5.2 Impact of Change in PTOs and Related Services 245
13.5.3 Impact of Variable-Gauge Trains 246
14 RISK AND REGULATORY 247
14.1 Risks and Mitigation 247
14.1.1 General Risks 249
14.1.2 Construction Phase Risks 252
14.1.3 Operation Phase Risks 255
14.2 Regulatory and Compliance 256
14.2.1 Environment 257
14.2.2 Railway 261
14.2.3 Competition 264
15 WIDER ECONOMIC IMPACT ANALYSIS 265
15.1 Introduction 265
15.2 General Literature Overview 266
15.3 Wider Economic Impact Overview 267
15.4 Economic Growth in the Catchment Area 270
15.4.1 GDP Contribution of Rail Baltica 270
15.4.2 Land Value Increase 274
15.4.3 Tourism and Hospitality 275
15.4.4 New Business Creation and Innovation 276
15.4.5 Productivity Growth and Agglomeration Effects 276
15.4.6 Inflow of Residents 277
15.4.7 Increased Market Competition 278
15.5 Enhanced Military Mobility 278
15.5.1 Enhanced Military Mobility in Armed Conflict 278
15.5.2 Enhanced Military Mobility in Peacetime 279
15.6 Improved Global Supply Chain Integration 281

15.6.1 TEN-T Core Network and Baltic-Adriatic Corridor 281
15.6.2 Asia – EU Land Corridor 281
15.6.3 Economic Rehabilitation of Ukraine 282

15.7 Improved Social Equity 284
15.7.1 Affordability 284
15.7.2 Accessibility for Reduced Mobility Passengers 286
15.7.3 Social Cohesion and Equal Opportunity 287
15.7.4 Wellbeing and Environmental Equality 288
15.7.5 Safety and Security 288

15.8 Environmental sustainability 289
15.8.1 Reduced Demand for Fossil Fuels 289
15.8.2 Induced Investment in Renewables 290
15.8.3 Short-Haul Flight Replacement 291

15.9 Corridor Synergies 292
15.9.1 Telecom Synergies 292
15.9.2 Local Transport Connections 292

15.10 WEI Conclusions and Recommendations 294

16 APPENDIX 296

16.1 Risk Mapping 296

16.2 Detailed Macroeconomic Overview 313
16.2.1 Population Decline in the Baltics 314
16.2.2 GDP Growth 316
16.2.3 Effects of the War in Ukraine 318

17 BIBLIOGRAPHY 328

2 List of Abbreviations and Glossary

Abbreviation	Meaning
AI	Artificial Intelligence
AsBo	Assessment Body, a body responsible for evaluating and assessing the safety levels of specific railway components or subsystems
ASTRA	ASsessment of TRAnsport Strategies, an integrated assessment model designed by the EC for strategic policy assessment of transport policies and investments
B2B	Business to Business
B2C	Business to Customer
BEV	Battery Electric Vehicle
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditures
CBA	Cost-Benefit Analysis
CCI	Construction Cost Index
CCS	Command-Control and Signaling system
CER	Community of European Railway and Infrastructure Companies
CEF	Connecting Europe Facility
CPI	Consumer Price Inflation
EBRD	European Bank for Reconstruction and Development
EBT/EBIT	Earnings Before Taxes/Earnings Before Interest and Taxes
EC	European Commission
ECBA	Economic Cost-Benefit Analysis
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EIM	European Rail Infrastructure Managers
END	Environmental Noise Directive
ENE	Railway Energy Costs
ENPV	Economic Net Present Value
EoY	End of Year
ERDF	European Regional Development Fund
ERFA	European Rail Freight Association
ERTMS	European Rail Traffic Management System
EU	European Union
EU ETS	EU Emissions Trading System
EU TEN-T	European Union's Trans-European Transport Network
FCBA	Financial Cost-Benefit Analysis
FCV	Fuel Cell Vehicle
FDI	Foreign Direct Investment

FDR	Financial Discount Rate
FNPV (C)	Financial Net Present Value on Investment
FNPV (K)	Financial Net Present Value on National Capital
FRR (C)	Financial Rate of Return on Investment
FRR (K)	Financial Rate of Return on National Capital
GDP	Gross Domestic Product
GDP PPP	Gross Domestic Product based on Purchasing Power Parity
GHG	Greenhouse Gas
GNI	Gross National Income
GTFS	General Transit Feed Specification
H&S	Health and Safety
HSR	High-Speed Rail
ICT	Information and Communication Technology
IM	Infrastructure Manager
MDST	MDS Transmodal, a firm of transport economists which specializes particularly in freight modes of transport, providing datasets for RB's traffic demand model
MFF	Multiannual Financial Framework
NoBo	Notified Body, an organization that assesses the conformity of rail subsystems or components with technical specifications for interoperability (TSIs) in the European Union
NGO	Non-Governmental Organization
NPV	Net Present Value
NUTS-3	Classification level of small regions for specific diagnoses within the Nomenclature of Territorial Units for Statistics
O&M	Operations and Maintenance
O/D	Origin-Destination pair
OEM	Original Equipment Manufacturer
OPEX	Operating Expenses
PAX	Passengers (unique passenger trips)
PISM	Project Implementation Support Measures activities, it covers organization-related expenses and RB global project management expenses for RB Rail core organization and implementing bodies
pkm	Passenger-kilometers
PPP	Public-Private Partnership
PSO	Public Service Obligation
PTO	Point-Type Objects
RB	Rail Baltica, intended to be used when referring to the global project and its full internal stakeholder group as per governance structure. For the coordinating entity, RB Rail, the abbreviations RBR or RB Rail are used

RBGP[1]	RB Global Project
RBM	RBR's Traffic Demand Model
RBR	RB Rail AS
ROSCO	Rolling Stock Company
RRF	Recovery and Resilience Facility
RU	Railway Undertaking
SAC	Special Areas of Conservation
SAF	Sustainable Aviation Fuel
TAC	Track Access Charge
TCO	Total Cost of Ownership
tkm	Ton-kilometers
TSIs	Technical Specifications for Interoperability
TTR	Timetable Redesign
UIC	International Union of Railways
UNIFE	European Railway Supply Industry Association
vkm	Vehicle-kilometers
WACC	Weighted Average Cost of Capital
WEI	Wider Economic Impact

[1] Rail Baltica Global Project is used to emphasize the global and political aspects of the project

3 Executive Summary

Rail Baltica (RB) is an international greenfield rail transport infrastructure project with an objective to connect the Baltic region with the European rail network. Offering high-speed, cross-border transportation for both passengers and freight via a fully electrified, European-standard gauge railway line stretching from Tallinn to Warsaw, the project is expected to yield significant economic benefits for the region. This analysis focuses on Phase 1 of the RB implementation (RB PH1 or RB Phase 1) which offers a double embankment line with single-track from Tallinn until Panevėžys, then double track onwards.

This economic appraisal assesses the financial and socio-economic benefits and costs of the Rail Baltica Global Project, focusing specifically on the Phase 1 implementation of the segment of RB within the three Baltic states, from the perspective of future infrastructure managers. The study establishes a rigorous cost-benefit analysis (CBA) framework adhering to applicable European Union guidelines to provide a comprehensive overview of the project's economic, environmental, and social impact.

CBA results suggest that RB Phase 1 implementation is expected to generate **an economic net present value[2] (ENPV) of EUR 8.5 bn** throughout the assessed timeframe of the project, including 7 years of construction and 73.7 years of operations, determined based on expected asset lifecycles. This value arises from a combination of the financial impact of construction, infrastructure usage, and the socio-economic impact stemming from demand for passenger and freight transportation.

- The **financial net present value (FNPV) of the investment is estimated at EUR -13.5 bn,** primarily due to construction CAPEX (91.2%), as well as overall loss-making future operations (8.9%), and a positive residual value of the infrastructure (-0.02%[3]). Future operations of the infrastructure are projected to incur losses, primarily due to unprofitable passenger segment TAC revenues, forecast at EUR -1.4 bn NPV. This is expected to be slightly offset by profitable freight operations, at EUR 0.03 bn NPV, and other activities (passenger stations, terminals, ancillary services, and electricity resale) with EUR 0.2 bn NPV. These projections indicate a potential requirement for state subsidies during the operational phase.
- However, this financial outlook is **compensated by net socio-economic benefits, valued at EUR 22.1 bn NPV. Benefits include transport value chain profits** (0.2% of total socio-economic impact), **passenger benefits** (time savings at 42.6%, reduced travel costs at 17.7%, accidents reductions at 13.9%, increased accessibility at 9.8%), **impact on freight shippers** (cost reduction 1.9%, time savings 0.8%, accident reductions 0.2% and induced freight flows 0.2%), **environmental impact** (including air, GHG and noise impact over construction and operations making up 12.2% of total socio-economic impact) and **direct labor benefits** (0.5%). Positive socio-economic advantages underscore the project's broader value beyond its financial aspects.

[2] as of the end of 2023

[3] The share of the residual value within FNPV is negative due to the residual value being positive in contrast to the negative overall FNPV.

The EUR 8.5 bn ENPV generated from financial and socio-economic impact is expected to be **resilient to changes in underlying parameters**, moving in a range between EUR 1.1 and 14.7 bn in worst- and best-case scenarios respectively, with the most significant sensitivity to discount rates, CAPEX overrun and construction delays.[4]

While financial impact is directly driven by construction and train services using the infrastructure, socio-economic impact is the result of **underlying traffic demand,** projected at 14.8 mn passenger trips (2.4 bn pkm) and 9.2 mn tons (1.6 bn tkm) of cargo annually (in 2046).

In addition to the Phase 1 base case results, **the Extended Scenario** assesses the potential impacts of additional project components covering 1) the earlier operational start on the existing RB1 line from year 2028 before any main part of the RB line becomes operational, 2) the change of scope elements, incl. stations such as Kaunas, additional freight terminals in Latvia and Lithuania such as Salaspils and related service changes, and 3) the application of variable-gauge rolling stock to connect Vilnius directly to long-distance locations, such as Tallinn or Warsaw. The **economic net present value of the Extended Scenario is EUR 10.1 bn** (EUR 1.5 bn higher than the base case) with the financial net present value amounting to EUR -14.2 bn, offset by the socio-economic impacts at EUR 24.3 bn. The greatest contributor to the increase of the ENPV is the change of scope elements with 87% followed by variable-gauge trains with 23% and the negative early opening of RB1 with -10%. The analysis reveals the value generation potential of new scope elements and direct connection to Vilnius, but with the given assumptions, early opening of RB1 would only be beneficial if there is additional non-quantified strategic value in the investment, such as fostering earlier socio-economic engagement.

Beyond the positive ENPV estimated within the CBA framework, RB Phase 1 is expected to generate **a substantial wider economic impact**, including tangible monetary economic benefits such as EUR 14.0-20.5 bn in induced GDP growth on top of impacts quantified in the CBA, as well as geostrategic benefits in the context of military mobility, both during peacetime and emergency situations. Further, the project is expected to benefit the region in terms of supply chain efficiency, social equity, corridor synergies, and environmental sustainability.

Consequently, **RB Global Project is a major advancement in integrating the Baltic region's infrastructure** with the broader European network. It not only connects the Baltic states more effectively but also enhances regional connectivity, positioning the Baltics as a strategic link within Europe. Beyond current expectations, the project holds potential for even greater impacts contingent upon further development of the Trans-European Transport Network (TEN-T) and adjacent infrastructure in the Baltics.

Large-scale infrastructure initiatives such as Rail Baltica **inherently carry risks**, including potential delays, coordination difficulties stemming from variable decision-making and absence of standardized processes or data management. However, the implementation of robust mitigation measures can ensure that these risks are effectively managed, enabling the successful realization of the project's extensive benefits.

To **provide a detailed context for the presented findings**, the report starts by outlining the CBA methodology and then presents the Rail Baltica Phase 1 project's context, objectives, and setup. Key assumptions and traffic demand modeling methodology are then explained, laying the foundations for financial and socio-economic impact analyses. The conclusion on the economic viability of the project is followed by a detailed analysis of sensitivities, scenarios, and risks. Finally, wider socio-economic impacts are assessed to understand broader implications of the project beyond the standard CBA framework.

---

[4] In addition, project phasing can significantly affect both CAPEX and OPEX. Implementing subsequent phases to achieve the full target state (Full Scope) will differ from executing a standalone Full Scope implementation and can raise construction and operational costs, thus thorough cost planning and management is necessary.

4 Economic Appraisal Introduction

4.1 Purpose of the Economic Appraisal

This economic appraisal aims to assess the financial and socio-economic impact of Rail Baltica Global Project within a rigorous CBA framework adhering to applicable EU guidelines required for funding applications. The appraisal not only follows these standards but frequently exceeds them, offering a comprehensive overview of the project's wide-ranging economic, environmental, and social benefits.

Therefore, **the appraisal comprises two components**: a standard, EU-compliant CBA, and an extended wider economic impact analysis (WEI) report. These components, while distinct, serve complementary purposes in evaluating the project's financial and socio-economic implications.

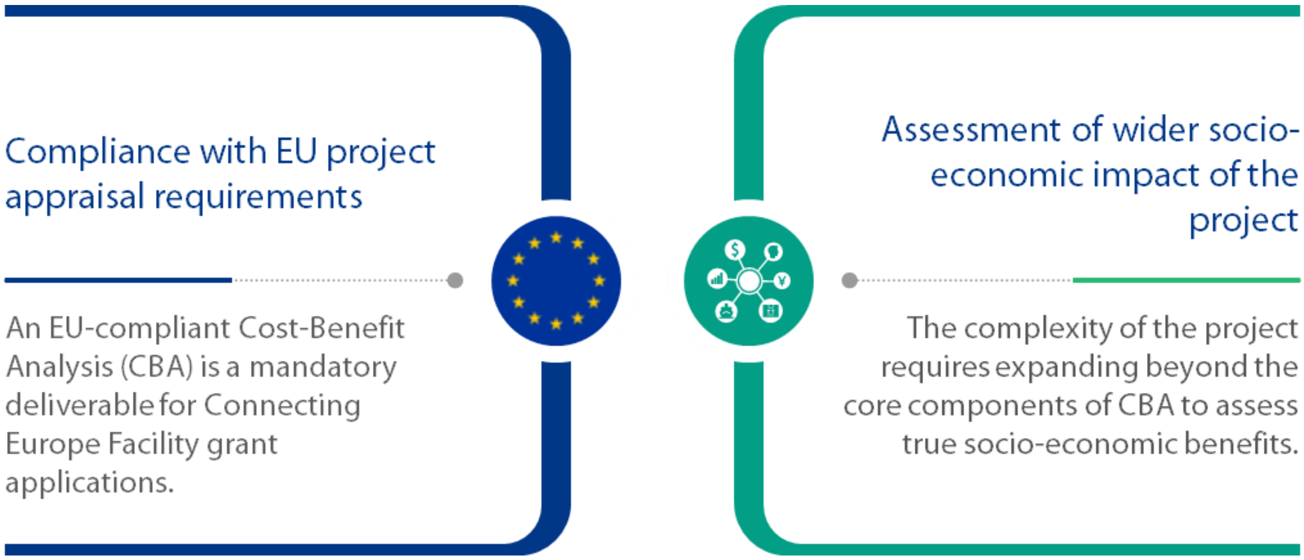


Figure 1: Purpose of the Economic Appraisal

Adhering to EU guidelines, the **CBA focuses on direct financial revenues and costs of RB Phase 1, alongside its direct economic impact** within the transport ecosystem, including impact on transport value chains, passengers, freight shippers, labor force and the environment. Such a thorough evaluation provides decision-makers with a robust understanding of the project's economic viability and potential benefits to society.

`The economic appraisal also extends to **a WEI analysis,** going beyond the standard EU framework by incorporating context-specific impacts. Thereby, it captures the true extent of the project's broader socio-economic effects such as indirect and induced economic impact, military mobility, energy security, and urban revitalization. This comprehensive approach provides a more holistic understanding of the project's potential impact on communities, local economies, and the wider society.

While the EU-compliant CBA and the WEI report serve distinct purposes, they are **interrelated in their evaluation of RB Global Project Phase 1**. While the CBA provides a rigorous and standardized assessment of the project's costs and benefits to determine financial and economic performance indicators, the WEI analysis offers a broader perspective, encompassing the indirect and wider socio-economic effects. Combined, they create a robust evaluation framework that enables decision-makers to make informed choices, allocate resources efficiently, and ensure that the project aligns with the EU's broader economic and developmental objectives. This approach ensures that the economic appraisal's results not only guide decision-making for funding applications but also offer valuable recommendations for entities evaluating economic appraisals.

These recommendations put forth in the report suggest **integrating the broader socio-economic impacts outlined in the WEI into the standard cost-benefit analysis framework** for large infrastructure projects. By proposing these enhancements, the appraisal acknowledges that the ultimate objective of such projects extends beyond just financial profitability and direct economic impacts within the transport ecosystem. It emphasizes the importance of capturing the full range of benefits and costs associated with such projects.

4.2 Structure of the Economic Appraisal

The economic appraisal is conducted through key steps to ensure a comprehensive and robust evaluation. This approach is grounded in the standard EU CBA framework, augmented by an additional WEI analysis.

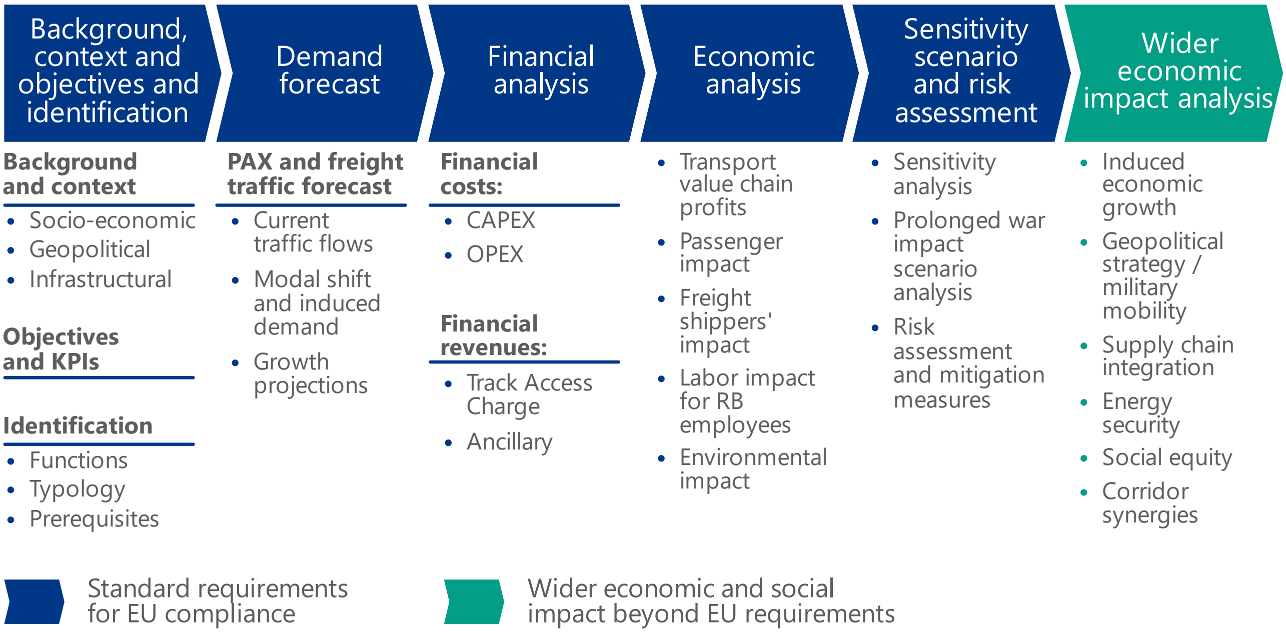


Figure 2: Economic Appraisal structure (Consultant team analysis)

The first step provides an **overview of the project's context**, outlining the current transportation system, regional characteristics, and policy objectives. It lays the groundwork for understanding the project's value proposition and the socio-economic context in which it will operate.

The appraisal proceeds with defining **clear and measurable objectives** for RB. It identifies economic, social, geopolitical, and environmental goals, as well as financial and operational goals. Defining desired outcomes helps align the appraisal with the project's intended goals and facilitates the evaluation of its performance against these targets.

Then, the specific **details of RB Global Project Phase 1 are identified** to provide a thorough understanding of how it will achieve its strategic objectives. This includes the project’s geographic scope, functions, timeline and implications of technical design project typology and physical realizations.

After this, a **traffic demand model** is employed to serve as the backbone of the economic appraisal, forecasting the project's impact on passenger and freight transportation. The outputs of the demand model are vital for assessing the costs and benefits of RB.

Financial and direct socio-economic costs and benefits of RB are evaluated using a CBA framework, in accordance with EU guidelines, and complemented by a wider economic impact analysis (see next figure). They build on the project's specific context and details, incorporating with and without project scenarios derived from the demand forecast model, enabling decision-makers to make informed choices about project viability and its socio-economic impacts.

Within the CBA framework, the financial and socio-economic analyses of the project determine the project's key financial and economic performance indicators such as the financial net present value (FNPV), economic net present value (ENPV), economic rate of return (ERR), and the benefit-cost ratio (BCR).

- The **financial analysis** quantifies the internal costs and benefits of RB Phase 1 in monetary terms, focusing on investment costs, operational costs, and direct revenues collected by RB. It assesses the financial viability of the project to identify potential funding gaps and calculates financial performance indicators such as the FNPV.
- The **socio-economic analysis** is also required by EU regulations to extend the analysis beyond financial aspects, including performance indicators such as benefits for passengers, freight users and carriers, direct environmental externalities, and labor impacts. To calculate the ENPV, BCR and ERR, the socio-economic analysis considers impacts occurring within the transport ecosystem, while excluding indirect and induced effects on other industries and society.

The WEI analysis expands the evaluation further beyond the CBA framework proposed by EU guidelines, capturing both monetizable, quantitative, and qualitative impacts such as indirect and induced economic impact, military mobility, land value appreciation, global supply chain integration, environmental sustainability, regional development, and social inclusion, tailored to the specific context and objectives of RB.

The following figure shows the decision tree for determining the right analysis for an inspected impact type.

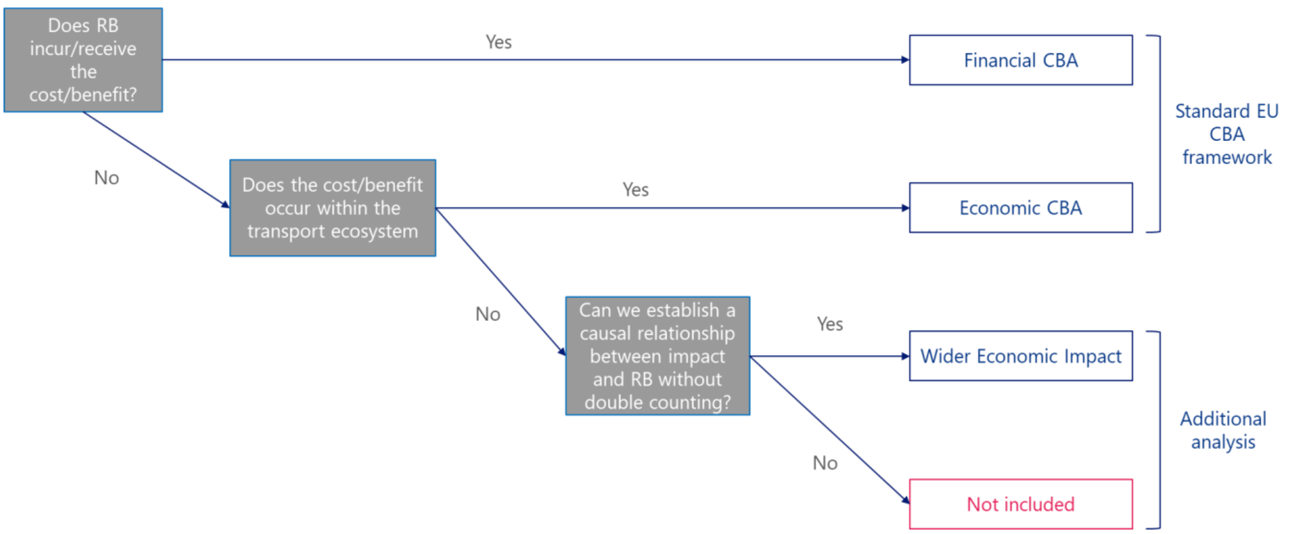


Figure 3: Categorization framework of costs and benefits (Consultant team analysis)

Results of the three assessments are additive if not stated otherwise. The FNPV, derived from the financial analysis and net direct economic benefits calculated in the socio-economic analysis, determines the ENPV of the project. The WEI analysis provides a comprehensive understanding of the indirect and induced impact, offering incremental monetary impacts in addition to the ENPV, as well as quantitative (but not monetized) and qualitative assessments of wider socio-economic impact components.

To guarantee the framework's robustness and adaptability, the study applies **sensitivity and scenario analyses, complemented by a comprehensive risk assessment.** This sensitivity analysis gauges the resilience of economic performance indicators to changes in key parameters such as construction costs, discount rates, and ridership forecasts. To reflect the project's sensitive geopolitical context, the impact of a potentially prolonged war in Ukraine is assessed as an additional scenario. Furthermore, key risk factors of the project are identified along occurrence probabilities and mitigation measures.

Based on these assessments, the appraisal concludes by summarizing the findings, drawing conclusions on project viability, and providing recommendations to decision-makers.

4.3 Methodology and Reference Framework

The **outlined analysis framework is grounded in rigorous methodologies** to comply with EU CBA guidelines and to also provide a comprehensive, context-specific economic appraisal of the RB project. The core study framework is developed based on the relevant guidelines of EU bodies, scientific literature on economic appraisal, official and proprietary databases, inputs from the RB project team and stakeholders, as well as information gathered by the consultant team and provided by external industry experts.

The **study rigorously follows reference EU guidelines for the economic appraisal** of large infrastructure investments, including the Guide to Cost-Benefit Analysis of Investment Projects (European Commission, 2014), the Economic Appraisal Vademecum (European Commission, 2021a) and the CINEA Guide on Economic Appraisal for CEF-T Transport Projects (European Commission, 2022). Furthermore, the study leverages key sources referenced by the guidelines above to define CBA assumptions such as the Handbook on the External Costs of Transport (European Commission, 2019a), The Economic Appraisal of Investment Projects at the EIB (European Investment Bank, 2023a) or the EIB Carbon footprint methodologies (European Investment Bank, 2023b).

In the **wider economic impact analysis, the study relies on scientific literature** advocating for the integration of wider economic impacts in standard economic appraisal framework. Venables (2016) highlights the shortcomings of traditional cost-benefit appraisals in capturing the full economic impact of large transport projects. The UK Department for Transport's Transport Analysis Guidance (2019) emphasizes the importance of the WEI assessment in certain market conditions and potential indirect and induced impacts on GDP. The European Commission's Economic Appraisal Vademecum (European Commission, 2021a) suggests the inclusion of induced and indirect impacts in economic evaluations of transport projects whenever boosting the economic activity of the region is a key objective of the project. Lastly, Graham (2019) critiques the conventional consumer surplus-based approach in the CBA, advocating for a broader perspective that includes externalities and imperfect competition. These sources collectively shaped the understanding and methodology for assessing WEI in transport infrastructure projects.

To offer a detailed analysis of project-specific impacts, the **study incorporates all available data from the RB project team and stakeholders,** including key project objectives, planned physical realizations, timelines, services, schedules and operating models, as well as results of traffic demand forecasting, environmental impact assessments (EIA) and all relevant studies conducted by the RB project team. Furthermore, the study also integrates insights from stakeholder and external expert interviews, including experts on military mobility from national and allied armed forces, on logistics and trade patterns in the Baltic region, representatives of national transport entities, as well as air, and maritime transport industry players.

To ensure the accuracy and reliability of the core methodologies and assumptions used in the CBA, the **study involves benchmarking** against guidelines, literature, and inputs from the RB project team. Additionally, it includes extensive review process involving all major stakeholders of RB, consultations with leading experts in the rail and transport industry, and the use of both official and proprietary datasets for validation purposes.

5 Project Context

This chapter provides a systematic evaluation of various factors impacting the project, beginning with the definition of RB Global Project (RBGP) and its boundaries including Phase 1. Further, the analysis of the Baltic Region establishes the geographical context essential for understanding the project's scope. The report then progresses to a Macroeconomic Overview, offering a critical assessment of the economic environment in which RB will operate. Subsequent sections include a detailed Geopolitical Overview and an assessment of the Effects of the War in Ukraine, both crucial for appreciating external influences on the project's feasibility and outcomes.

The chapter further analyses the Transportation Market of the Baltic countries for both passenger and freight traffic, a core component to gauge the project's impact potential. This is followed by an exposition of Rail Baltica's Value Proposition, aligning the project's objectives with identified needs. Stakeholders Mapping is conducted to precisely identify and analyze the interests and influences of various parties involved. The chapter concludes with a thorough examination of Regulatory & Compliance issues, ensuring that the project adheres to necessary environmental, railway, competition, and national guidelines.

5.1 Project Definition

RB is a greenfield high-speed rail infrastructure project connecting major cities of the three Baltic states and Warsaw, with tracks to be shared by both passenger and freight services. The fully electrified, ERTMS-equipped, 1435 mm gauge double track line is **designed to integrate with the European TEN-T railway network, through the North Sea – Baltic and Baltic – Adriatic priority corridors** and to offer direct connectivity to and from the three Baltic states (see next figure). **The project is planned to be constructed in separate phases, and this Cost Benefit Analysis is focusing on Phase 1.** In the Rail Baltica Global Project’s Phase 1, the primary objective is to connect the three Baltic States to Poland via high-speed rail infrastructure, utilizing a 1435 mm gauge. However,

Phase 1 will primarily feature a simplified configuration enabling later expansion, including single-track line with a reduced number of operational Point-Type Objects.

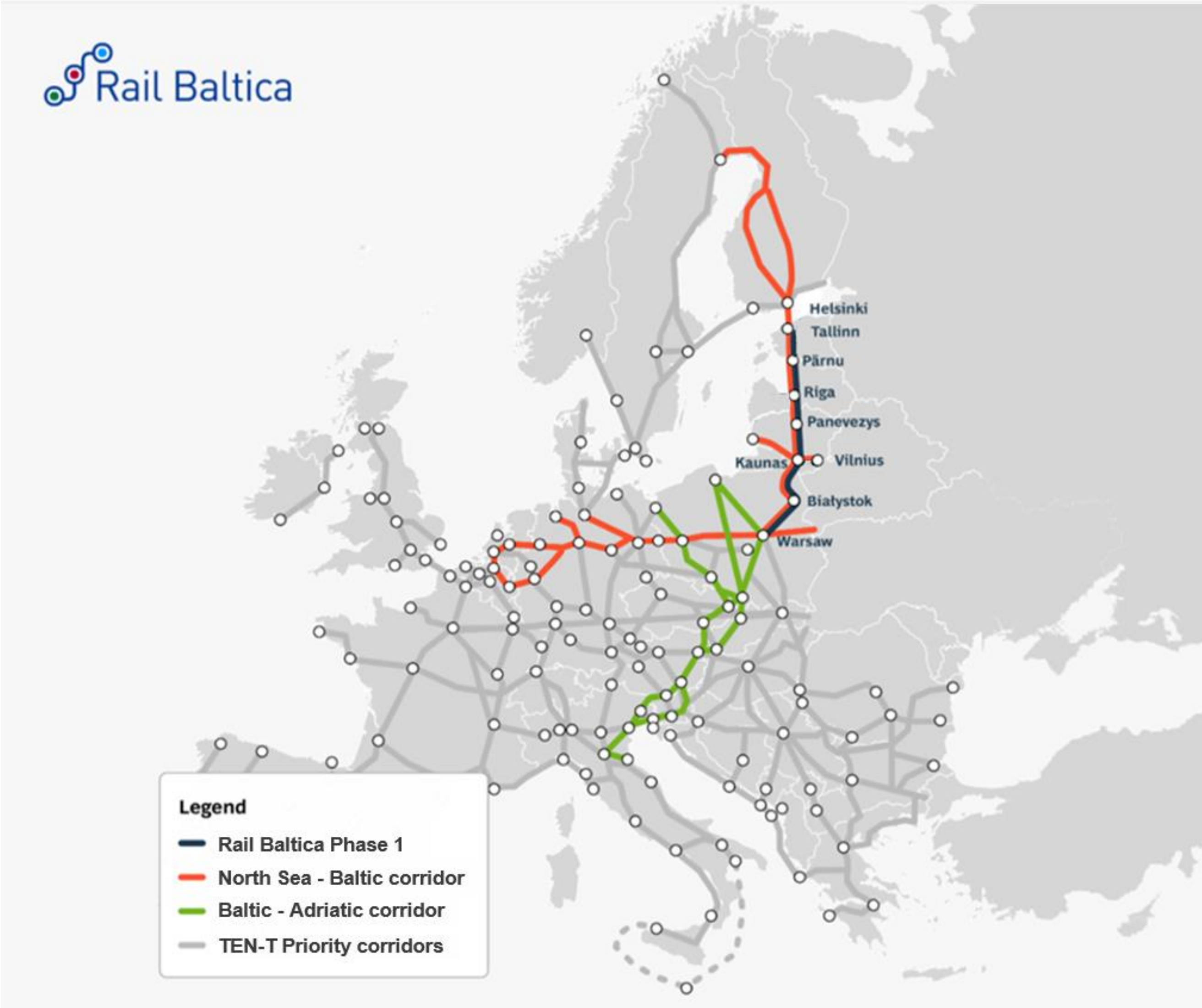


Figure 4: RB's contribution to TEN-T priority corridors

The line spans across 4 European countries: Estonia, Latvia, Lithuania, and Poland, connecting the major cities of Tallinn, Pärnu, Rīga, Panevėžys, Kaunas, Białystok and Warsaw[5]. The Baltic part of the RB project is referred to as the RB Global Project. With a total line length of 951 km for the full scope and 763 km for Phase 1, RB Global Project is considered the largest infrastructure project in the Baltic region in the last 100 years.

RB is designed to **provide infrastructure capacity to both passenger (high-speed, night and regional) and freight services**, with the infrastructure supporting speeds up to 249 km/h for passenger trains and up to 120

[5] These are only major cities highlighted through the corridor; for a more detailed overview of the cities connected though Rail Baltica infrastructure by passenger and freight services, please refer to *Geographic Scope* section within the *Project Specification* chapter.

km/h for freight trains. Phase 1 development includes 28 international and regional passenger stations[6], as well as 1 freight terminal in Estonia (and additional sidings for freight capabilities at Salaspils in Latvia, with service potential exploited already in the extended Phase 1 scenario), strategically positioned to enhance both international and regional connectivity and foster economic growth. Upon completion of the full Rail Baltica scope, there will be 54 international and regional passenger stations (including the development of Vilnius and its connection to Kaunas on the 1435 gauge) and 9 freight terminals, further boosting connectivity and economic development.

The implementation of **RB Global Project is enabled by agreements among Estonia, Latvia, and Lithuania**. Transport ministries or equivalent bodies of each state serve as the project's key decision-makers and beneficiaries. They have established publicly owned national project companies, which collectively formed the joint venture RB Rail to oversee the railway line's development. These companies also function as the Implementing Bodies, executing the project in their respective countries, with RB Rail providing oversight.

Moving from the specifics of Rail Baltica, **the subsequent chapter examines the Baltic Sea region**, focusing on its economic and geographic characteristics and existing infrastructure. This analysis positions Rail Baltica within a regional context, highlighting its potential influence and role in improving the region's connectivity and development, and offers insights into the wider environment where Rail Baltica will operate.

5.2 The Baltic Sea Region

Building upon the detailed description of the Rail Baltica project, **this chapter shifts focus to the Baltic Sea region, examining it from economic, geographic, and infrastructure perspectives** within Europe. This analysis is crucial to understand the broader context in which Rail Baltica operates. It explores the regional economic and geographic landscape, as well as existing infrastructure, factors that are integral to assessing the project's potential impact and alignment with regional development goals. This examination not only contextualizes Rail Baltica within the larger framework of regional connectivity and development but also highlights the project's role in enhancing the economic and infrastructural dynamics of the Baltic Sea region.

The Baltic region, due to its unique geographical location, faces certain **challenges in seamlessly integrating with the rest of continental Europe**. The region is positioned in a strategic location between Asia, Western Europe and the Nordics and relies heavily on east-west oriented transportation infrastructure based on 1520 mm railway gauge. In this context, the lack of interoperable rail infrastructure with the rest of Europe deepens socio-economic distances and hinders further cohesion.

[6] Including Polish border station

Economically**, the lower GDP per capita observed in the Baltic states compared to the rest of continental Europe** (see next figure), combined with demographic challenges such as high emigration and an aging population, underscores its unique socio-economic situation. While on par with other Eastern European countries, geographic and socio-economic characteristics hinder the region's development potential. The accompanying map visually represents the GDP per capita across EU regions, clearly depicting the Baltic countries' economic position relative to the more prosperous Western Europe.

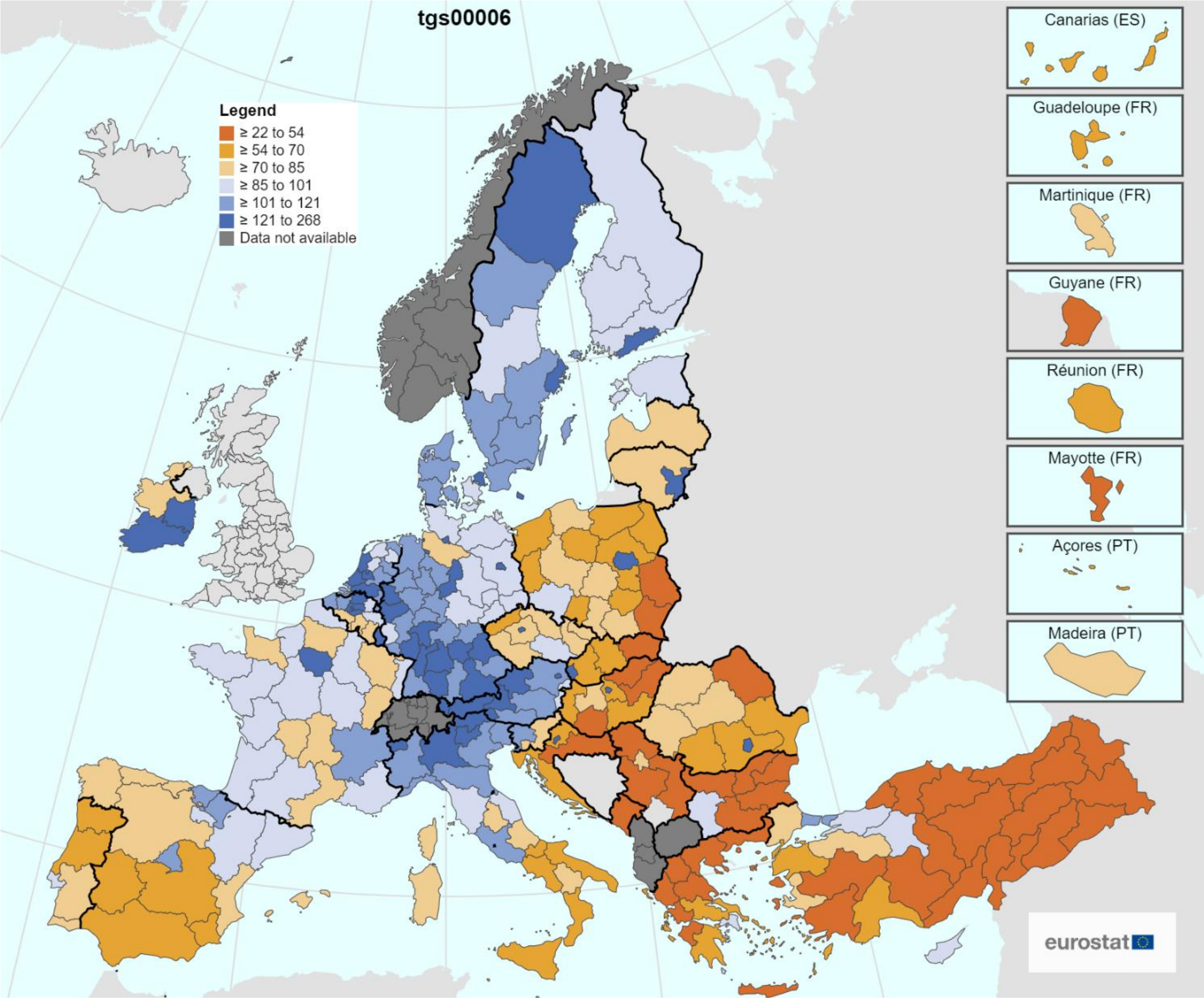


Figure 5: GDP per capita in EU regions, 2021 (Eurostat, 2021)

Existing rail infrastructure in the Baltic region, predominantly using the 1520 mm broad-gauge, contrasts with the European standard gauge of 1435 mm (see next figure). This discrepancy hinders direct train travel into Europe, necessitating facilities connecting 1520 mm and 1435 mm gauge networks, for both passengers and freight.

The region's predominantly single-track broad-gauge system requires intricate train scheduling for opposing directions, leading to slower operations and increased downtime. Notably, **Baltic capitals and adjacent**

countries, as shown in the simplified figure below, lack direct rail connections[7] among themselves and with the rest of Europe, adding pressure to the highway system, resulting in increased traffic flows and reduced efficiency in passenger and freight movement, further emphasizing the region's infrastructural challenges.

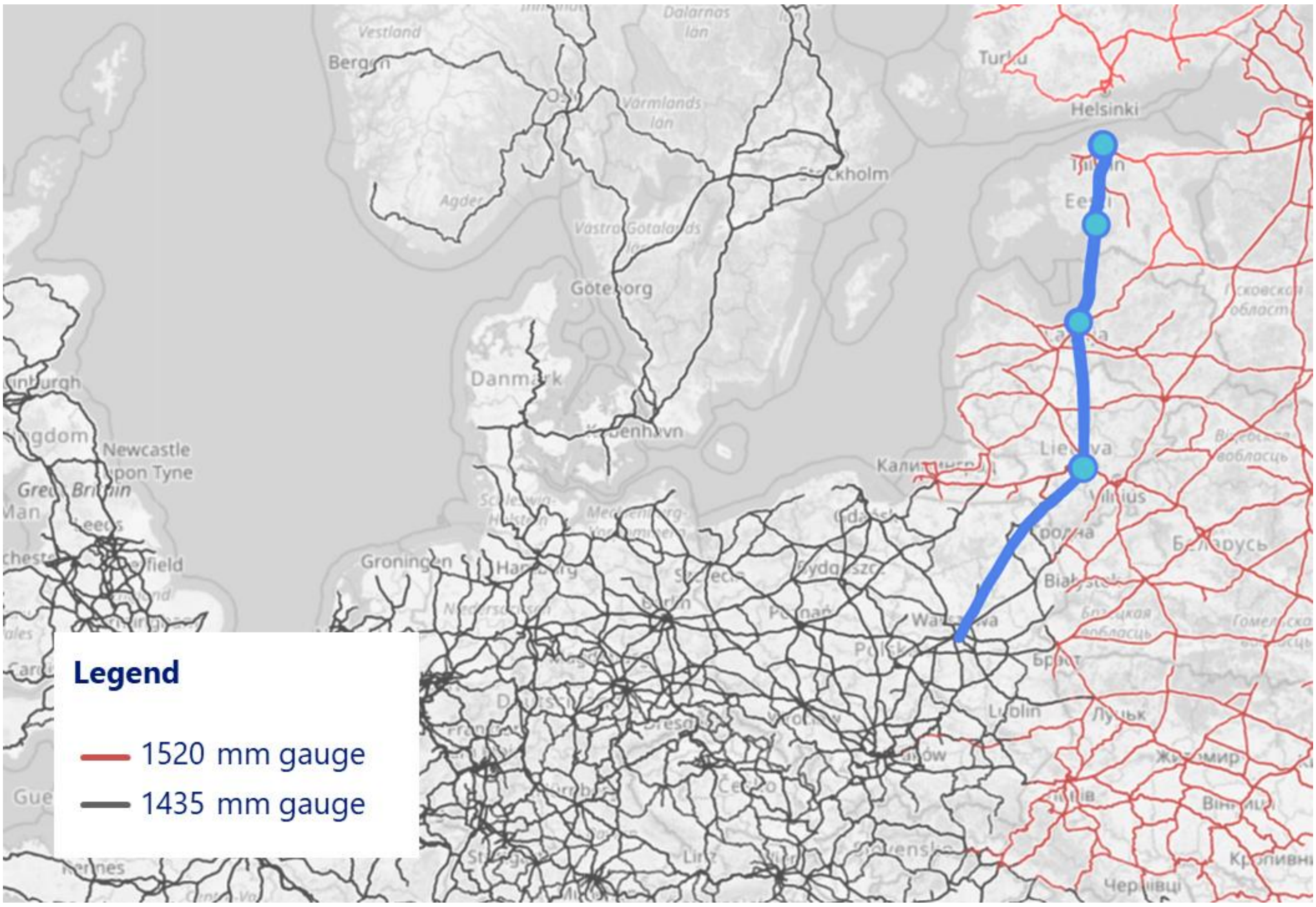


Figure 6: European rail infrastructure systems by gauge type (openrailwaymap.org)[8]

In this context, adopting the 1435 mm gauge in Estonia, Latvia, and Lithuania would not only **enable direct connections to Europe, but also upgrade the quality of rail services**, eliminating the need for train changes at the LT/PL border. Implementing a high-speed line would significantly improve connectivity within the Baltic states and offer a viable alternative to existing transport modes, crucial for their integration into the European high-speed rail infrastructure. This enhancement is particularly pertinent given the prevalent high-speed rail developments in Western and Central Europe, in contrast to the absence of such advancements in Eastern Europe and the Baltic region.

Further, the development **improves the rail freight route between the Baltics and major European cargo hubs** including further Baltic Sea (e.g., Gdansk, Rostock) and North Sea ports (e.g., Rotterdam, Hamburg, Antwerp), as well as inland ports such as Duisburg. It also enhances connections to via short sea shipping links across the Gulf

---

[7] Except Rīga-Vilnius passenger line, as well as a network of freight terminals in the three Baltic states.

[8] Bold lines refer to RBGP tracks within EE, LV, LT. Track from LT/PL border to Warsaw go through Ełk and Białystok.

of Finland. Additionally, extending this corridor northward could pave the way for future connections with the emerging Arctic corridor, especially considering the potential of the Northern Circle maritime route as a new link between Europe and Asia.

The implementation of high-speed rail across the Baltics stands to **establish a precedent for Eastern Europe**, potentially incentivizing future railway network developments. This advancement would facilitate further economic growth and stimulate increased demand for rail services. The maps provided below showcase the potential impact and reach of high-speed rail in Europe, emphasizing its significance for the Baltic region's connectivity and economic progress.

Figure 7: High-Speed rail development in Europe (Railtech.com, 2023)

After examining the Baltic Sea region's geographic and economic role within Europe, its current rail infrastructure and the potential impact of high-speed rail, the subsequent chapter transitions to an in-depth analysis of the macroeconomic landscape and trends in the Baltic states.

5.3 Macroeconomic Overview

This section presents a detailed **analysis of the macroeconomic landscape and trends in the Baltic states**, focusing on Estonia, Latvia, and Lithuania. This comprehensive overview examines key economic indicators, economic policies and strategies of each state, their impact on regional development to contextualize potential benefits and challenges of infrastructure projects like Rail Baltica within the region's economic framework.

The future progress of Rail Baltica will be significantly shaped by **four key macroeconomic drivers in the transportation industry**: population decline, GDP growth, inflation, and shifts in the construction market. These elements are not only anticipated to critically influence the trajectory of the overall transportation and infrastructure market but will also determine the extent of impact RB can achieve in the region.

5.3.1 Population Decline

Declining population in the Baltic states (following figure) emerges as a significant trend[9]. Between 2010 and 2023, Lithuania and Latvia witnessed a population decline, demonstrating a CAGR of -1.2% and -1.1%, respectively. Estonia experienced a gradual decrease, recording a CAGR of -0.1%. Projections for the future indicate a continuation of this trend. It is anticipated that Latvia and Lithuania will both sustain a population decline from 2023 to 2080, with projected CAGRs of -0.8% and -0.8%, respectively. Estonia's population is also expected to decrease, albeit at a slightly slower pace, with a projected CAGR of -0.5% in the same time frame.

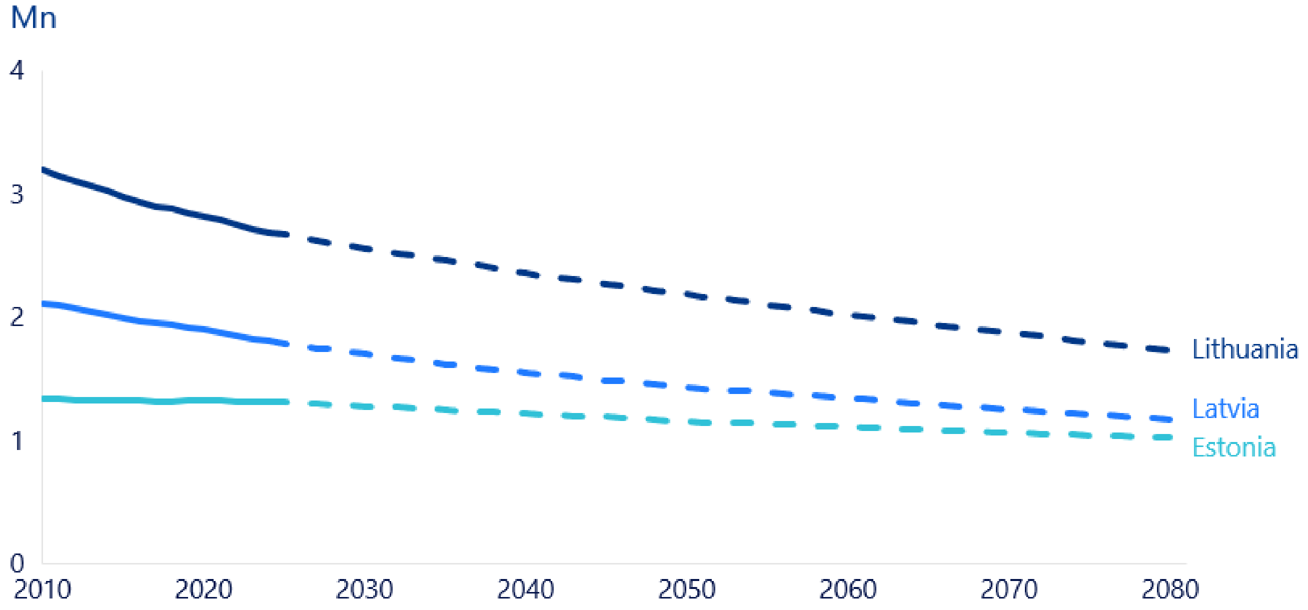


Figure 8 - Population decrease in the Baltic states until 2080 (S&P Capital IQ, 2023a)[10]

This **demographic trend might pose challenges** to the RB project, as a decreasing population could translate to lower demand for rail services. However, the effect of declining population is offset by **expected GDP/capita growth**, explored in the following subsection.

5.3.2 GDP Growth

From 2010 to 2023, the Baltic states experienced **consistent GDP growth despite a decreasing population** (following figure)**,** a trend offset by increase in GDP per capita. Estonia recorded a real GDP growth with a compound annual growth rate (CAGR) of 2.7%, Latvia at 2.6%, and Lithuania led with a growth rate of 3.3%. Projections until 2053 indicate a continued upward trajectory: Estonia is expected to see real GDP growth at a

---

[9]To understand historical and projected population trends, data from S&P Capital IQ were primarily utilized, especially for GDP forecasts in the traffic demand model. In instances where S&P Capital IQ data are not available, alternative sources are employed to ensure analytical consistency. A comparison between S&P Capital IQ and UN data for population analysis reveals a close alignment. For more detailed insights into fertility, mortality, life expectancy, median age, and net migration, UN data is used, as detailed in the appendix.

[10]Data from 2010 to 2023 is categorized as historical, while projections for 2023 to 2053 are provided by S&P Capital IQ and 2053-2080 calculated based on the CAGR of 2043-2053 projections.

CAGR of 1.9%, with Latvia and Lithuania leading closely with a CAGR of 2.1%. This pattern of economic growth, largely driven by rising GDP per capita, is projected to sustain until 2105, demonstrating a balance against the demographic decline.

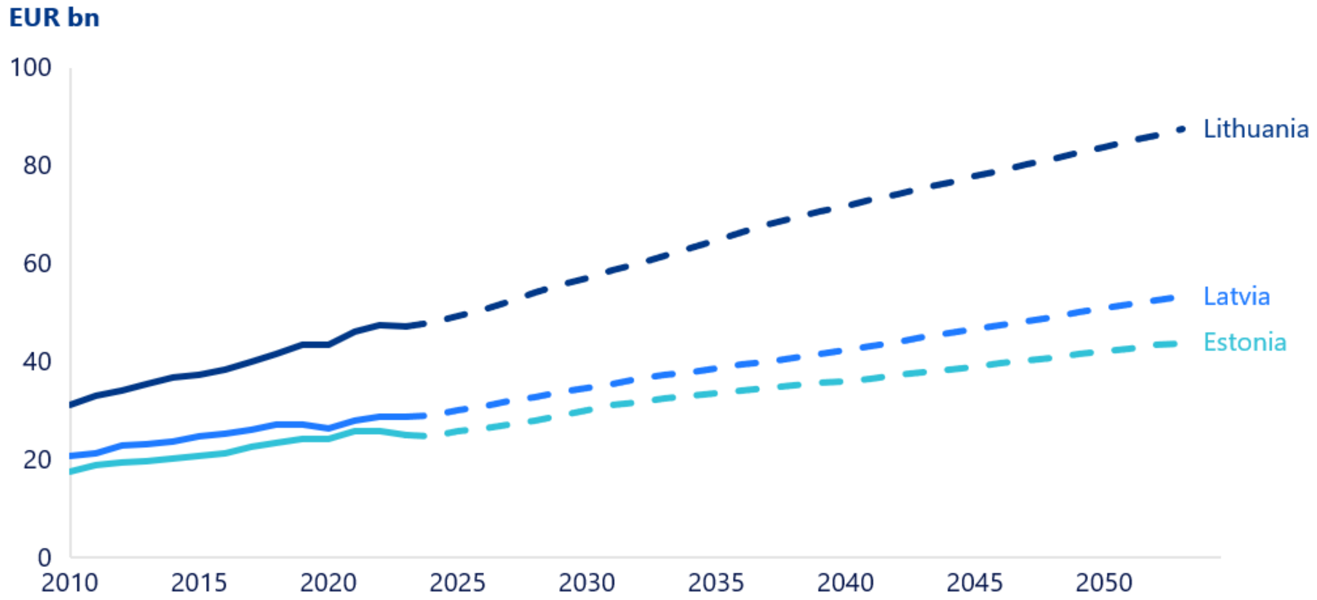


Figure 9: Evolution of real GDP (2010-2060) in the Baltic region by country (S&P Capital IQ, 2023b)

To sustain GDP growth in the Baltic states despite population decline, **three key factors are expected to drive economic development**: enhanced productivity through improved skills and technology, increased foreign capital and investment fostering sectoral growth, and deeper integration with European markets enhancing trade and economic practices. These elements collectively boost economic resilience and growth, effectively countering the demographic challenges.

GDP, encompassing both population and GDP per capita, thus reflecting welfare growth, emerges as a **critical direct driver of passenger traffic volumes**. Its influence extends indirectly to freight volumes as well, primarily through its impact on trade. This makes GDP a pivotal factor in shaping both passenger and freight traffic dynamics in the region.

5.3.3 Inflation

Following the analysis of population and economic outlook in the region, this subsection addresses inflation in the Baltics. **Inflation directly affects construction and operational costs**, crucial for the financial planning of large infrastructure projects like Rail Baltica. This subsection provides key insights into inflation trends, essential for understanding their effect on the economics of infrastructure development in the region.

The **Baltic economic landscape has been recently characterized by significant inflationary pressures** and rising construction costs. The Consumer Prices Index (CPI) has seen a significant jump in all three Baltic countries from 2021 to 2022, with Estonia and Lithuania experiencing a 19% rise, and Latvia experiencing 17% growth. Inflation is however expected to return to normal levels (2% target rate) in the following years.

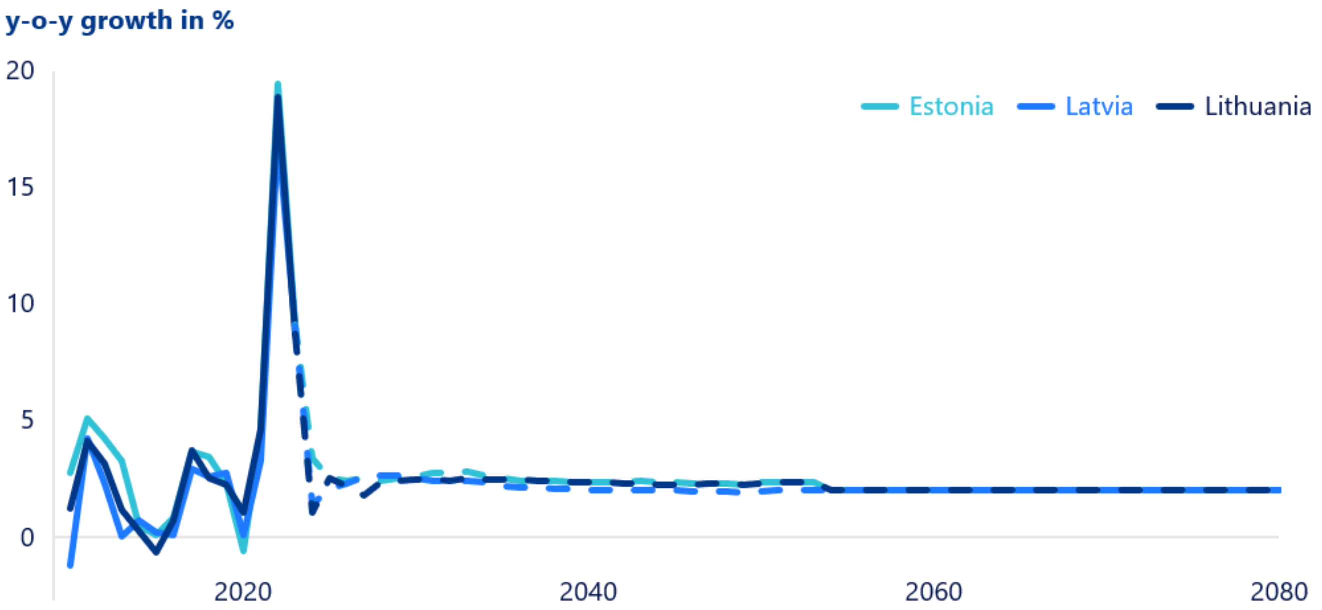


Figure 10 - Projected inflation between 2020 and 2080

Concurrently, the **Construction Cost Index (CCI) has also escalated in each state**, with Estonia reporting a 14.1% increase, Latvia 11.8%, and Lithuania a significant 17.5% hike. These rising costs in the construction sector are particularly relevant for the financial planning of RB, as they may necessitate budgetary revisions and financial recalibrations.

5.3.4 Construction Market Capacity

Total **construction output value**[11] in the Baltics was EUR 22.5[12] bn in 2022. On a national level, Estonia's construction sector output value was EUR 7.6 bn (GlobalData, 2023a), Latvia's EUR 5.5 bn (GlobalData, 2023b), and Lithuania's EUR 9.4 bn (GlobalData, 2023c). Estonia, Latvia and Lithuania are forecasted to have a construction output value decline of -5.3%, -1.3% and -0.5%, respectively in 2023 followed by an average real growth of 4.5%, 4.1% and 4.9%, respectively from 2024 to 2027 (GlobalData, 2023a).

The figure below shows how the **construction market output value compares to CAPEX values** from 2025 to 2030. Since GlobalData doesn’t provide construction output value data from 2027 to 2030, those values are hypothesized to grow based on the average growth from 2022 to 2027 according to GlobalData data. Estonia’s

---

[11] Construction output value is defined in general as the total value of construction activity in any given period, including costs related to all materials, equipment and services used. It is synonymous with measures such as construction value put in place or value of construction work done (GlobalData, 2023a). It's a measure of the industry's total capacity to undertake construction projects.

[12] Values presented are real values in 2023 prices.

construction output values are hypothesized to grow at an average CAGR of 3.7% from 2027 to 2030, Latvia's at a CAGR of 4% and Lithuania's at a CAGR of 4.4% in the same period.

	2025	2026	2027	2028	2029	2030
RB's CAPEX (in bn EUR)[13]	3.09	3.47	3.78	3.0	2.56	0.90
Construction output value in the Baltics (in bn EUR)[14]	24.00	25.15	26.38	27.23	28.40	29.66
RB share of the construction output value in the Baltics	**12.9%**	**13.8%**	**14.3%**	**12.0%**	**9.0%**	**3.0%**

Figure 11: RB share of the construction output value in the Baltics (GlobalData, 2023a)

The potential strain on construction resources posed by the RB project is recognized as a strategic risk. For actions that can be followed to minimize this effect, please refer to the *Risk and Regulatory Chapter*.

5.4 Geopolitical Overview and Effects of the War in Ukraine

As critical dual-use rail infrastructure, Rail Baltica holds significant geopolitical importance, requiring the understanding of the geopolitical context of the region, how **Rail Baltica's strategic role is shaped by the current landscape**, particularly in the context of the ongoing conflict in Ukraine. While acknowledging the devastating consequences of the war, this study focuses on examining specific impacts relevant to RB, aiming to understand their implications for the project's development and impact.

Following a brief geopolitical overview, this section analyzes the **potential impacts of the war along four key dimensions** in the context of RBs: the development of alternative trade routes, increased costs due to trade disruptions, rising electricity prices, and shifts in population and labor market dynamics.

5.4.1 Geopolitical Overview

The **Baltic states, strategically located between Northern, Central, and Eastern Europe,** hold a key position due to their access to major Baltic Sea shipping routes and their proximity to Russia and Belarus. This places them at the forefront of NATO's eastern defense line. Since gaining independence from the Soviet Union in 1991, they have actively worked towards integrating with Euro-Atlantic institutions, distancing themselves from Russian influence. Their accession to NATO and the European Union in 2004 marked a significant shift, yet their intricate history and geopolitical stance still heavily influence their foreign policy and security strategies.

---

[13] CAPEX values used are real values in 2023 prices and they represent total CAPEX, including both material and non-material assets

[14] Values are real in 2023 prices

The annexation of Crimea by Russia in 2014 and the subsequent invasion of eastern Ukraine have escalated tensions in the Baltic region. Russia's military buildup along the Baltic border and the ongoing conflict in Ukraine have intensified fears of a possible Russian advance into NATO territories. In response, the Baltic states have ramped up their defense spending and enhanced military collaboration with NATO allies. The following subsection provides an analysis of the **effects of the war in Ukraine on this region**.

5.4.2 Effects of the War in Ukraine

In response to trade sanctions on Russia and Belarus, there is a **shift towards alternative trade routes**, impacting both global and Baltic trade dynamics. The conflict in Ukraine has particularly disrupted the Northern Corridor through Russian and Belarusian territories, leading to a renewed focus on the Middle Corridor. The future role of Rail Baltica in this evolving trade landscape will depend on the development trajectories of both the Middle and Northern Corridors.

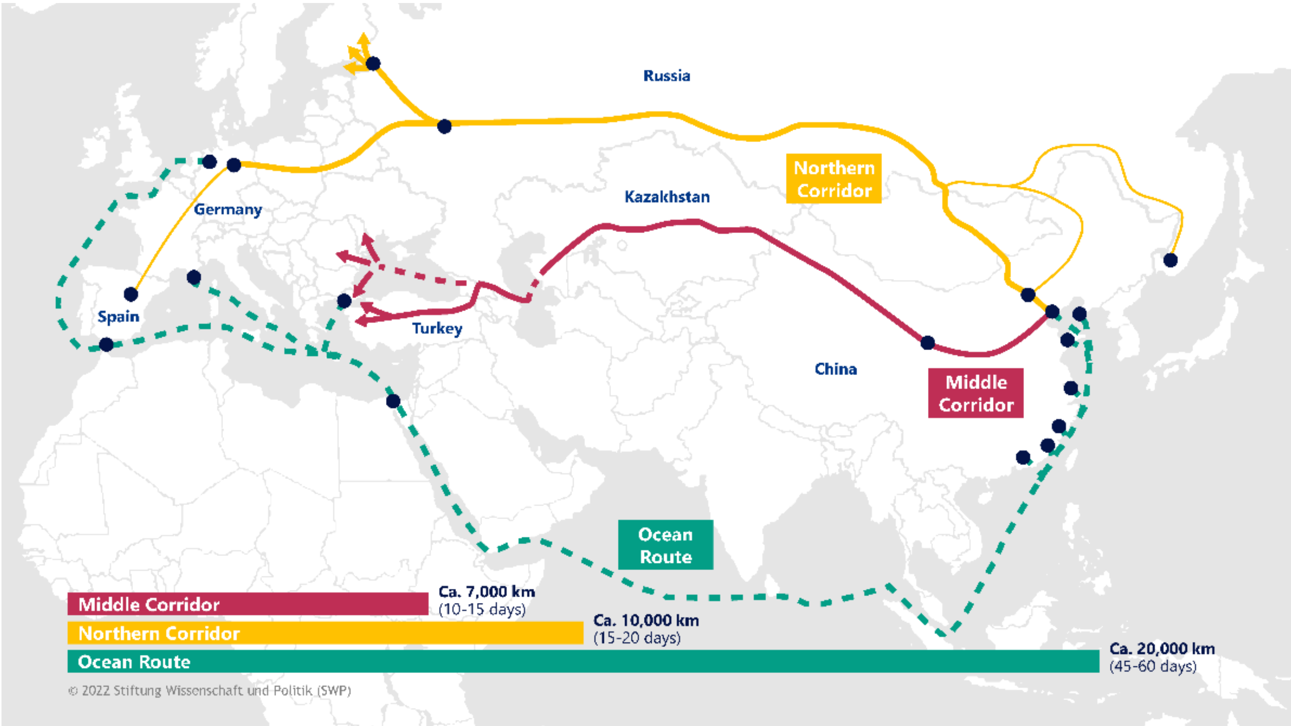


Figure 12: Alternative routes from China to Europe (Stiftung Wissenschaft und Politik, 2022)

Additionally, in the event of a prolonged war in Ukraine, the development of infrastructure in the Baltic region, including Rail Baltica, could become **crucial in expanding grain export capacity.** As traditional Black Sea routes face disruptions, the Baltic ports offer a viable alternative, especially as Polish ports approach full capacity. This shift would significantly enhance the Baltic region's role in maintaining critical global grain supply chains during geopolitical crises.

In terms of **trade disruptions,** historical data and projections suggest that the impact of the current war is temporary, with trade volumes in the Baltic countries expected to recover and resume their upward trend. This resilience, coupled with an anticipated global economic recovery and easing geopolitical tensions enables a positive outlook for future trade growth, with CAGR projected in Estonia and Latvia at 1.7% and Lithuania at 2.7%.

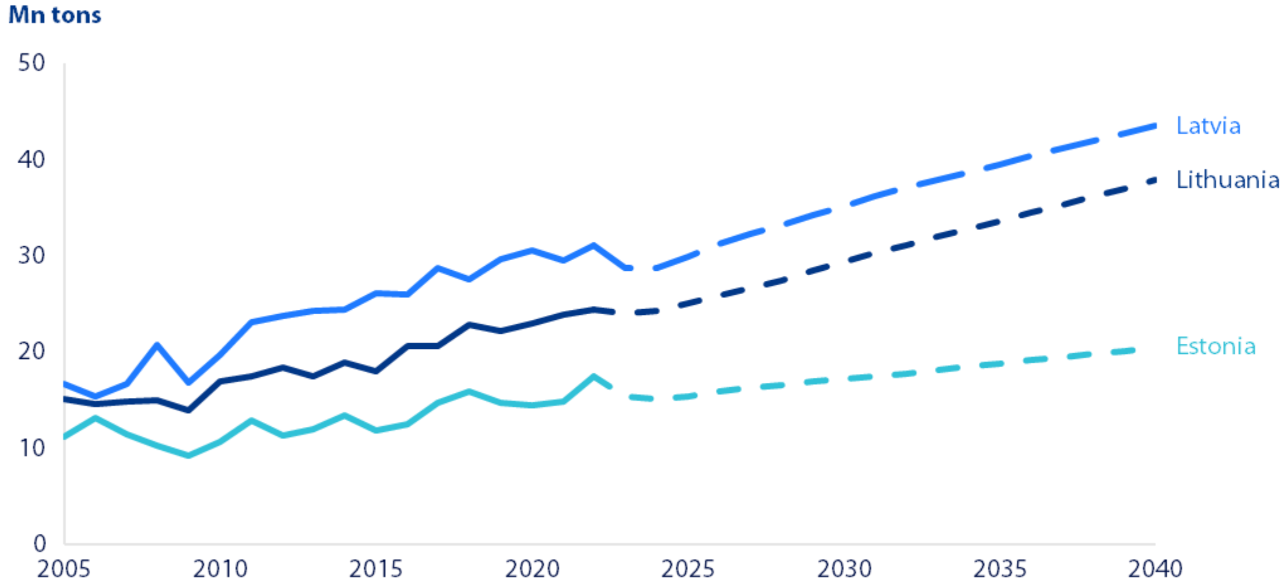


Figure 13: Trade evolution and forecast between years 2005 and 2040 (S&P Global, 2023)

The war in Ukraine has also impacted the Baltic economies through **increased electricity prices**. Observing the trend, electricity prices were normal until 2020. In 2021, there was a notable increase, primarily attributed to the impact of COVID-19. Subsequently, following Russia's invasion of Ukraine in February 2022, electricity prices were driven even higher. However, in 2023, recent data indicates that electricity prices in the Baltic States have begun to return to the levels observed in 2021, as shown in the figure below. This suggests that the war has not had a lasting effect on electricity costs in the region.

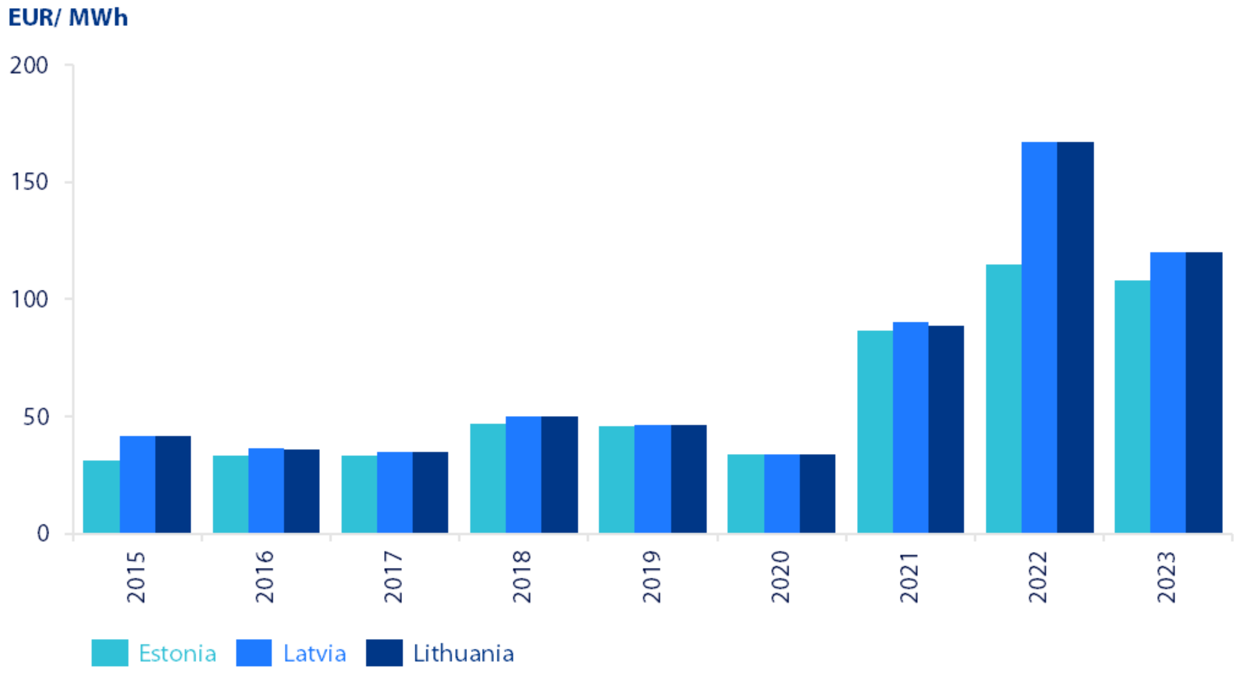


Figure 14: Electricity prices in Lithuania, Latvia and Estonia (Consultant team analysis[15])

Further, the war in Ukraine has influenced the **population and labor market dynamics** in the Baltic states. As of November 2023, the Baltic states are hosting 73,627 Ukrainian citizens, accounting for about **1% of their total population**, with most Ukrainian war refugees planning to return to Ukraine (Statistics Estonia and Estonian Ministry of Economic Affairs and Communications, 2023).

Ultimately, the analysis of the geopolitical landscape and the effects of the war in Ukraine indicates that the **long-term disruptions impacting Rail Baltica's viability are relatively contained**. Moreover, there is potential for Rail Baltica to enhance the flexibility of trade corridors, such as those from Ukraine, adapting to changing geopolitical circumstances.

5.5 Transportation Market

Following an overview of the macroeconomic and geopolitical environment, this chapter assesses **trends in the passenger and freight transportation market** in the Baltics. The section begins with a historical review that considers the impact of the COVID-19 pandemic. Despite initial disruptions caused by the pandemic, there is an expectation of recovery. Subsequent paragraphs provide insights into both markets separately, exploring the varying dynamics and forecasts among the Baltic countries. To understand freight dynamics driving traffic volumes, the subchapter also analyzes key trade patterns, identifying major routes and commodities handled in the Baltic region through specific transport corridors.

[15] For a comprehensive understanding of the methodology and sources behind the electricity price data, please see the Electricity Price Forecasting subsection.

5.5.1 Passenger

From 1995 to 2020, the **land-based passenger transportation sector** (including cars, buses and trains) in the Baltic region experienced a 1.7% CAGR in passenger-km. Estonia recorded the most rapid expansion with a CAGR of 2.5%, while Latvia and Lithuania experienced CAGRs of 1.75% and 1.4%, respectively.

The **growth trajectory,** however**, has not been straightforward**. From the late 1990s to the early 2000s, transportation demand consistently increased. Yet, the effects of the global economic downturn after the 2007 peak with 75.9 bn pkm made their impact felt in the Baltic transportation sector, resulting in a noticeable decline in demand. As shown in the figure below, after the 2008 downturn the demand increased slowly until 2019 to 70.8 bn pkm (European Commission Directorate General for Mobility and Transport, 2022). And, in 2020, the COVID-19 pandemic had a significant impact on the passenger market. Overall, the traffic decline is more pronounced in Estonia. On average, passenger-km fell by 14% across the Baltics, with a 19% decline in Estonia, a 10% decline in Latvia, and a 13% in Lithuania from 2019 to 2020. These trends highlight the sector's vulnerability to global economic fluctuations.

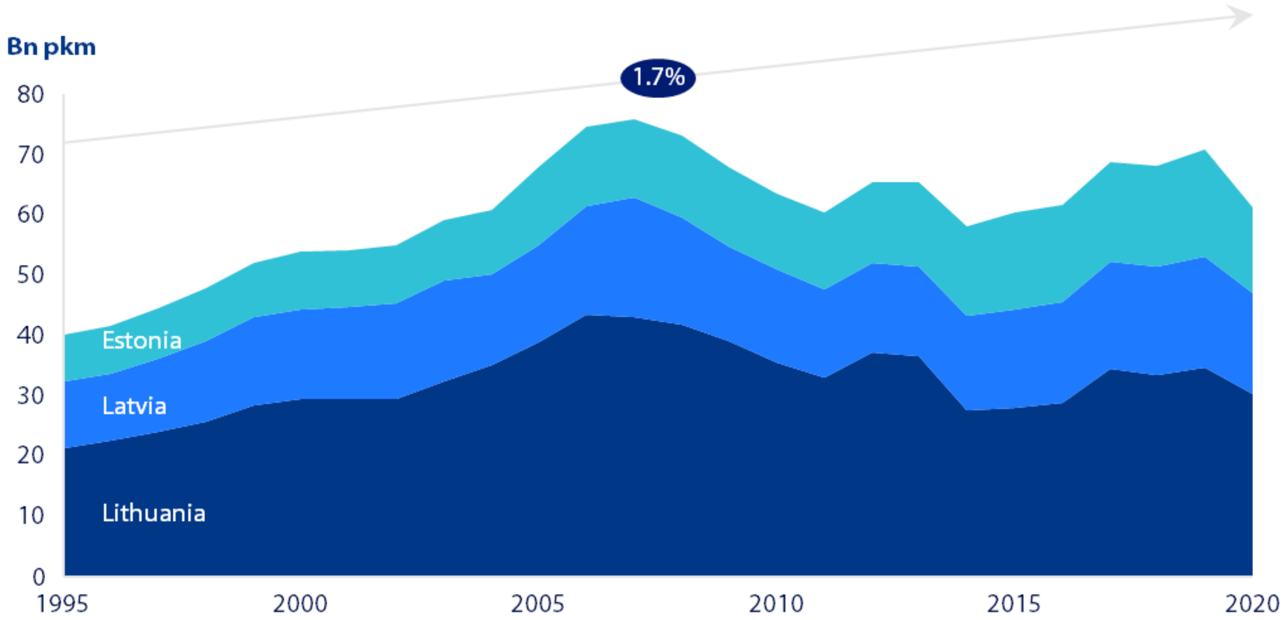


Figure 15: Development of land-based passenger transportation in Estonia, Latvia and Lithuania (European Commission Directorate General for Mobility and Transport, 2022)[16]

To understand the **future evolution of transport demand**, RBR's traffic demand model is utilized. Differences between the historical data presented and the RBR's model output can be attributed to methodological variations in the calculation process. Notably, while Eurostat data focuses solely on land transportation, this study also forecasts demand for air transportation.

[16] This is the most recent data available from Eurostat

According to the RBR's model, the total **passenger transportation market for the Baltic region is expected to reach approximately 100 bn pkm in 2031**, coinciding with the start of operations. Lithuania is projected to have the largest share at 48 bn pkm, followed by Latvia with 30 bn, and Estonia with the smallest share at 21 bn pkm.

The **passenger market is forecasted to grow** from about 100 bn pkm in 2031 to around 126 bn by 2056, as depicted in the figure below. This growth is expected to follow a 0.5% CAGR trajectory, indicating a steady increase in demand for passenger transportation services over the next five decades. Each country in the Baltic region is projected to experience nearly simultaneous growth.

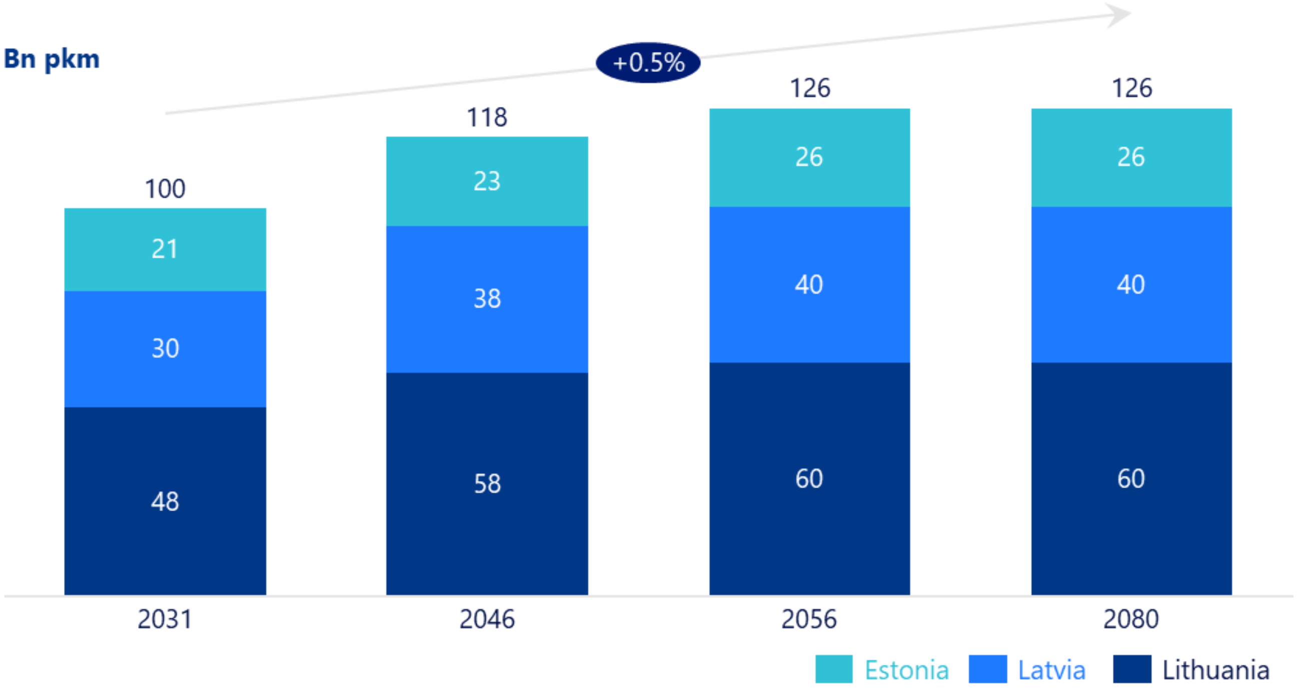


Figure 16: Passenger demand forecast until 2080, all transport modes (Rail Baltica TDM, 2024)

5.5.2 Freight

Historical data (see figure below) reveals **an upward trend** in land-based freight transportation in the Baltic region in the period 2013-2022. The growth in land freight transportation volumes from 2013 to 2022 is led by Lithuania, experiencing a 4.9% CAGR. In contrast, Latvia witnessed a substantial decrease in land freight transportation, experiencing a CAGR of -4.2% during the same period. Estonia, on the other hand, faced an even more pronounced decline, with a CAGR of -6.5% from 2013 to 2022.

The **COVID-19 pandemic moderately influenced the Baltic freight market** during 2020, with significant differences between the countries. Latvia experienced the most significant decline in freight volumes (-28% in tkm), while Estonia saw its demand declining by 14%. Between 2020 and 2019, Lithuania experienced instead a 3% increase (in tkm).

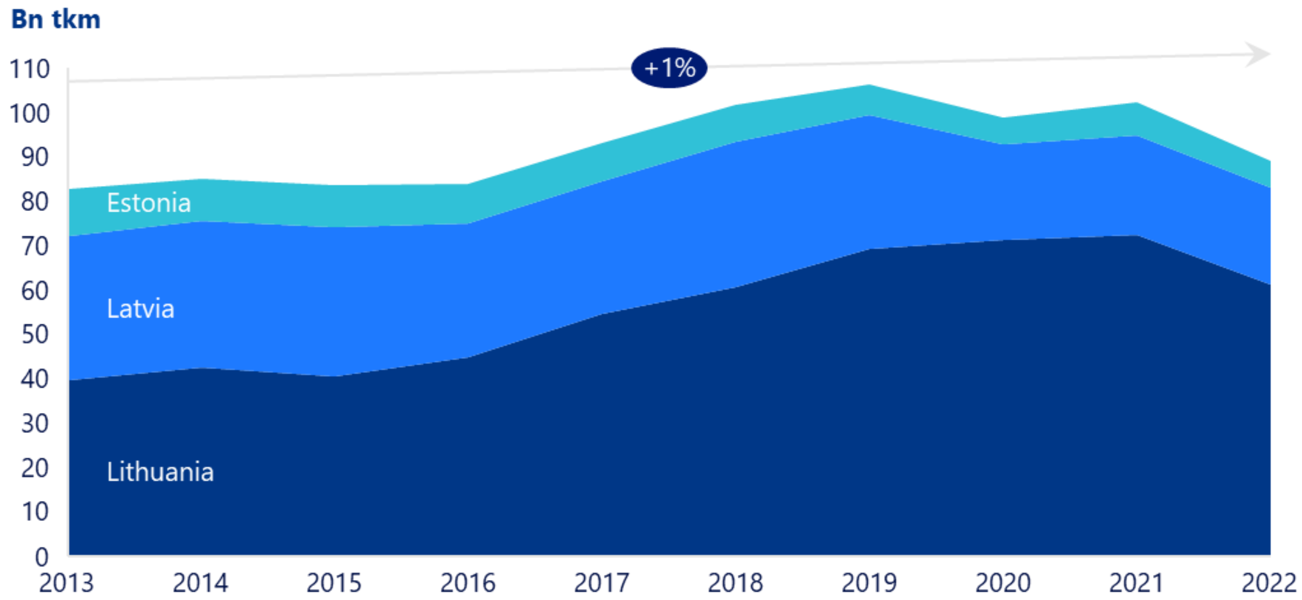


Figure 17: Total land freight transportation market per Estonia, Latvia and Lithuania, Consultant team analysis based on Eurostat (2024a) and Eurostat (2024b)

To extend on land-based freight transport volumes, analyzing the **short sea market** in the Baltic area is essential for a well-rounded understanding. From 2013 to 2022, the Baltic region saw a reduction in the total tonnage handled, from ~150 mn tons to ~ 120 mn. This decline coincides with a negative CAGR of -2%. In this timeframe, Estonia encountered a decline in handled goods with a CAGR of -3%, while Latvia had an even more sustained decrease, with a -4% CAGR. In contrast, Lithuania stayed at approximately the same level, as illustrated in the figure below.

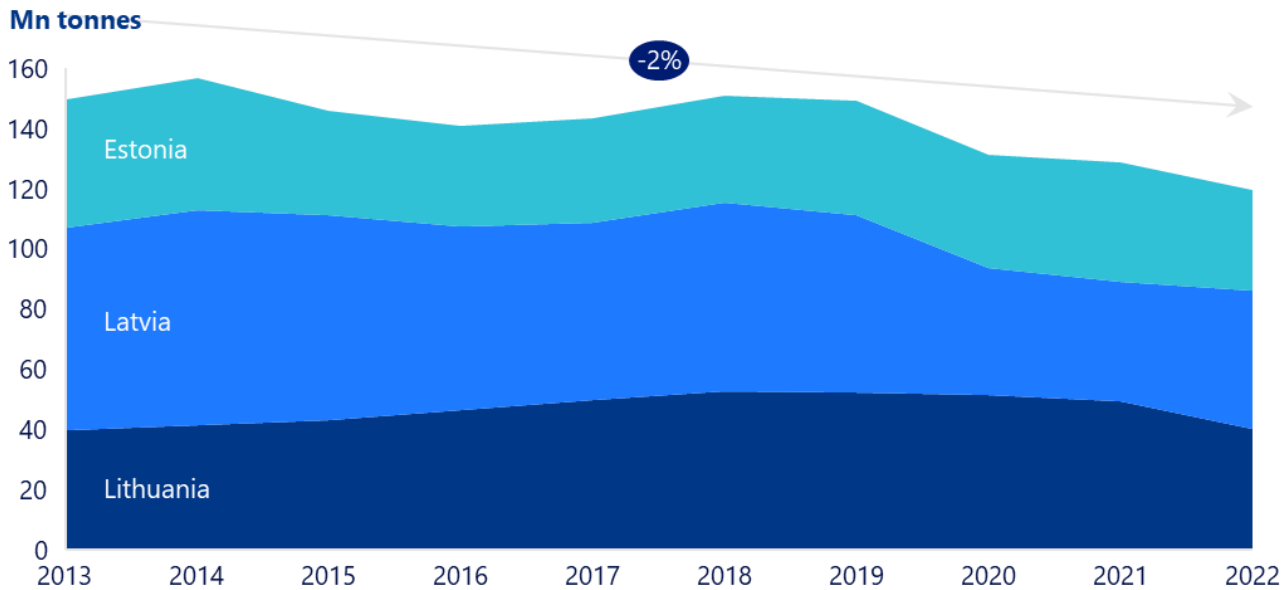


Figure 18: Total freight handled in ports per Estonia, Latvia and Lithuania (Eurostat, 2023a)

Overall, the Baltic freight market between 2013 and 2022 showcases **mixed trends**; while land transportation volumes rose in the region, short sea volumes experienced a downward trend during this timeframe. Lithuania stands out as the primary driver of growth in both transportation modes, achieving increased freight volumes across the board.

Future developments in freight demand are projected using RBR's traffic demand model[17]. According to the model, the cumulative freight demand for the Baltic region is expected to amount to ~446 bn ton-kilometers by 2031, at the start of RB operations. Among the Baltic countries, Latvia holds the largest share of this volume with 205 bn ton-kilometers, closely followed by Lithuania with a contribution of 186 bn ton-kilometers. Estonia is expected to have the smallest share, accounting for 56 bn ton-kilometers of the freight market. The overall growth in freight demand across these countries is anticipated to follow an approximate 1% CAGR, with each country experiencing nearly simultaneous growth.

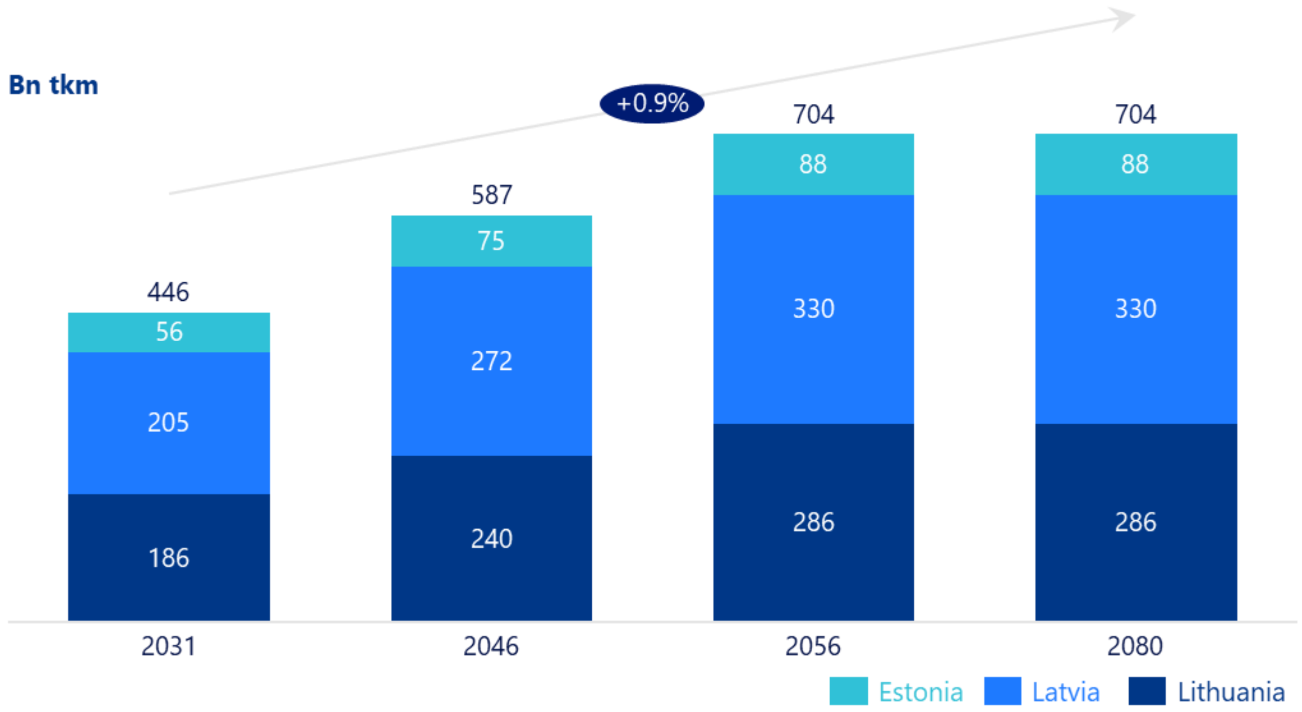


Figure 19: Freight demand forecast until 2080 (Rail Baltica – internal document)

In total, the Baltic region's freight transportation landscape, while experiencing mixed developments over the past decade, is expected to evolve in an upward trend. Forecasts indicate a **continued increase in freight demand** for the coming decades.

In conclusion, this analysis of passenger and freight transport markets has highlighted the substantial potential of RB in transforming transportation dynamics. The following section will focus on the value proposition of RB, exploring its strategic advantages and the benefits it is expected to bring to the region.

---

[17] Also for freight transportation, the disparity in total volume between the historical overview presented and the data from the RBR's traffic demand model is to be attributed to methodological variations in the calculation process. RBR's traffic demand model considers indeed all transport modes at aggregate level, while Eurostat splits land and sea transportation.

5.6 Value Proposition of Rail Baltica Phase 1

This section evaluates RB's **potential to become a preferred option in passenger and freight transportation**. It differentiates RB from other modes, preparing for an analysis of RB's competitiveness in time, cost, and reliability, alongside a review of current market players and their shares, offering a clear overview of the competitive landscape RB will face.

5.6.1 Passenger

In this subsection, the **competitiveness of passenger services is assessed**, with car transportation identified as a significant competitor to RB due to its cost-effectiveness and flexibility. Air travel, while faster on some routes, is less competitive in cost-effectiveness, flexibility, and reliability, and is mostly limited to major cities in the Baltic region. In this context, the potential reduction of certain short-haul air routes, influenced by low profitability and environmental concerns, further strengthens RB's position. Good connectivity is offered by buses, but they are impacted in terms of speed and reliability due to road traffic. Existing train services in the Baltics, while reliable, do not pose a significant challenge to RB due to the scarcity of the 1520 mm network (Grandsart, 2021).

The assessment of RB's competitiveness focuses on key Origin-Destination pairs (O/Ds) in the region for high-speed train services, comparing transport modes competing with RB on these routes across **time, cost, reliability, and accessibility**[18] dimensions.

- **Travel time** measures the duration of journeys on various routes, assessed through the planned service data from the RBR project team and additional research.
- **Travel cost** analysis is based on RB's demand model and pricing assumptions for competing transport modes, reviewed and validated by industry consultants.
- **Reliability** evaluates the punctuality and dependability of the transport services.
- **Accessibility** assesses the convenience of accessing and utilizing the transportation system, including connectivity and ease of use.

[18] Environmental aspects are not taken into consideration, as they are not expected to directly influence passenger decisions. In this context, the environmental impact of RB is analyzed in the *Socio-Economic Analysis* chapter.

Results of evaluation are derived from ranking alternative transport modes against each other along the dimensions listed above. A summary of the overall assessment is provided in the figure below.

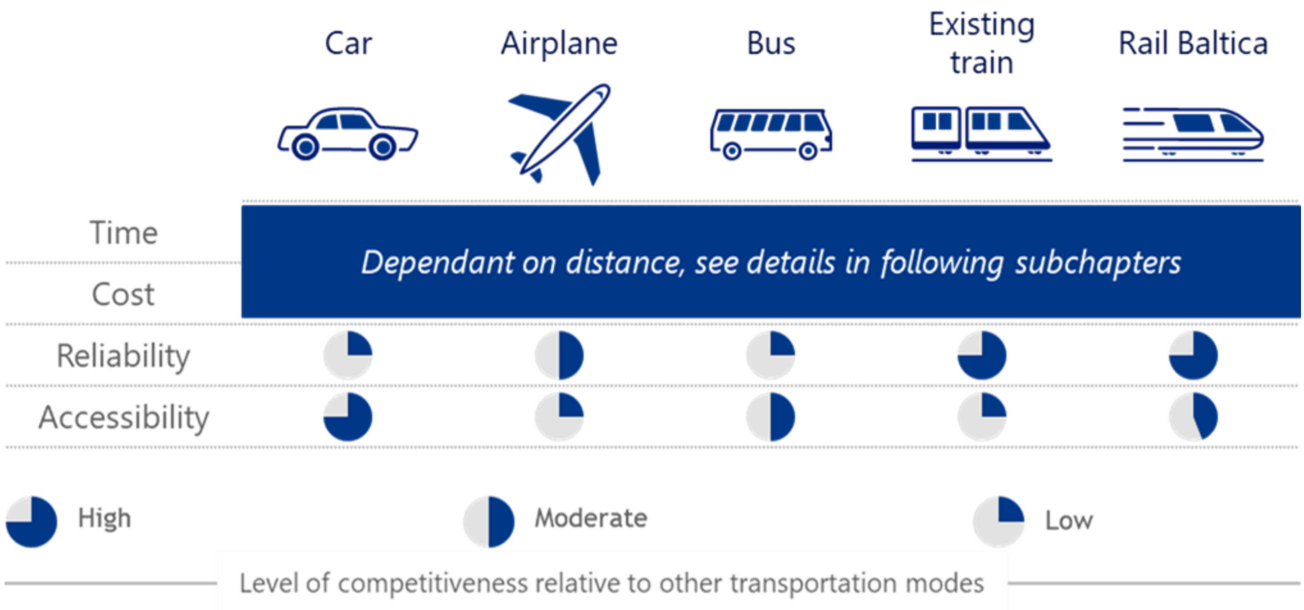


Figure 20: Summary of the competitiveness assessment of passenger transportation modes (Consultant team analysis)[19]

Reflecting the characteristics of each transport mode and passenger preferences, the **attractiveness of rail travel is strongly associated with the distance of the journey**. Empirical benchmarks indicate that rail becomes highly competitive with travel time for journeys ranging between 450 and 900 kilometers against road-based travel mode. For shorter distances, cars often have the advantage due to the convenience of first and last mile travel, whereas longer distances are more efficiently covered by air travel in terms of time. Rail transportation can also be effective for distances shorter than 450 km, thanks to its fixed routes which are less affected by traffic jams, unlike car journeys. Additionally, the competitiveness of rail travel depends on various factors such as the state and layout of the infrastructure, the number of stops along the route, and how well it connects with other modes of transportation.

Next, **each scoring aspect** (time, cost, reliability, accessibility) **is introduced in detail** to provide insights into passenger modal choice parameters across different route lengths and types. These analyses aim to deepen the understanding of the transportation market supply and demand, yet only indirectly impact CBA calculations, which are based on more specific analyses detailed out in respective chapters and sections including their respective assumptions. Since the Rail Baltica project is phased, this chapter focuses on Phase 1, which is expected to be completed by the end of 2030. Consequently, the value proposition is to be evaluated based on the specifications of the Phase 1 project scope.

[19] Accessibility of infrastructure-dependent transport modes is influenced by density of access points (e.g. train stations)

Time- and cost-based comparison

Travel modes are comparatively analyzed from time and cost perspectives, using RB's traffic demand model and open-source research[20]. The analysis also includes routes to and from Vilnius, which play a significant role in the Baltic transport ecosystem, despite Vilnius not yet having direct connectivity to Rail Baltica in Phase 1. However, rail travel is emerging as a valuable alternative for journeys between Vilnius and major Baltic cities along the RB Phase 1 network, made possible through the existing 1520 mm Kaunas-Vilnius line. In addition, it's important to highlight that in the full scope of the Rail Baltica project, extensions will connect the network directly through the Kaunas-Vilnius section.

In terms of travel costs, car and bus are the most competitive transport modes in the Baltics[21]. While high-speed rail is more expensive than bus or car, it connects major cities, offering an advantage on routes like Rīga-Kaunas where flights are not available. Additionally, train fares are significantly lower than airfares on average, positioning Rail Baltica as a moderately priced and very fast, therefore competitive choice for passenger travel between cities

[20] To validate RB Traffic Demand Model assumptions for cost and time of travel, desktop research was conducted to collect average travel times and distances with different transportation modes, including sources like Google Maps, Skyscanner, Air Miles Calculator.

[21] In the context of competitiveness comparison, the study evaluates direct variable costs attributed to trips across each transport mode. This approach has significant implications in the case of car trips, where fixed or hidden semi-variable costs, such as amortization, maintenance and other costs of ownership were not considered as their impact is limited on modal choices for a particular trip. In long-term economic impact calculations, full ownership costs are considered to capture the full socio-economic impact of ownership decisions.

with the Baltic countries. Other aspects, such as infrastructure condition, comfort can also play a role in decision making for passengers.

		0-650 km						650+ km		
Rail distance		276 km	362 km	347 km	501 km	599 km	583 km	659 km	772 km	1069 km
Air distance		229 km	261 km	280 km	353 km	393 km	500 km	529 km	560 km	835 km
RB routes		Rīga* – Kaunas	Rīga* – Vilnius **	Tallinn – Rīga*	Kaunas – Warsaw	Vilnius ** – Warsaw	Tallinn – Kaunas	Tallinn – Vilnius **	Rīga* – Warsaw	Tallinn – Warsaw
Travel time (min)	RB HSR	175	255	217	256	336	271	351	393	493
	Air	n.a.	220	220	n.a.	235	n.a.	240	255	270
	Bus	300	300	325	455	480	690	600	630	1140
	Car	230	220	240	300	360	450	420	500	750
Travel cost (EUR/pax)	RB HSR	29	34	36	52	57	61	66	81	112
	Air	n.a.	138	118	n.a.	201	n.a.	169	213	184
	Bus	17	19	21	25	31	34	37	34	58
	Car[1]	16	19	21	24	31	34	36	40	58

Note: Car travel costs include direct trip-related costs (i.e., fuel) but exclude long-term ownership and maintenance costs.

*Routes to and from Rīga include a transfer to the shuttle service between Rīga Central Station and Rīga Airport Station
**Routes to and from Vilnius include a transfer to the existing 1520 mm service between Kaunas and Vilnius.

least favorable
moderate
most favorable

Figure 21: Gross time- and cost-based transport mode comparison in Rail Baltica Phase 1 (Rail Baltica – internal document, 2023; Desktop research, 2023; Consultant team analysis)

The **analysis of travel time** data reveals a strong connection between travel distance and efficiency of different modes. For distances up to 650 km by rail, RB's high-speed service emerges as the fastest option among the listed destinations, with air travel as its nearest competitor, when available due to high fixed costs of air travel (early arrival and security checks). **Rail travel remains the more economical option also**, compared to air travel. Air travel becomes faster but significantly more expensive beyond this distance. RB outperforms other modes (excluding air travel) in terms of travel time across in almost all distances evaluated. In the case of routes to and from Vilnius, where other means of transportation may allow faster travel times, it is important to note, that on those parts of the journey, that are serviced by RB, RB remains a faster alternative compared to bus or car travel.

Further, most routes serviced by RB currently lack existing train services. Where trains do operate, they are significantly slower due to the absence of north-south connectivity and high-speed rail infrastructure in the region. Consequently, for high-speed rail comparisons on these routes, existing rail is not considered a direct competitor.

In the above analysis for bus, train, and air travel, the **calculations of travel time incorporate waiting and feeder travel times**. For bus and rail trips, waiting and feeder times are assumed at 60 minutes. In the case of air travel, an average of an additional 120 minutes is factored in for early arrival, pre-flight procedures including baggage claim and security checks in addition to feeder travel assumed at 50 minutes.

While waiting times and other additional times to reach the stations from home, or destination from stations influence choices between travel modes, as an overview, travel times considering only the time spent in the vehicle of the travel mode are summarized in the table below.

In the case of routes to and from Vilnius, additional transfer time from the existing 1520 mm gauge network to RB in Kaunas is assumed at 15 minutes. Regarding routes to and from Rīga, an additional 10 minutes is factored in for the transfer time from RB to the shuttle service between Rīga Airport Station and Rīga Central Station. As these transfers take place during travels between the O/D pairs, they are factored into net travel times as well.

		0-650 km						650+ km		
Rail distance		276 km	362 km	347 km	501 km	599 km	583 km	659 km	772 km	1069 km
Air distance		229 km	261 km	280km	353 km	393 km	500 km	529 km	560 km	835 km
RB routes		Rīga* – Kaunas	Rīga* – Vilnius**	Tallinn – Rīga*	Kaunas – Warsaw	Vilnius** – Warsaw	Tallinn – Kaunas	Tallinn – Vilnius**	Rīga* – Warsaw	Tallinn – Warsaw
Travel time (min)	RB HSR	115	195	157	196	276	211	291	333	433
	Air	n.a.	50	50	n.a.	65	n.a.	70	85	100
	Bus	240	240	265	395	420	630	540	570	1080
	Car	230	220	240	300	360	450	420	500	750

Note: Car travel costs include direct trip-related costs (i.e., fuel) but exclude long-term ownership and maintenance costs.

*Routes to and from Rīga include a transfer to the shuttle service between Rīga Central Station and Rīga Airport Station
**Routes to and from Vilnius include a transfer to the existing 1520 mm service between Kaunas and Vilnius.

Figure 22: Net time- and cost-based transport mode comparison in Rail Baltica Phase 1 (Rail Baltica – internal document, 2023; Desktop research, 2023; Consultant team analysis)

On **routes served by regional services**, RB fares are competitive, often matching or slightly undercutting the costs of car and bus travel. In areas where RB's routes coincide with existing regional train services, RB aims to align its pricing with that of the existing regional network to encourage the adoption of the new infrastructure. On regional routes, air travel options are not available.

Furthermore, **RB serves routes currently not covered by the existing rail network**, which is a significant draw for potential travelers. RB is also expected to offer a more comfortable travel experience compared to existing regional rail services, potentially further enhancing its competitive position.

While this **comparison primarily addresses travel costs and durations**, aspects like comfort, reliability, and accessibility are also crucial for a comprehensive evaluation and are anticipated to be among RB's primary advantages. Subsequent figures provide an analysis of transportation modes, characterizing O/D pairs by travel time and costs, along with projected modal shares for the year 2046 based on RB’s traffic demand model.

For all **destinations from Tallinn**, while Rail Baltica offers a fast alternative compared to other modes of transportation, car travel remains the most favored mode of transport, primarily due to its cost efficiency. However, in the case of the Tallinn-Kaunas route, RB has the potential to become the most favored mode of transportation due to the significantly faster travel time compared to car and bus travel and the lack of available air service.

High-speed rail travel comparison from Tallinn

A Tallinn - Warsaw — Rail ~1069 km; Air ~835 km

	Time	Cost	Modal share %
Rail Baltica	433 min.	112 EUR	18%
Air	220 min.	184 EUR	33%
Bus	1080 min.	58 EUR	<1%
Car	750 min.	58 EUR	49%

B Tallinn - Rīga — Rail ~347 km; Air ~279 km

	Time	Cost	Modal share %
Rail Baltica	157 min.	36 EUR	30%
Air	170 min.	118 EUR	1%
Bus	265 min.	21 EUR	3%
Car	240 min.	21 EUR	65%

C Tallinn - Kaunas — Rail ~583 km; Air ~500 km

	Time	Cost	Modal share %
Rail Baltica	211 min.	61 EUR	43%
Air	n.a.	n.a.	11%
Bus	630 min.	34 EUR	<1%
Car	450 min.	34 EUR	46%

D Tallinn - Vilnius — Rail ~659 km; Air ~529 km

	Time	Cost	Modal share %
Rail Baltica + Existing 1520 mm service	291 min.	66 EUR	13%
Air	190 min.	169 EUR	20%
Bus	540 min.	37 EUR	<1%
Car	420 min.	37 EUR	68%

Legend

- Rail Baltica
- Existing 1520 mm service
- Air travel, incl. Time spent on airport
- Bus
- Car
- Time – Avg. Minutes
- Cost – Avg. EUR per passenger
- XX km – Rail distance
- XX km – Air distance

Note: Assumed occupancy rates for car travel: 1.8 people

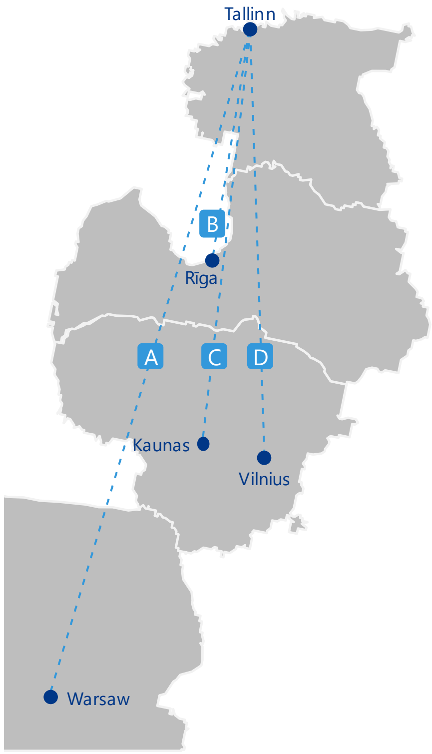


Figure 23: Comparison of travel modes between Tallinn and key destination cities in Rail Baltica Phase 1 (Rail Baltica – internal document, 2023; Desktop research, 2023; Consultant team analysis)

For journeys **originating from Rīga**, rail travel, when assessed in terms of time and cost, emerges as an advantageous option, offering quicker transit times and substantially lower costs compared to air travel. However, other factors like flexibility, accessibility, and the potential duration of stay in the destination city contribute to a considerable preference for car-based travel.

High-speed rail travel comparison from Rīga

B Rīga - Tallinn (rail ~347 km; air ~279 km)

	Time	Cost	Modal share %
Rail Baltica	157 min.	36 EUR	30%
Air	170 min.	118 EUR	1%
Bus	265 min.	21 EUR	3%
Car	240 min.	21 EUR	65%

E Rīga - Warsaw (rail ~772 km; air ~560 km)

	Time	Cost	Modal share %
Rail Baltica	333 min.	81 EUR	48%
Air	205 min.	213 EUR	6%
Bus	570 min.	34 EUR	<1%
Car	500 min.	40 EUR	46%

F Rīga - Kaunas (rail ~276 km; air ~229 km)

	Time	Cost	Modal share %
Rail Baltica	115 min.	29 EUR	32%
Air	n.a.	n.a.	<1%
Bus	240 min.	17 EUR	3%
Car	230 min.	16 EUR	65%

G Rīga - Vilnius (rail ~362 km; air ~261 km)

	Time	Cost	Modal share %
Rail Baltica / Existing 1520 mm service	195 min.	34 EUR	18%
Air	170 min.	138 EUR	6%
Bus	240 min.	19 EUR	2%
Car	220 min.	19 EUR	74%

Legend

- Rail Baltica
- Existing 1520 mm service
- Air travel, incl. Time spent on airport
- Bus
- Car
- Time – Avg. Minutes
- Cost – Avg. EUR per passenger
- XX km – Rail distance
- XX km – Air distance

Note: Assumed occupancy rates for car travel: 1.8 people

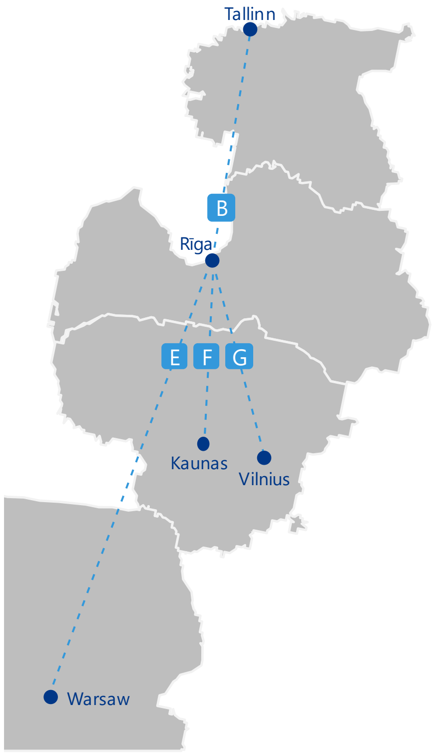


Figure 24: Comparison of travel modes between Rīga and key destination cities in Rail Baltica Phase 1 (Rail Baltica – internal document, 2023; Desktop research, 2023; Consultant team analysis)

Travel options from Kaunas are more constrained due to the limited availability of flights to major cities in the region. This limitation positions Rail Baltica's high-speed service as the fastest mode of transportation for passengers departing from Kaunas. However, it's noteworthy that the cost of this service is nearly twice that of car and bus travel. An exception is the Kaunas-Vilnius route, where the existing 1520 mm service results in similar travel time and costs to traveling by coach or car. Regarding trips across Kaunas, the *Extended Scenario Chapter* assesses - among other assumptions - the impact of deploying variable-gauge rolling stock to enable seamless gauge transition. This solution is projected to further enhance Rail Baltica's competitiveness.

High-speed rail travel comparison from Kaunas

C Kaunas - Tallinn: Rail ~583 km, Air ~500 km

	Time	Cost	Modal share %
Rail Baltica	211 min.	61 EUR	43%
Air	n.a.	n.a.	11%
Bus	630 min.	34 EUR	<1%
Car	450 min.	34 EUR	46%

F Kaunas - Rīga: Rail ~276 km, Air ~229 km

	Time	Cost	Modal share %
Rail Baltica	115 min.	29 EUR	32%
Air	n.a.	n.a.	<1%
Bus	240 min.	17 EUR	3%
Car	230 min.	16 EUR	65%

I Kaunas - Vilnius: Rail ~104 km, Air ~90 km

	Time	Cost	Modal share %
Existing 1520 mm service	80 min.	5 EUR	23%
Air	n.a.	n.a.	<1%
Bus	90 min.	7 EUR	8%
Car	80 min.	6 EUR	69%

H Kaunas - Warsaw: Rail ~501 km, Air ~353 km

	Time	Cost	Modal share %
Rail Baltica	196 min.	52 EUR	48%
Air	n.a.	n.a.	<1%
Bus	395 min.	25 EUR	1%
Car	300 min.	24 EUR	51%

Legend

- Rail Baltica
- Existing 1520 mm service
- Air travel, incl. Time spent on airport
- Bus
- Car
- Time: Avg. Minutes
- Cost: Avg. EUR per passenger
- XX km – Rail distance
- XX km – Air distance

Note: Assumed occupancy rates for car travel: 1.8 people

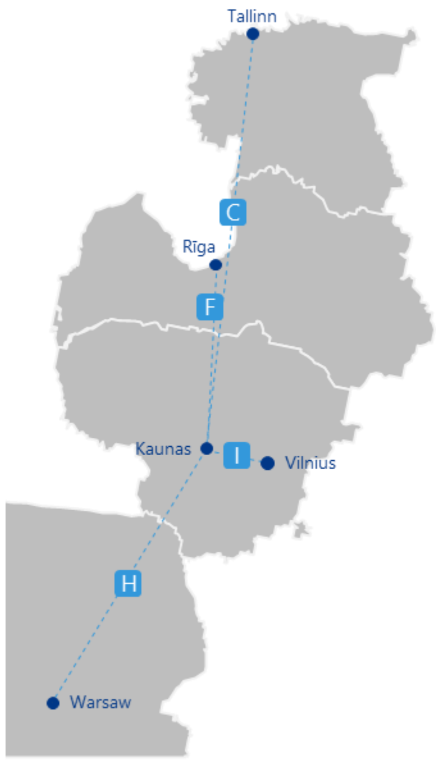


Figure 25: Comparison of travel modes between Kaunas and key destination cities in Rail Baltica Phase 1 (Rail Baltica – internal document, 2023; Desktop research, 2023; Consultant team analysis)

Finally, **travel options from Vilnius** are compared to evaluate the attractiveness of indirect rail connectivity with Estonia, Latvia and Poland. While passengers to/from Vilnius rely on connecting from existing rail lines to Rail Baltica via Kaunas, it is important to recognize the establishment of mainly high-speed rail connections to Tallinn, Rīga Airport and Warsaw. In this context, the coordination of RB and 1520 mm services is expected to play an essential role in supporting modal shift towards rail on these routes.

For the Vilnius-Warsaw route, both the cost and travel time of RB HSR service are potentially more favorable compared to air travel. In terms of time, the rail journey is twice as fast as traveling by car or bus. Similarly, for the

Vilnius-Tallinn route, while the travel time via rail is comparable to air travel, it is nearly twice faster than bus, coach, or car. In terms of cost, Rail Baltica's HSR service is expected to be significantly less expensive than air travel.

High-speed rail travel comparison from Vilnius

D Vilnius - Tallinn (~659 km rail; ~529 km air)

	Time	Cost	Modal share %
Rail Baltica	291 min.	66 EUR	13%
Air travel	190 min.	169 EUR	20%
Bus	540 min.	37 EUR	<1%
Car	420 min.	37 EUR	68%

G Vilnius - Rīga (~362 km rail; ~261 km air)

	Time	Cost	Modal share %
Rail Baltica	195 min.	34 EUR	18%
Air travel	170 min.	138 EUR	6%
Bus	240 min.	19 EUR	2%
Car	220 min.	19 EUR	74%

I Vilnius - Kaunas (~104 km rail; ~90 km air)

	Time	Cost	Modal share %
Existing 1520 mm service	80 min.	5 EUR	23%
Air travel	n.a.	n.a.	<1%
Bus	90 min.	7 EUR	8%
Car	80 min.	6 EUR	69%

J Vilnius - Warsaw (~599 km rail; ~393 km air)

	Time	Cost	Modal share %
Rail Baltica	276 min.	57 EUR	34%
Air travel	65 min.	201 EUR	9%
Bus	420 min.	31 EUR	<1%
Car	360 min.	31 EUR	56%

Legend

- Rail Baltica
- Existing 1520 mm service
- Air travel, incl. Time spent on airport
- Bus
- Car
- Time – Avg. Minutes
- Cost – Avg. EUR per passenger
- XX km – Rail distance
- XX km – Air distance

Note: Assumed occupancy rates for car travel: 1.8 people

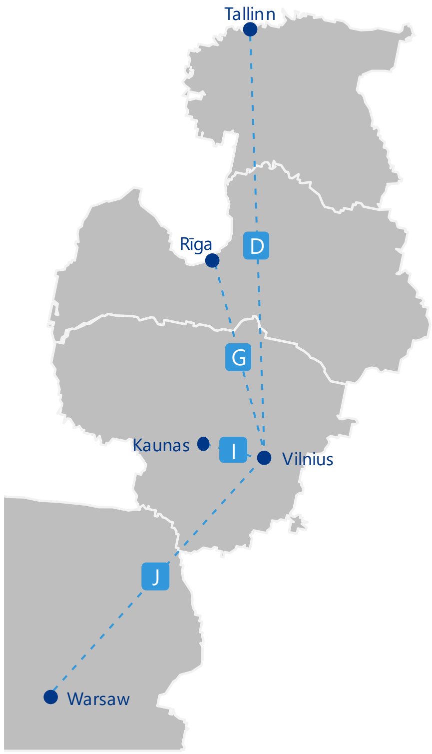


Figure 26: Comparison of travel modes between Vilnius and key destination cities in Rail Baltica Phase 1 (Rail Baltica – internal document, 2023; Desktop research, 2023; Consultant team analysis)

When **contrasting the projected modal share potential for Rail Baltica with benchmark HSR modal shares** based on air distance categories for locations served by the network, the attractiveness of high-speed rail shows significant correlation with distance. This comparison suggests that while RB modal shares are aligned with standards set by international examples, there is still potential for increased rail share in the long term.

Additionally, it is important to note the **growth potential in most distance buckets to be realized through further development of adjacent infrastructure**, as well as the prominence of large O/D pairs in the modal share curve, including the ferry connection between Helsinki and Tallinn, representing a significant element in the network's overall connectivity and modal share dynamics.

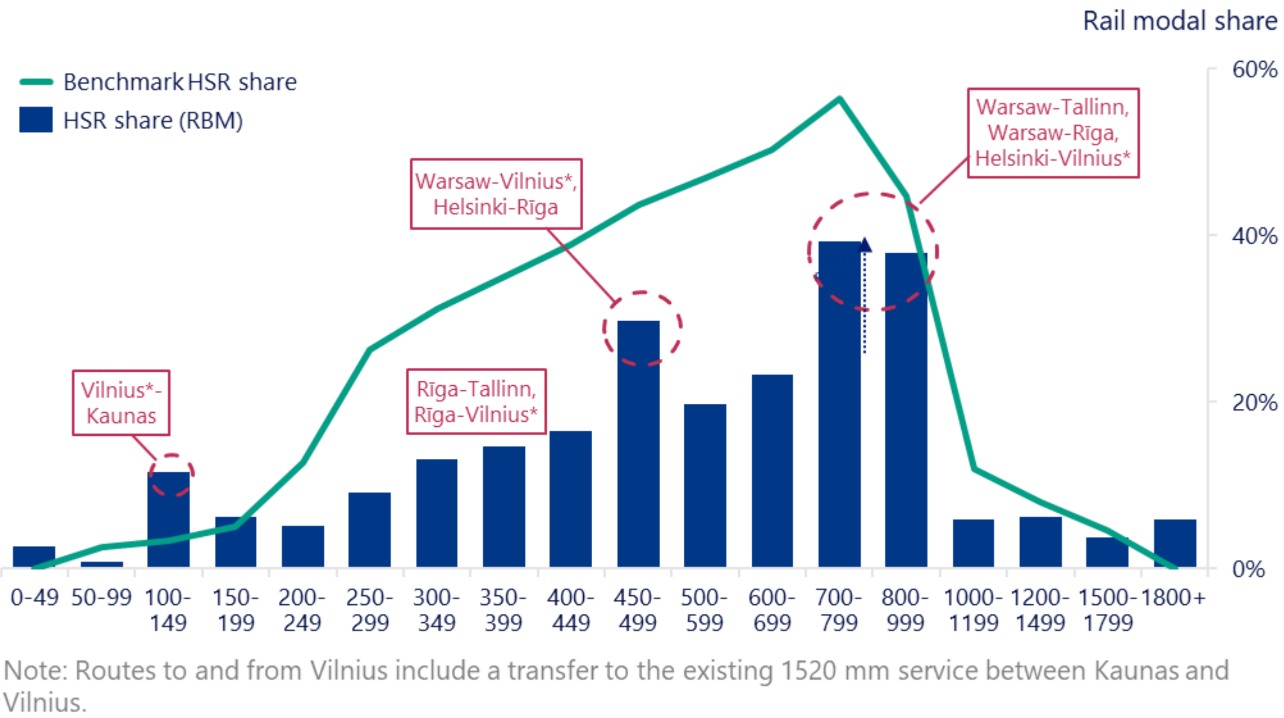


Figure 27: Rail modal share by distance buckets, % of total pkm in Rail Baltica Phase 1 (Rail Baltica – internal document, 2023; Consultant expert analysis)

Reliability

Reliability also plays a crucial role in evaluating the competitiveness of alternative transport modes. For passenger trains, reliability is assessed by looking at punctuality. For medium and short-distance passenger trains, the Baltics are reported to be at the top spot at the European level in terms of reliability, featuring a punctuality rate above 98% as of 2019 98% as of 2019 (Grandsart, 2021). In long-distance passenger services, Lithuania and Latvia also emerge among the top three European countries, with respective punctuality rates of 99% and 94%, though data for Estonia are unreported. For a comparative analysis of EU performance in terms of passenger trains performance, refer to the next figure.

Reliability is a key factor in assessing the competitiveness of various modes of transport. In this analysis, reliability is evaluated through punctuality metrics. For medium and short-distance passenger trains, the Baltic states have achieved a leading position in Europe regarding reliability, boasting a punctuality rate exceeding 98% as of 2019 (please see following figure). For long-distance passenger services, Lithuania and Latvia rank among the top three European countries, with punctuality rates of 99% and 94%, respectively. However, data for Estonia in this category is not available (Grandsart, 2021).

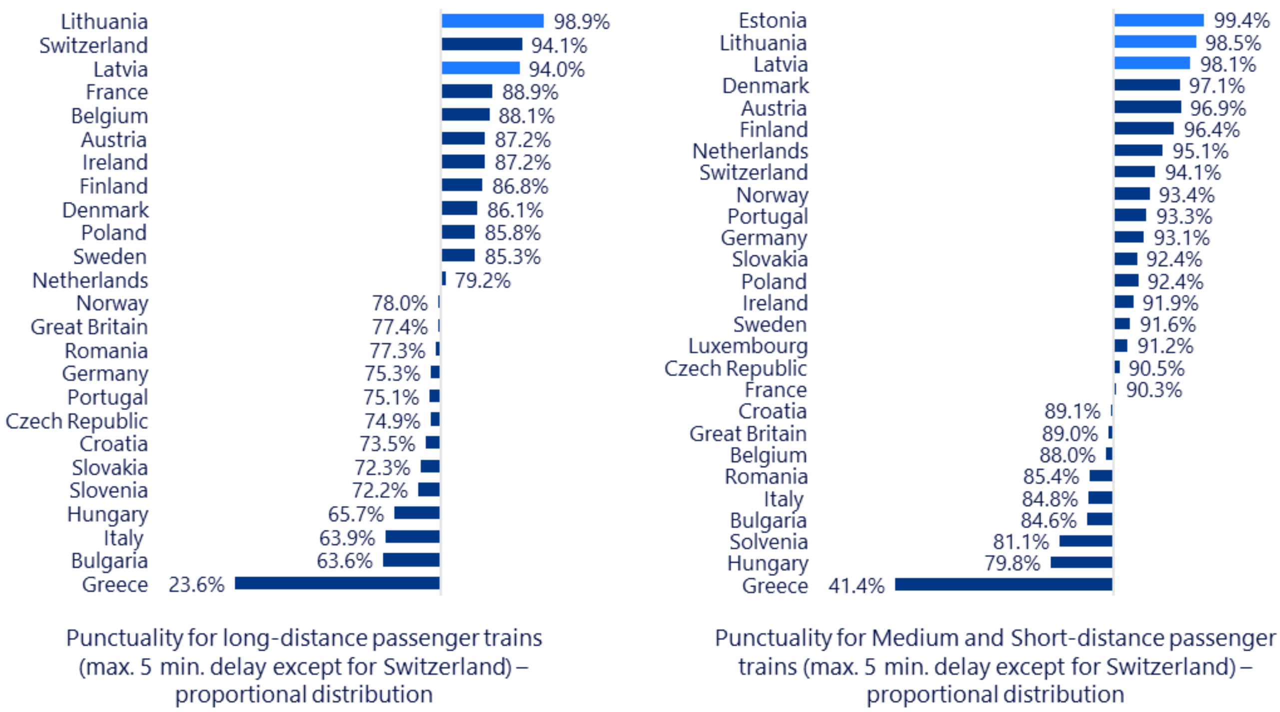


Figure 28: Punctuality for passenger trains (max. 5 min. delay except for Switzerland) – proportional distribution (European Commission, 2019b)

In the context of **air travel**, two key airlines operating routes relevant to RB are LOT[22] and airBaltic. LOT was recognized as the 9th most punctual airline in Europe in 2022, with a punctuality rate[23] of 75%, according to OAG's 2023 report. This performance is notable as air travel typically shows less reliability than train services, yet LOT's punctuality stands out positively among its European counterparts.

In contrast, airBaltic experienced a decrease in punctuality in 2022. The airline's 3-minute punctuality rate fell to 54.5%, a decline from 66.3% in 2021, and its 15-minute punctuality rate reduced to 72% from 85% in the previous

[22] LOT Polish Airlines

[23] On-time punctuality refers to level of success of the service remaining on the published schedule

year. This downturn in reliability is largely due to a range of operational challenges, including airport restrictions, reduced airport slots, aircraft rotation issues, technical difficulties, and staff shortages at airports (airBaltic, 2022).

Rank	Coverage	Airline Name	Code	OTP 2022	Cancellation Rate % 2022	OTP 2019	Rank in 2019
1	96.6%	Eurowings	EW	95.26%	3.62%	80.20%	9
2	89.0%	Iberia	IB	86.54%	0.03%	84.06%	3
3	99.6%	Air Europa	UX	84.44%	0.21%	79.30%	13
4	99.8%	Austrian Airlines AG dba Austrian	OS	81.05%	0.58%	78.31%	18
5	99.7%	ITA Airways	AZ	79.59%	1.09%	81.58%	7
6	94.1%	Norwegian Air Shuttle	DY/DB	79.12%	0.60%	75.61%	22
7	98.3%	Finnair	AY	77.36%	0.51%	77.42%	19
8	85.9%	Pegasus Airlines	PC	75.07%	0.75%	79.74%	11
9	99.9%	LOT—Polish Airlines	LO	74.75%	0.13%	73.59%	28
10	99.6%	KLM—Royal Dutch Airlines	KL	73.06%	0.54%	78.57%	16

Figure 29: European airlines by OTP (OAG, 2023)

Regarding **buses**, specific punctuality data are not readily accessible. Nevertheless, it is recognized that buses are frequently affected by road traffic conditions, potentially leading to significant punctuality issues. In urban areas, where traffic congestion is common, buses are prone to delays, generally resulting in lower punctuality compared to trains and planes. Consequently, bus services are expected to exhibit lower punctuality rates. A similar logic applies to car travel, which is also susceptible to variations in traffic conditions, affecting its punctuality and reliability.

Accessibility

Moreover, **accessibility plays a crucial role in determining the competitiveness of different transport modes**. Car travel is notably versatile, offering unmatched accessibility thanks to its ability to reach almost any area connected by a road network. Rail Baltica, while not as flexible as car travel, still offers significant accessibility due to its integration with other European rail networks, enabling seamless cross-regional and international travel with fewer transfers.

In contrast, the existing railways in the Baltics are less appealing for regional travel due to limited coverage and inadequate network integration. Coaches, however, emerge as an attractive option for accessibility; they are the preferred transport mode for most daily commuters in areas with scarce rail connectivity. Air travel, although efficient for longer distances, can be less accessible in rural areas or smaller towns without nearby airports, thereby limiting its overall reach.

Competition

A high-level analysis of the Baltic passenger transportation sector unveils a diversified competitive landscape. While the **air travel market is** somewhat **consolidated** with key players like Ryanair and airBaltic holding significant shares, it still encompasses a variety of operators targeting distinct geographies. Similarly, the rail sector is mostly served by state-owned companies with an established presence in the region. In contrast, the road transportation sector is experiencing a high degree of fragmentation, indicating a densely populated market.

In the region, the **air travel** market is showing signs of concentration, with Ryanair and airBaltic emerging as popular choices for travelers as shown in the figure below. While Ryanair mainly provides routes to destinations outside the Baltic area, airBaltic has a strong grip on domestic and intra-Baltic routes, offering direct flights between the Baltic states, together with LOT. RB is thus going to face competition from these players. An aggregated view on the region suggests that Ryanair holds the highest market share, with 33%, followed closely by airBaltic, with 28%. Players with lower market share include Norwegian, Wizz Air, LOT, and Finnair, indicating a competitive yet somewhat consolidated market landscape (Statista, 2023).

Figure 30: Market share of key players in the Baltic passenger air travel segment as of 2022 (European Commission, 2023a)

The coach passenger market in the Baltics is moderately fragmented with many small companies operating within this sector. The total annual value of the market is estimated to be around EUR 1.1 bn as of 2022 (Bureau van Dijk, 2023); however, this figure encompasses both urban transportation and intercity or long-distance transport[24]. As of 2022, the companies offering predominantly inter-city transportation report similar turnover figures, indicating no dominant market leader. One contributing factor to the fragmentation of the market is the presence of numerous small- or medium-sized enterprises. Although individual firms often specialize in specific routes and might have limited regional outreach, when viewed collectively, they offer comprehensive coverage and multiple travel options for passengers.

Competition is likely to be faced by companies like Ecolines, Kautra, Infobus, Lux Express, GoBus and Flixbus (via its Estonian branch), which have a slightly higher market share and also offer inter-regional passenger services. Out of them, GoBus, LuxExpress and Kautra emerge as the players with the most significant 2022 turnover, amounting to approximately EUR 43 mn, EUR 27 mn, and EUR 31 mn, respectively (Bureau van Dijk, 2023).

The **rail passenger** market in the Baltics can be characterized as concentrated, with dominant state-owned RUs in every state. At the same time, the level of competition is low, as most of the traffic is captured by the below-mentioned entities.

In Estonia, the rail passenger market is mainly served by AS Eesti Liinirongid, also known as Elron. Elron, a state-owned company, operates various routes in Estonia including East, West, Southeast, and Southwest directions from main stations in Tallinn and Tartu. As an example, one of the routes, Tallinn–Tartu–Valga, connects to the Pasažieru Vilciens trains, which further lead to Rīga, Latvia. As of 2022, the company's turnover totaled EUR 56 mn (Bureau van Dijk, 2023), and it carried over 7 mn passengers (Rail Target, 2023).

[24] Market size has been approximated by considering the 2022 turnover of all active companies with headquarters in Latvia, Estonia and Lithuania registered under NACE codes 493, 4931, 4939, indicating that their primary activity is urban/suburban/other passenger land transport. This is only an estimate number as foreign companies operating in the region are excluded from the calculation.

In Latvia, Pasažieru Vilciens is the state-owned company which specifically handles passenger services. Pasažieru Vilciens transported around 15.7 mn passengers in 2022 (Latvijas dzelzceļš, 2022), generating EUR 54 mn in turnover for that period (Bureau van Dijk, 2023). This entity is the main carrier for passenger rail services in Latvia.

Finally, LTG is the national railway company of Lithuania, managing most of the country's railway network. Its subsidiary LTG Link provides passenger services. It made around EUR 72 mn in turnover cumulatively in 2022 (Bureau van Dijk, 2023). In the same year, 4.7 mn passengers used LTG Link's services (LTG Link, n.d.). In December 2023, LTG Link launched a new route operating directly between Vilnius and Rīga, having signed an agreement with the Latvian IM to facilitate this development (LTG Link, 2023).

Since the RUs for RB's future operations have not been established, it is currently not feasible to determine if RB's RUs will encounter competition from these entities or what their involvement in train operations will be. However, it can be noted that as of 2023, these players do not offer direct connections between the Baltic capitals, except for the recently launched Vilnius - Rīga connection.

5.6.2 Freight

RB's shared tracks, accommodating both freight and passenger transportation, offer a **seamless and efficient freight transit solution**. This setup not only minimizes delays but also reduces the risk of goods damage during transit, crucial for maintaining the integrity of freight. Additionally, rail transportation presents a more sustainable alternative compared to other carbon-intensive transport modes, contributing to the reduction of carbon footprints and aligning with the EU's green initiatives.

Furthermore, RB's connectivity with the existing 1520 mm rail, road, and maritime networks supports intermodal connections. This integration enables door-to-door logistics, providing businesses with comprehensive supply chain solutions. In **evaluating the competitiveness of freight transport**, four key modes are pivotal: road-based (truck) freight, air-based transportation, maritime transportation, and rail transportation.

These transportation modes are **evaluated based on time, cost, capacity, and accessibility**. Transport time denotes the total duration required to transport goods along specific routes. Transport cost involves the expenses incurred per unit of goods transported over selected distances. Transport capacity represents the maximum volume that can be carried using a particular mode. Accessibility indicates the adaptability and flexibility of transport routes to different destinations.

Distance plays an important role as a differentiator in the competitiveness of freight transport modes due to different fixed cost components. Therefore, these modes are analyzed in three distinct distance categories:

- Short distance: 0-450 km.
- Medium distance: 450-900 km.
- Long distance: above 900 km.

For short distances (0-450 km), truck transportation is expected to remain the optimal choice based on the evaluated aspects**,** followed by rail transportation. On short-distance routes freight is usually faster and can provide cheaper delivery fees combined with easy accessibility, mainly due to first and last mile convenience. Rail on the other hand can deliver higher volumes and performs relatively well regarding accessibility compared to other modes.

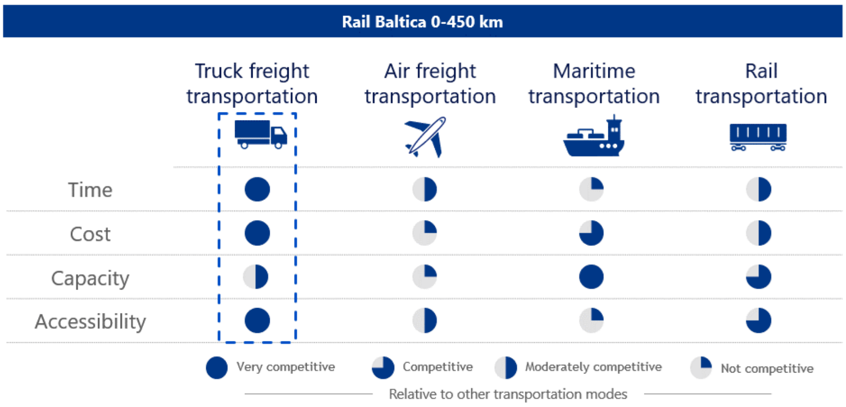


Figure 31: Summary of the competitiveness assessment of freight transportation modes on short distance[25] (Consultant team analysis)

In the **medium-distance range of 450-900 km**, selecting the most suitable mode between truck and rail freight transportation presents a complex decision. Trucks often provide faster transit times, making them a favorable option for time-sensitive deliveries. However, rail transportation tends to be more cost-effective and offers greater capacity, making it a preferable choice for larger or less time-critical shipments. Maritime transport, while not always applicable in this distance range, can offer significant advantages in terms of capacity and cost for suitable routes, particularly for bulk or heavy goods. This comparison highlights the importance of weighing time efficiency against the economic and capacity benefits of rail and maritime options in medium-range freight logistics.

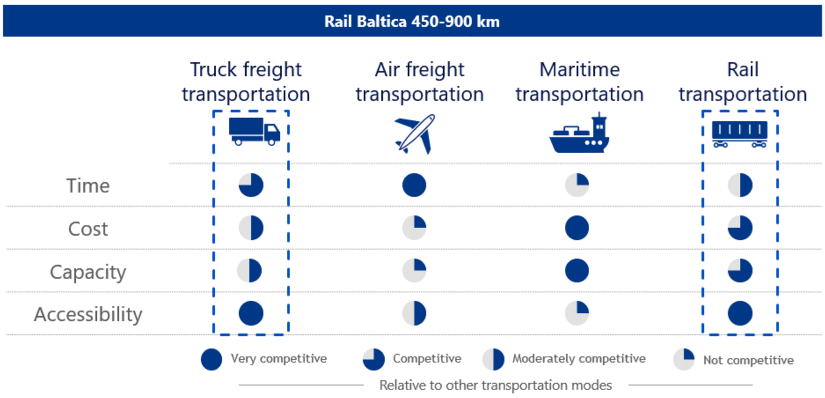


Figure 32: Summary of the competitiveness assessment of freight transportation modes on medium distance (Consultant team analysis)

For **long-distance freight transport over 900 km,** rail emerges as an increasingly competitive choice due to its cost efficiency, high capacity, and good accessibility, particularly for bulk or non-urgent shipments. Maritime transport, however, plays a crucial role in this range, offering substantial benefits in terms of cost and capacity, especially for international shipping and heavy or voluminous cargo.

[25] The blue box with dotted line highlights the most competitive transport mode within the respective distance ranges.

While **rail and maritime are strong contenders for efficiency and volume**, trucks retain an advantage in terms of flexibility and direct access, making them ideal for certain time-sensitive or specialized deliveries. Air freight, though often the most expensive option, provides the quickest transit times, suitable for high-priority or lightweight shipments. This scenario highlights the need to carefully consider each mode's strengths—cost and capacity for rail and maritime, and speed and flexibility for truck and air freight—in long-distance freight transportation decisions.

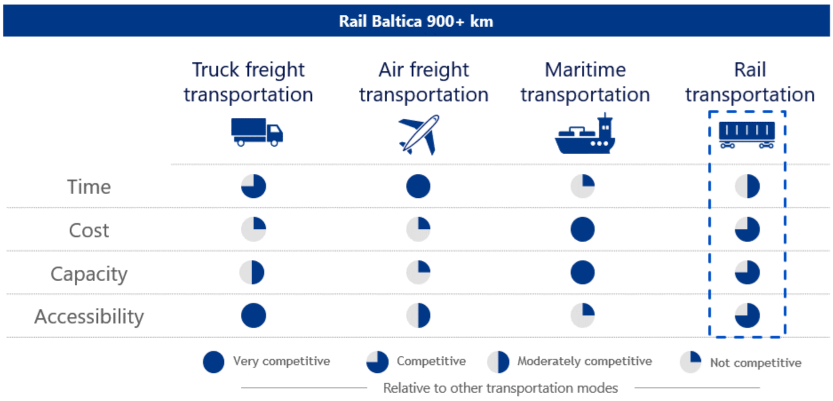


Figure 33: Summary of the competitiveness assessment of freight transportation modes on long distance (Consultant team analysis)

Overall, **maritime transportation has a high limitation as access to water is a key enabler**. Similarly, air-based transportation requires built infrastructure for airport connection. Concerning land-based freight transport, the expected routes of RB – identified based on RBR project team input – will face competition primarily from the trucking industry. These are inland routes where maritime transportation is not a significant rival. Existing rail networks[26], despite representing theoretical competition, do not cover the same routes and are therefore excluded from the analysis in the following subchapters.

Next, land-based freight transport modes are analyzed comparing RB freight service and truck freight transportation in detail based on time, cost, accessibility, capacity, and competitive environment.

Transport time

When considering the time dimension, it becomes evident that **trucks hold a competitive advantage over RB freight services**. This advantage is primarily attributed to the extended loading, unloading, and maneuvering times associated with the latter, resulting in an average speed difference of approximately 15% (with an advantage

[26] Referred to the 1520 mm gauge infrastructure.

over truck transport). Despite truck transport being usually faster, Rail Baltica can still provide high value for customers through potentially lower costs, high reliability and higher capacity potential.

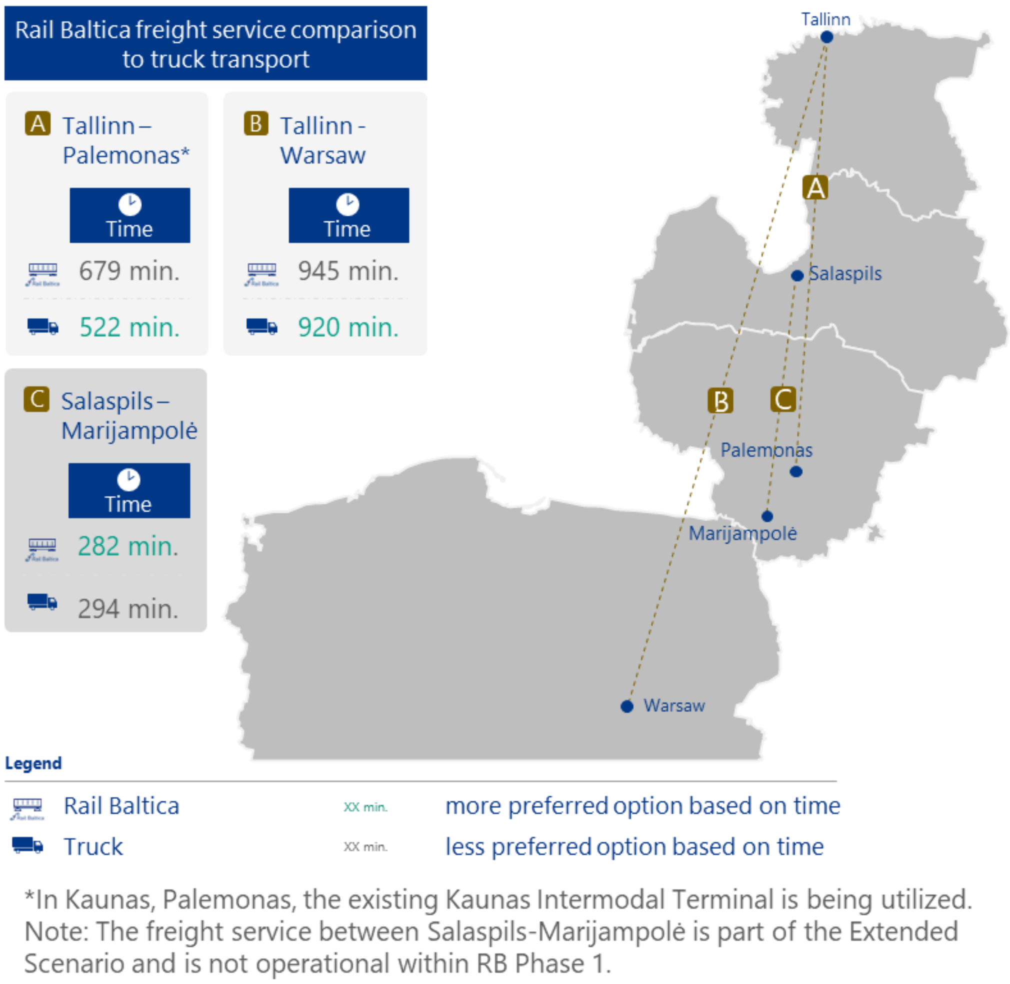


Figure 34: Transport time on routes planned on RB in Rail Baltica Phase 1 (RBR Project Team input, 2023; Consultant team analysis)

Cost

In terms of transport costs, rail transport's higher fixed expenses render it a more viable option over longer distances. Rail Baltica's (RB) traffic demand model, backed by consultant expert analysis, indicates that RB becomes a more economical choice than trucks for dry bulk[27] transport on average journeys exceeding 50 kilometers. For

[27] Materials like grains, coal, or minerals in large quantities, usually without packaging.

liquid bulk[28] transport, RB's cost advantage becomes apparent for distances beyond 175 kilometers, and for semi-bulk[29] goods, the cost-effectiveness of RB over trucks is seen at distances surpassing 300 kilometers.

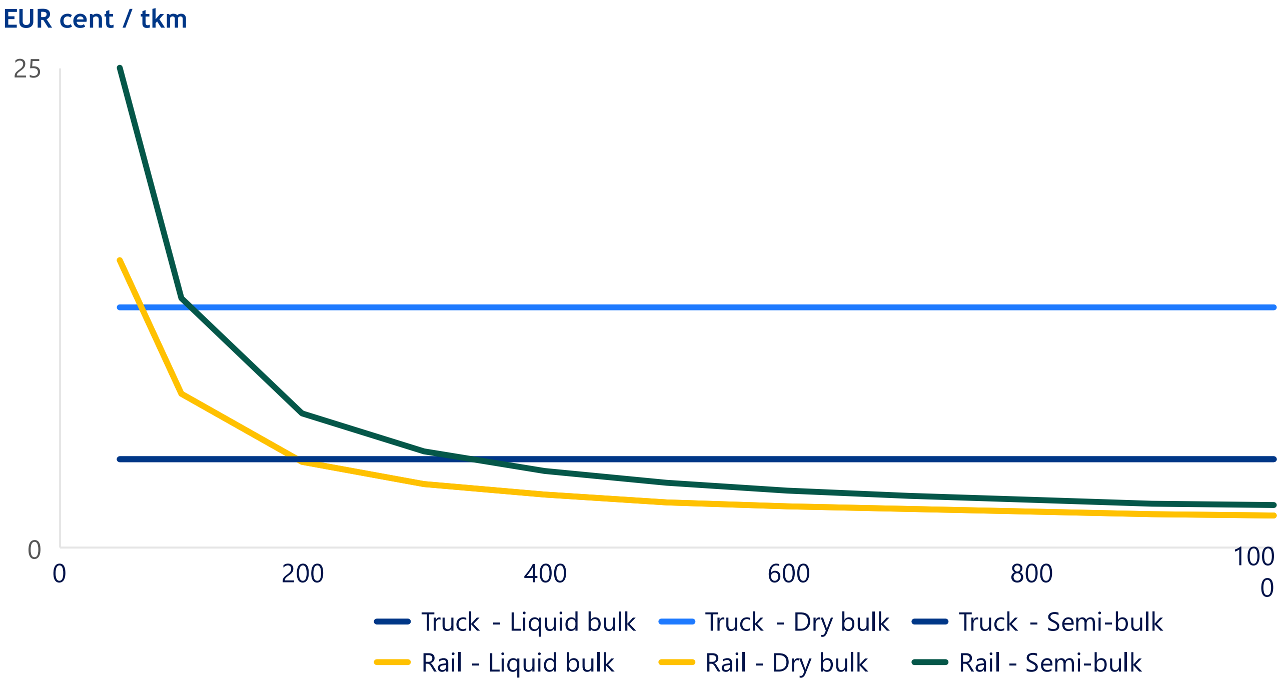


Figure 35: Cost efficiency curve for rail and truck transport modes (Rail Baltica TDM, 2024)

Accessibility

After evaluating cost and time, the study shifts its focus to **accessibility, an important aspect of freight transport**. Here, trucks stand out for their ability to provide door-to-door logistics, efficiently managing first and last-mile operations, collecting goods from various locations, including urban and remote areas, and delivering them directly to final destinations like retail outlets, homes, or business centers. This direct delivery approach, with fewer deliveries of goods, offers significant advantages to customers.

In contrast, while trains are effective for transporting bulk cargo over long distances, they often rely on other modes, such as trucks, for the beginning and end of the journey. This reliance hinders their capacity to offer complete door-to-door service. For Rail Baltica to remain competitive, enhancing intermodal connectivity at terminals, ports, airports, and yards is critical. Addressing the need for transloading to adjust to different track gauges is also a key consideration for RB. The availability of necessary transloading facilities, particularly cranes, is essential to counter this potential long-term limitation and ensure effective service.

---

[28] Liquid-bulk cargo is usually oil, petroleum products, chemicals, LNG, etc. and it is packaged in tanks.

[29] Semi-bulk cargo is usually wood chips, lumber, steel coils, etc. and it is mostly packaged in large containers or pallets.

Capacity

From a **capacity perspective in freight transportation**, maritime shipping stands out as the most capable, followed by train, and then truck. Maritime transport excels in handling large volumes, making it the preferred choice for bulk cargo. Trains, including those on RB, offer significant capacity as well, with an average load capacity of 820 tons, far exceeding that of trucks. Trucks, with their average capacity of 14 tons, are more suited for smaller loads and provide flexibility but cannot match the volume capacity of maritime and rail transport. This hierarchy of capacity underscores the importance of RB in managing substantial cargo volumes and highlights the ongoing reliance of certain industries on rail, especially for transporting dangerous goods, where capacity is a critical concern.

Competition

The **road freight** transportation landscape in the Baltics is fragmented, indicating the presence of numerous national and international carriers operating in the region, with no major large international players dominating the market. It is also highly competitive – this competitiveness stems from various factors including the presence of numerous service providers, fluctuating fuel prices, advancements in technology, and evolving customer expectations. Moreover, the industry is characterized by thin profit margins, which drive companies to constantly improve efficiency and seek improvements to gain an edge over competitors. According to a report by GSCi, as of 2022, the total road transport market size in Estonia is EUR ~2 bn, in Latvia EUR ~1.3 bn, and in Lithuania EUR ~2.2 bn, which amounts to EU ~5.5 bn for the entire region (GSCi, 2023).

Across the Baltics, the carriers serving similar routes to the proposed one for RB may be divided into two major segments, depending on their origin – SMEs from the Baltics, and international operators. While large international players, such as CEVA Logistics, DHL freight, DSV, LKW Walter, and Girteka[30] have a substantial presence due to their extensive networks and resources, SMEs also hold a significant share as they can offer specialized services and have a deeper understanding of the local market dynamics. As mentioned in the beginning of this part, RB is expected to face competition from trucks. Therefore, a few examples of road freight companies of Baltic origin,

[30] Despite Girteka being a local player headquartered in Lithuania, it could not be classified as a SME. Girteka has extensive operations across Europe, with a reported turnover of EUR 1.93 bn as of 2022, indicating its significant scale in the transportation industry.

which operate across the three states and on similar routes as RB, can be found in the table below, including their country headquarters, as well as their fleet size, and turnover as of 2022.

Carrier	Headquarters	Turnover (EUR mn)	Fleet size
Kreiss		240	3,000 transport units
BLS Baltic Logistic Solutions		64	284 transport units
BT Baltic Transline		483	1,505 transport units
Vlantana Logistics Company		459	2,750 transport units
Linford		30	550 transport units
Prenton		29	N/A

Figure 36: Largest road freight carriers (by 2022 turnover) of Baltic origin operating regionally (Bureau van Dijk, 2023)[31]

As this chapter concludes with a comprehensive understanding of Rail Baltica's value proposition after Phase 1 implementation, it becomes evident how Rail Baltica is expected to reshape the transportation landscape in the Baltics. The next chapter on stakeholder mapping builds upon the value proposition presented above to maximize the project's potential and address challenges identified in the competitive analysis, thereby ensuring Rail Baltica's successful integration into the regional transportation network.

5.7 Stakeholder Mapping

A large-scale project like RB has a large variety of stakeholders to manage. In the following section, **major stakeholders are identified** to highlight the widespread impact and complexity of the project and to further reinstate the priorities of each actor participating in it. Relevant stakeholders are identified through several iterations in a collaboration with the RB Communication Department, based on information available in the fall of 2023, during the completion of the full scope CBA.

To reflect the characteristics of the project, **RB stakeholders are categorized in two groups**: project stakeholders and broader audience.

[31] All logos and trademarks displayed herein are the property of their respective owners and are utilized for illustrative purposes only.

5.7.1 Project Stakeholders

The stakeholders of the project have different degrees of support and influence towards the project and can be thus further classified into four groups, as seen in the figure below.

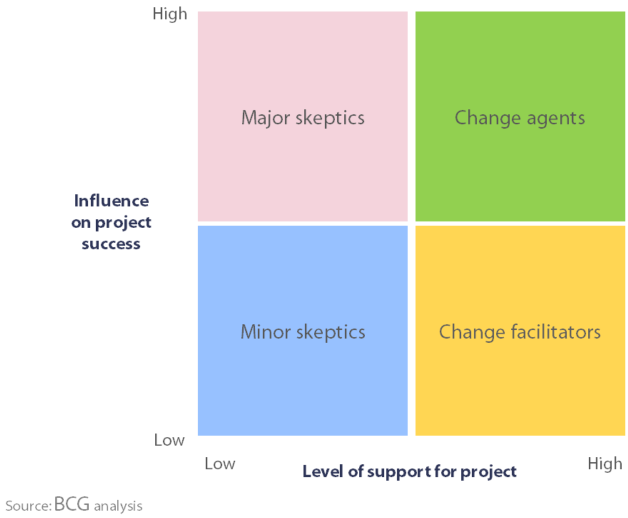


Figure 37: Classification of project stakeholders based on their attitudes

Major skeptics, crucial in the Rail Baltica project, have low support but significant influence. This group includes municipalities, NGOs, and multimodal partners, key in shaping public opinion and outcomes. Their skepticism often centers around the project's cost, environmental impact, and effect on existing services. Addressing their concerns through open, evidence-based discussions is vital for positive public perception, while monitoring their attitudes and engaging proactively in perception management is essential for project success.

Change agents, with high support and influence, are another key stakeholder category, including a wide array of entities like internal stakeholders, the European Commission, regulators[32], financial institutions, and various industry stakeholders. As influential advocates, their role in swaying major skeptics is crucial. Engagements should focus on building strong relationships and effective communication. Regular contact and public recognition of their support can maximize their contribution to the project.

Change facilitators, although not directly critical, are valuable for building a positive project ecosystem. This group comprises governments, ministries, municipalities, educational institutions, and contractors. Keeping them informed and involved is recommended to ensure their ongoing support aligns with RB's goals. Their input and support can significantly enhance public perception.

Finally, **minor skeptics**, who exhibit low support for the project and are not crucial for its overall success, can be approached with less intensive influencing strategies. While their support may not be pivotal, it's still worthwhile

[32] It is important to note, particularly in the case of regulators, that while they are typically seen as change agents, their role may sometimes align more closely with that of skeptics or facilitators of change, similar to ministries. Therefore, when strategizing engagement with regulators, it is beneficial to consider approaches that are adaptable and responsive to their unique position and perspective within the project.

to engage with them in a more moderate manner to address concerns and potentially convert them to more favorable attitudes.

The following table categorizes each stakeholder of RBGP, emphasizing their interests and goals. Identifying their position within this matrix helps tailor engagement strategies, ensuring effective and successful project delivery.

Background

		Members	Influence / support	Interests / goals
Internal stakeholders	**Beneficiaries**	Ministry of Transport & Comm. of Lithuania, Ministry of Transport of Latvia, Ministry of Climate of Estonia	Change agents	• Physical implementation of the project • Creation of an economic corridor
Internal stakeholders	**RB Rail Supervisory Board**	6 members: 2 shareholder representatives per each country	Change agents	• Delivery of the game-changing RB project in a coordinated manner
Internal stakeholders	**RB Rail**	Central coordinating authority with 3 national branches	Change agents	• Central coordination of the RB project and delegation of implementation
Internal stakeholders	**National implementing bodies**	Rail Baltic Estonia, Eiropas Dzelzceļa līnijas, LT Infra (Rail Baltica Statyba)	Change agents	• Physical implementation of the project
Internal stakeholders	**Infrastructure management entities**	Entities responsible for infrastructure management yet to be formed	Change agents	• Contribution to the efficient RB project delivery • Ensuring long-term operations
Public institutions	**Governments - Sectoral ministries**	National non-beneficiaries, ministries (e.g., economy, defense); special country formats created to support cross-sectoral & sectoral cooperation	Change facilitators	• Socio-economic benefits of the project related to their areas of work (e.g., military mobility, increased geopolitical power, new job opportunities)
Public institutions	**Regulators**	Procurement monitoring offices, state audits, rail regulators and safety authorities, cultural heritage and env. protection offices, etc.	Change agents	• Delivery of the RB project in line with all relevant laws

		Background		
		Members	Influence / support	Interests / goals
International partnerships	Municipalities	Municipalities related to areas where railway stations or the tracks are built	Change agents/ Change facilitators / Major sceptics (varies per municipality)	• Socio-economic benefits related to their municipalities (e.g., better connectivity, job opportunities)
	European Commission	DG MOVE & DGs, TEN-T coordinator	Change agents	• European integration of Baltics, improved mobility and increasing of the sense of common European identity • Showcasing RB as a catalyst for new rail standards, military mobility and socio-economic benefits
	Neighboring countries and other authorities	Authorities in countries with socio-economic interest in RB (e.g., Ukraine with military mobility, Poland and Finland)	Change facilitators	• Derive positive socio-economic benefits from RB's influence on their country (e.g., geopolitical, economic)
	Railway industry associations	International railway industry associations, e.g., UNIFE, CER, UIC, EIM, ERFA, etc.	Change agents	• Delivery of the RB project in line with industry best practices
	Infrastructure providers	Various providers of non-railway infrastructure, e.g., telecom, energy providers	Change agents	• Alignment of all components of wider RB infrastructure with the existing infrastructure
	Certificators	Institutions providing certificates indicating satisfied standards	Change facilitators	• Delivery of the RB project in line with the industry standards • Setting up of new standards for game-changing modern railways
Financial institutions	Banks	Various banks potentially providing funding	Change agents	• Achieve the desired financial rate of return
	Infrastructure investment funds	European Investment Bank and other infrastructure-related investment funds	Change agents	• Achieve the desired financial and/or internal rate of return for the community

		Members	Influence / support	Interests / goals
Non-profit	**Schools & universities**	Schools and universities educating potential future RB users and employees	Change facilitators	• Collaborate with RB in its employer branding for future project workers
	NGOs	Various national and international environmental and social NGOs	Major sceptics / Change agents (depending on country and entity itself)	• Improve net RB project environmental externalities • Improve governance and accountability of internal stakeholders responsible for project delivery
Businesses	**Contractors**	Various procurement partners	Change facilitators	• Profit making based on procurement partnerships with RB
	Multi-modal partners	Airplane, maritime and truck partners collaborating with RB	Major sceptics / Change agents (depending on whether they perceive RB as a competitive threat or a cooperating partner)	• Maintaining or increasing the demand for their services and improving their quality

Figure 38: Stakeholder mapping (based on interviews with RBR communication department)

5.7.2 The Broader Audience

The second group of stakeholders relevant for RB is the broader audience. Broader audience includes end users, NGOs, suppliers, and media.

End users of the project encompass a diverse group with distinct needs and expectations. **Passengers**, mainly representing the B2C category, are the individuals who will directly benefit from the improved transportation services. Their primary concern is convenience, reliability, and efficiency in transportation. They expect seamless and comfortable travel experiences, with a focus on accessibility, safety, and affordability. On the other hand, **freight clients**, falling under the B2B (business-to-business) umbrella, are focused on efficient logistics and cargo transport. They require reliable logistics and timely delivery, with a keen eye on cost-effectiveness. **Future end users**, including schoolchildren and kindergarteners, represent a generation that will grow up with the project's offerings, impacting their future mobility. Their priorities include safety in transportation, environmental responsibility, and accessible infrastructure, which will impact their mobility as they grow up. Lastly, the **general public** also has to be targeted to foster a core understanding of the project's benefits (balanced with costs) for widespread support.

Furthermore, **NGOs**, encompassing environmental, social, and governance (ESG) sectors, consist of both for-profit and non-profit associations and business chambers. Environmental NGOs focus on ecological sustainability and conservation, social NGOs prioritize community well-being and social equity, while governance-oriented NGOs aim to ensure responsible and ethical practices in both public and private sectors. Their collective goal is to advocate for a more sustainable and responsible future, addressing a wide range of issues, from environmental protection to social justice and corporate governance.

Suppliers, both existing and potential, play a crucial role in the project's procurement work. Their primary objective is to provide the necessary goods and services efficiently and effectively, contributing to the project's successful implementation by ensuring a consistent supply chain and meeting the project's material and service requirements. Therefore, they are the ones more concerned with the commercial dimension, or the market appeal of RB.

Finally, **media**, comprising national, regional, and international channels, serve as the diverse conduits for information dissemination. They cater to distinct audiences and perspectives. Their mission is to provide accurate and relevant information to their respective audiences. Hence, their specific interests are contingent upon the audience they serve.

5.8 Regulatory & Compliance

Navigating the complex environment of regulations and ensuring compliance are fundamental for successful project implementation. This chapter explains the most relevant regulatory frameworks affecting RB involving environmental, railway, and regulations related to the usage of road[33]. The objective of this section is to present a foundational overview of key regulatory aspects, with an in-depth analysis of each regulatory area and its implications provided in the appendix. While the chapter does not aim to provide legal advice, an overview of the main regulations governing these sectors is presented.

Environment related regulations are the European Green Deal and "Fit for 55" package. These contain the EU's goal of reducing greenhouse gas emissions by 55% by 2030. RB can emerge as a sustainable transportation alternative in the Baltic states, by reducing CO_2 emissions in the passenger and freight sectors. Moreover, policies like taxation on fossil fuels could further boost RB's appeal by making traditional fossil fuel-dependent transportation less economically attractive. However, discussions surrounding fossil fuel subsidies are pertinent as they may pose a challenge to RB by potentially diverting resources away from the transportation sector. Regulations like Directive 2008/68/EC, for handling hazardous goods transportation, promote the safe transportation of several goods on the RB line. Additionally, the Environmental Noise Directive requires the assessment and management of noise pollution from infrastructure projects, ensuring that RB adheres to standards that protect human health and the environment from excessive noise. The Habitats Directive focuses on protecting environmental and ecosystem integrity during RB's construction phase, emphasizing RB's commitment to preserving natural habitats. Finally, the EU's Environmental Impact Assessment Directive mandates assessing major infrastructural projects like RB for environmental impacts. Together, these regulations guide RB towards achieving its sustainability goals and aligning with broader EU environmental requirements.

Railway related regulations contain the 4th Railway Package, alongside the EU Directive 2012/34. These regulations aim to ensure competitiveness and interoperability within the European rail sector. The minimum access package ensures fair and non-discriminatory practices for European networks. The alignment with the EU's technical standards, especially the revised Technical Specifications for Interoperability (TSIs), is important for ambition to harmonize operations across Estonia, Latvia, Lithuania and the European network. Finally, EU's state aid railway guidelines aim to transition towards sustainable transport modes, allowing member states to subsidize

[33] Please refer to chapter *Risk and Regulatory* for a detailed overview of related aspects of the project.

operations like RB. This is further elaborated in the EU Directive 2016/797, aiming to enhance the interoperability of Union rail system on a technical harmonization level.

Transport-related regulations play an important role in shaping the transport landscape. RB stands to gain as bans on heavy goods vehicles are on the rise, primarily for environmental reasons. Such bans could channel more traffic onto rail routes. In peak traffic times, some EU countries like Austria impose restrictions on trucks on busy roads under Regulation (EC) No 561/2006. This regulation seeks to prevent overburdening of road infrastructure and enhance safety by improving both drivers working conditions and road safety standards. While these measures could nudge industries towards alternative transport modes, it is crucial for the Baltic states to uphold a regulatory environment that promotes rail competitiveness. Decisions favoring road transport could potentially decrease RB's competitiveness.

This chapter has evaluated key factors affecting Rail Baltica Global Project, providing essential context for its implementation. The analysis covered RBGP's definition as a project, geographic context within the Baltic Sea region, macroeconomic and geopolitical environments, transportation market dynamics, the value proposition of the planned infrastructure, stakeholder structure and regulatory compliance, all crucial for understanding the project's situation, challenges and potential. The subsequent chapter presents project objectives, clearly linked to this established context, emphasizing the importance of these insights for achieving RBGP's goals.

6 Objectives

Building on the analysis of contextual elements, this chapter assesses the regional and sectorial needs that Rail Baltica aims to address. Within this context, **operational, financial, and socio-economic objectives are identified** to meet these needs, providing a robust performance measurement framework. The objectives also define the impact components assessed in the CBA, offering quantifiable insights into the project's expected performance in various dimensions.

Ultimately, the goal of RB is to induce socio-economic benefits in the Baltic region and Europe, building on the contextual elements outlined in the previous chapter**.** To realize these benefits, RB needs to set and meet operational and financial targets. Balancing these objectives, RB aims to bring economic benefits that outweigh operational and financial costs, resulting in a positive return on investment from a social perspective. While achieving a positive benefit-cost ratio can be realized through various cost and benefit compositions, the following socio-economic, operational, and financial targets provide a structured roadmap to ensure a desired outcome for the Baltic region.

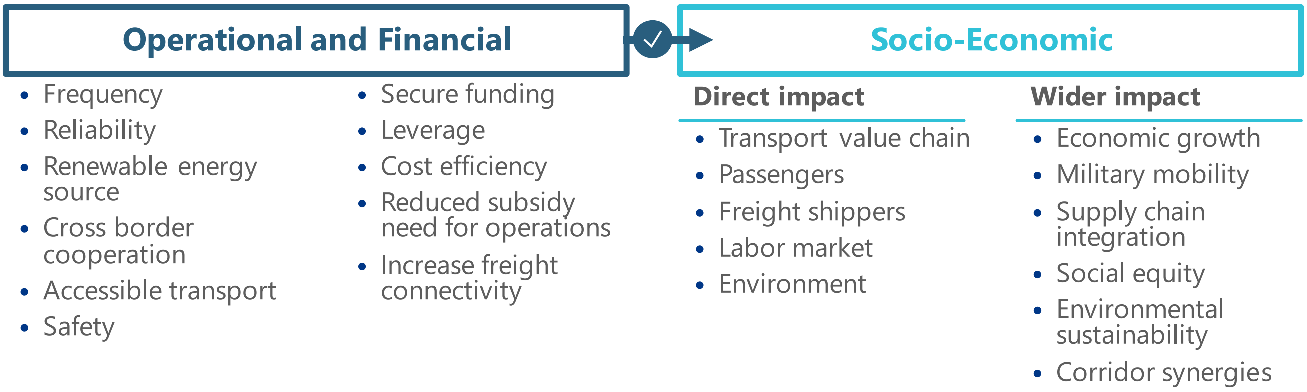


Figure 39: Overview of operational, financial, and socio-economic objectives

6.1 Operational and Financial Objectives

Operational and financial targets are essential in both planning and gauging the performance of the investment, as they directly drive socio-economic impacts. RB is committed to providing the Baltics with a competitive mode of transportation that adds value for both passengers and the freight value chain. To achieve this, RB needs to set and meet operational targets regarding capacity offered to railway undertakings, train frequencies, and physical realizations of mainline and point-type objects. From a financial perspective, RB's goals encompass benchmarks for cost-efficiency, cash flow management, and subsidy needs.[34]

Operational and Financial

- Frequency
- Reliability
- Renewable energy source
- Cross border cooperation
- Accessible transport
- Safety

- Secure funding
- Leverage
- Cost efficiency
- Reduced subsidy need for operations

Figure 40: Operational objectives overview

Frequency

RB targets to offer frequent rail services to its passengers to accommodate a broad user base and present a competitive alternative to other transport modes. To ensure a frequent service, RB must have a strong operational plan with enough trains along its routes. Currently, 156 trains per day are planned for passenger services. RB should aim to expand the number of services while facilitating track capacity to accommodate growing demand for freight.

Reliability

To achieve operational efficiency and satisfy both passenger and freight needs, RB aspires to be a reliable mode of transport with limited delays. This reliability can be attained through efficient coordination across stations and robust centralized planning. RB should target a punctuality rate of 98% within the last 10 minutes of scheduled arrival times as previously observable in other rail transportation in the Baltic.

Renewable Electricity Source

The newly constructed railway plans to be fueled entirely by electricity. More specifically, RB has set a target for 100% renewable electricity to power the project. This means that RB will need to be able to buy Guarantees of Origin to cover electricity usage. Furthermore, this requires a potentially induced investment in the region to accommodate the renewable electricity requirement for operating RB. The latter is detailed in the WEI report, presented in subsequent chapters in this report.

Cross Border Cooperation

Cross-border cooperation is crucial for achieving operational efficiency in RB. Given that the railway traverses multiple Baltic countries, effective collaboration and coordination among the infrastructure managers of these countries are essential, especially when trains cross from one nation into another. For RB, it will be particularly important to establish a dedicated corridor management system to address these cross-border operational aspects.

[34] Subsidy refers to the additional cash needed to sustain operations, calculated from revenues and costs from all activities directly related to the project.

Affordable transport

As RB strives to become a competitive alternative to traditional transportation modes in the Baltic region, it is crucial to ensure the affordability of the service for low-income passengers. To that end, RB is focused on optimizing costs to ensure competitive prices for railway undertakings and carriers alike. In turn, this would enable the provision of competitive fares for the end-users, namely passengers or freight shippers.

Safety

RB is set to be the largest infrastructure undertaking in the Baltics in the last 100 years via providing state-of-the-art transportation to the region. Safety is a key consideration of the project as it aims to offer a competitive and accessible alternative to all residents regardless of their financial means. Consequently, it is essential for the project to ensure the highest degree of safety during both the construction and operational phases. During the latter, it will be important for RB to guarantee timely maintenance of the rail infrastructure, which is to be ensured through effective collaboration between the infrastructure managers.

Secure funding

The primary financial objective for RB is to secure adequate funding, as the project will require substantial investments throughout the construction period to establish an operational rail connection on the new line by the end of 2030. Ensuring a steady flow of funding over that period is essential to meet the capital expenditure needs and prevent any capital shortages that could potentially delay the construction process.

Leverage

Given the recent macroeconomic environment characterized by higher-for-longer interest rates, RB targets to have limited exposure to debt, with a preference towards national or supranational funding such as grants or governmental subsidies.

Cost efficiency

Given the magnitude and operational complexity of the project, it is important for RB to maximize cost efficiency. It aims to do so by analyzing cost efficiency according to three metrics and setting a targeted goal for each. The relevant metrics are detailed below:

- **Overall cost efficiency:** RB plans to assess overall cost efficiency by maximizing the train kilometers by total operating cost (train-km/EUR). More specifically, it aims at an average cost of between 0.8 train-km/EUR and 0.12 train-km/EUR.

- **Passenger cost efficiency:** The project aims to consider cost efficiency for its passenger services by calculating passenger volumes enabled by a unit of passenger operating costs (pkm/EUR). The specific target for its passenger business is an average cost of between 12 pkm/EUR and 15 pkm/EUR.

- **Freight cost efficiency:** Much like its passenger business, RB focuses on assessing and increasing freight volumes handled per unit freight operational cost (tkm/EUR). Consequently, it aims to achieve an average between 40 tkm/EUR and 50 tkm/EUR.

Other focus areas for cost efficiency include the optimization of maintenance and asset renewal expenses over time. The forecasted annual asset renewal and maintenance per route-km is EUR ~370,000. RB should aim to decrease this as operations become more established to EUR ~330,000 annually.

To achieve indicated results from the analysis, the following initiatives could improve overall cost efficiency:

- **Predictive Maintenance:** Utilize predictive analytics and IoT sensors to anticipate maintenance needs before they become critical, reducing downtime and associated costs
- **Collaborative Scheduling:** Collaborate with train operators to develop efficient scheduling systems that can minimize wear and tear on the infrastructure
- **Streamlined Procurement Processes:** Streamline procurement processes through the adoption of digital platforms, reducing administrative overheads

Reduced Subsidy Need for Operations

RB aims to progressively decrease its dependence on subsidies by enhancing operational efficiency, and, consequently, increasing its average cash flows over time. Additionally, the project intends to enable railway undertakings and carriers to run profitable businesses independently, without needing government subsidies. This approach would alleviate the financial strain on the Baltic governments, contributing to the long-term sustainability of the project.

Increase Freight Connectivity

According to current plans, there is limited connectivity to other modes of freight transportation. A long-term goal for RB should include the expansion of such connection points (e.g., connection to the Rīga port) to attract additional traffic to the line. This would not only support financial and sustainability targets but would also significantly facilitate the unequivocally important shift of freight transportation from trucks to trains.

Indicator	Unit	Target, 2050
Train capacity utilization	%	80%
Maintenance and asset renewal	EUR/route-km per annum	330,000
Last 10-minute punctuality	%	98%
Passenger train frequency	# of trains per day	180

Figure 41: Operational and Financial target objectives for 2050

Some initiatives to increase train capacity utilization could include:

- **Network Integration:** Collaborating with other transport modes (like buses) to ensure seamless connectivity, encouraging more people to use trains
- **Flexible Pricing:** Implementing dynamic pricing strategies for track access charges during off-peak hours in collaboration with train operators to provide lower ticket prices

6.2 Socio–Economic Objectives

Reaching financial and operational targets outlined in the previous section is set to enable **RB to further increase social well-being and spur economic development through improved connectivity** within the Baltic countries and across Europe. Furthermore, it aims to offset the potentially negative financial outcomes with substantial socio-economic benefits. Therefore, targets set for the project refer to both the direct impact of the development and the wider economic benefits attributable to RB over the project's lifetime (stated in discounted NPV where targets are monetized).

Socio-Economic

Direct impact	Wider impact
• Transport value chain • Passengers • Freight shippers • Labor market • Environment	• Economic growth • Military mobility • Supply chain integration • Social equity • Environmental sustainability • Corridor synergies

Figure 42: Socio-economic objectives overview

6.2.1 Direct Socio-Economic Objectives

Direct socio-economic targets of the RB project are identified in the context of **transport value chains, passengers, freight shippers, the labor market, and the environment.** Economic impacts related to the direct socio-economic targets listed below are detailed in the Socio-Economic chapter.

Transport value chain impact

Players across the transport value chain are expected to be directly impacted by RB due to the ability to operate on the new rail infrastructure connecting the Baltics to the European rail network. To assess the impact on transport operators, targets are outlined for both passenger and freight transport players:

- **Passenger transport value chain:** RB aims to provide state-of-the art rail infrastructure to support both high-speed rails, and regional and night train services across the Baltic region. In the case of the passenger transport value chains profit generation is not a primary objective, nevertheless RB aims to minimize negative impacts. RB targets to generate between EUR 0.01 bn and EUR 0.02 bn in passenger transport value chain expenses. However, the potential negative effects are offset through other socio-economic components.

- **Freight transport value chain** players are set to benefit in terms of revenue and profitability from the newly built railway, as a modal shift towards rail is anticipated across the region. Therefore, RB targets to generate between EUR 0.06 bn and EUR 0.08 bn in benefit for carriers.

Passenger impacts

Passengers are key beneficiaries RB and at the heart of the socio-economic objectives of the project. The introduction of the new railway will impact their daily lives in various ways, including time savings, reduced travel costs, enhanced accessibility, and a decrease in the number of accidents, among aspects. The main socio-economic targets related to passengers are detailed below:

- **Travel cost savings:** limited cost-efficiency and connectivity of public transportation systems often lead to citizens incurring excessive expenses on inefficient commutes. RB aims to provide a competitive service that enables passengers to save by travelling by rail. Therefore, the project aims to realize between EUR 3.4 bn and EUR 4.4 bn in travel cost savings.

- **Time savings:** congested roads and limited efficiency of public transportation options curtail the potential productivity of citizens. By providing a reliable and time-efficient alternative, RB aims to achieve EUR 8.4 bn to EUR 10.4 bn in net discounted time savings benefits.

- **Reduction in accidents:** RB aims to reduce the annual number of fatalities and severe accidents, alongside the related property damage, by providing a safer option compared to traditional transportation modes. More specifically, the project targets achieving between EUR 2.7 bn and EUR 3.5 bn in accidents and property savings.

- **Job accessibility:** by connecting underserved areas to larger urban centers and offering shorter commuting times, RB has the potential to provide citizens with access to a wider range of job opportunities, thereby enabling them to better meet their employment needs. Therefore, the target for job accessibility benefits is set between EUR 0.12 bn and EUR 0.16 bn.

- **Leisure accessibility:** the newly constructed railway has the potential to enhance accessibility to leisure opportunities, fostering cross-cultural integration, and providing improved access to healthcare services. RB aims to increase non-business-related commutes and thus realize leisure benefits between EUR 1.75 bn and EUR 2.05 bn.

- **Education accessibility:** efficient public transportation enables citizens to gain better access to a wider range of educational opportunities, which in turn may lead to better employment opportunities. Consequently, this is a key objective for RB as it aims to achieve between EUR 0.14 bn and EUR 0.17 bn in education accessibility benefits.

Freight shippers

Freight shippers are essential market players in the value chain for rail freight. RB aims to provide freight shippers with a more efficient and safer transportation mode that connects the Baltic states with one another and to the rest of Europe. To clearly outline the objectives concerning these stakeholders, they have been categorized into three key areas: time savings, cost savings, and volume expansion. The specific objectives for each category are detailed below:

- **Cargo time savings:** road congestion and inefficient travel modes lead freight shippers to higher interest expenses on capital invested in freight transit. By providing a more connected and efficient alternative, RB aims to realize benefits of between EUR 0.12 bn and EUR 0.22 bn in cargo time savings.

- **Shipping cost savings:** freight shippers often incur substantial costs related to environmental, stockholding, and insurance expenses, among others, when transporting cargo over medium to long distances. RB aims to provide a safer and cost-competitive transportation option with the target of achieving a benefit between EUR 0.33 bn and EUR 0.53 bn for freight shippers in shipping cost savings.

- **Reduction in accidents:** RB aims to reduce the annual number of severe freight-related accidents, alongside the related property damage, by providing a safer option. More specifically, the project aims to achieve between EUR 0.04 bn and EUR 0.06 bn in accidents and property savings.

- **Trade volume expansion:** an increase in induced trade flows in the region has a direct positive impact on freight shippers as they can increase revenues and benefit from additional capacity and network flexibility. RB has the potential to generate such an increase in trade volume and aims to realize between EUR 0.01 bn and EUR 0.05 bn in benefits for freight shippers.

Labor market

RB is set to be the **largest infrastructure undertaking in the Baltic States** in over 100 years and, as such, will support the local economy by providing a substantial supply of employment. As for RB employees, 4.3% of them are expected to be hired from the ranks of the unemployed. Additionally, a further 45% of RB employees are expected to experience an average salary increase of 43%. Therefore, RB aims to foster employment growth and is projected to generate an incremental labor benefit valued between EUR 0.08 bn and EUR 0.14 bn.

Environment

Transportation modes significantly impact the environment, and a **shift towards greener alternatives will play an important role in achieving policy objectives** to move towards a more sustainable future. In particular, the EU aims to achieve carbon neutrality by 2050 and, as an important step in that direction, it has decided to ban the sale of gasoline and diesel-powered vehicles by 2030. RB is designed in alignment with the EU's objectives and has environmental sustainability at the center of its strategy. The objectives contain the pollution generated during both the construction and operation phase, including passenger and freight transportation. In all cases the pollution generated during the construction phase are greatly offset during operations. Specific socio-economic objectives of RB in this respect are outlined considering GHG emissions, noise pollution, and air pollution:

- **GHG emissions:** traditional modes of transport depending heavily on combustion engines have contributed over time to the acceleration of climate change by fostering a rapid increase in GHG emissions. RB is set to be powered entirely by renewable electricity and provide a greener alternative to transportation methods based on the use of internal combustion engines. The RB project aims to reduce GHG emissions through a modal shift towards rail and consequently to realize between EUR 1.9 bn and EUR 2.1 bn in net GHG cost reduction.

- **Noise pollution:** combustion engine vehicles and public transportation systems contribute towards increasing noise pollution in cities, impacting the well-being of the residents. RB tracks are primarily planned to be situated at a considerable distance from densely populated areas, while the implementation of noise barriers alongside railways further mitigates the impact of vibrations and noise compared to traditional transport modes. This is further supported by the absence of a motorway system in Estonia and Latvia causing increased traffic near households. By reducing noise pollution through a modal shift to rail, RB plans to achieve between EUR 0.40 bn and EUR 0.50 bn in net noise pollution cost reductions.

- **Air pollution**: traditional modes of transport, relying heavily on the combustion of fossil fuels, emit harmful pollutants such as nitrous oxides, particulate matter, and volatile organic compounds into the air, degrading air quality and posing a serious health risk to both urban and rural populations. RB aims to provide a less harmful alternative and, therefore, to realize a net air pollution cost reduction of between EUR 0.18 bn and EUR 0.28 bn.

6.2.2 Wider Socio-Economic Objectives

Wider socio-economic objectives of RB are categorized based on the project's potential impact as identified in the WEI analysis. This analysis, which is detailed in a separate section in this report and distinct from the ECBA calculations, offers insights into additional economic and strategic benefits not fully captured in the ECBA. This subsection details RB's wider objectives related to economic growth, social equity, military mobility, and environmental sustainability.

Economic Growth

Rail development has the potential to **enable economic growth in its catchment area**[35]. RB aims to create additional GDP growth in the Baltics states through positive induced effects on the local economies. To achieve such economic benefits, RB has set specific objectives pertaining to the various drivers of economic growth. More specifically, the project has established targets for land value appreciation, tourism, business innovation, increased market competition, inflows of new residents, and enhanced productivity. The targets are outlined below:

- **Land value appreciation:** rail infrastructure projects like RB have the potential to enhance connectivity in rural regions, thereby boosting underserved economies and leading to an increase in land and property values along the railway. RB aims to achieve land value appreciation impacted rural areas.

- **Tourism and hospitality:** tourism and hospitality represent important economic drivers that may boost local economies' GDP. In this context, RB could aim to boost both tourism to and from Europe and flows between the Baltic states.

- **Business creation and innovation:** innovation and new business creation are essential components in economic development as they boost competition and enhance productivity. RB aims to foster innovation across the Baltics alongside the formation of new businesses along the railway and in the stations.

- **Productivity:** as a main driver for economic development, enhanced productivity represents a key step in achieving GDP growth in the Baltics. RB aims to increase productivity in the region by leveraging agglomeration economies and providing a more efficient and greener mode of public transportation.

- **Inflow of residents:** by connecting remote regions to economic centers, rail infrastructure projects can unlock broader employment and service access, leading to improved living standards**.** RB aims to increase the inflow of residents in the Baltic Region.

- **Market competition:** by providing a more efficient alternative to traditional transport modes, RB aims to increase market competition in transportation. This could lead to an increase in service standards and competitive pricing dynamics.

Social equity

The **RB project aims to advance social equity by providing affordable and sustainable transportation,** especially for communities with inadequate public transportation. To accomplish such an ambitious objective, RB

---

[35] See the Assumptions chapter for a detailed explanation of the RB Catchment Area

has set specific targets according to the three main drivers of social equity, namely accessibility, affordability, and social closeness. The detailed targets are outlined below:

- **Accessibility:** accessibility for reduced mobility passengers is an aspect that is frequently neglected in public transportation despite its importance for social inclusion. RB aims to stand out in this regard by providing an accessible service for reduced mobility passengers in the Baltics.

- **Affordability:** public transportation is broadly designed to be accessible, catering to the needs of a diverse population by linking various areas, including urban and rural locations. It is particularly vital for individuals with lower incomes have access to affordable but enhanced services and to opportunities in urban centers. RB seeks to improve this accessibility for all income groups, providing a cost-effective and well-connected travel option in urban, suburban, and rural areas.

- **Social closeness:** accessible rail systems play an important role in providing equitable access to education and enhancing employment opportunities. RB aims to facilitate social connectivity by encouraging residents to pursue university education, thanks to improved accessibility to urban centers.

Military mobility

Alignment to the European 1435 mm rail network poses an opportunity for **RB to enhance the military logistics strategy in the region**. RB is dedicated to enhancing military mobility in the region, both during peacetime and in an armed conflict. To assess RB's military mobility objectives, they have been categorized based on the time efficiencies gained and the increased transport capacity for both passengers and freight. The detailed description of the specific objectives is outlined below:

- **Military transport time savings:** enhanced efficiency provided by RB aims to reduce transit times in peacetime as well as in an emergency situation for both passengers and freight.

- **Increased civilian movement capacity:** railways by design can efficiently and safely move significant amounts of passengers between destinations. In the event of an armed conflict, RB aims to provide efficient transport between the Baltic capitals and the Polish border for both residents and strategic goods.

- **Increased freight transport capacity:** transporting large amounts of cargo such as heavy military equipment and emergency supplies over long distances is a challenge for military logistics planning when considering the efficiency and capacity of other modes of transportation. RB aims to provide an efficient alternative with superior transport capacities.

Environmental Sustainability

As the EU is transitioning to renewable energy sources to achieve carbon neutrality by 2050, **Baltic states aim to limit their reliance on fossil fuels**. This move would also enable the region to achieve a higher degree of energy security. RB aims to contribute to this goal as the wider economic impact of the project extends to several aspects of environmental sustainability:

- **Reduced demand for fossil fuels:** As RB aims to capture a portion of the demand for transport in the region by providing a greener source, it delivers an induced reduction in fossil fuels.

- **Induced renewable investment:** RB plans to operate entirely on renewable electricity. This will lead to an increased demand for such electricity in the Baltic region. Consequently, the project aims to stimulate investments in the region to meet the electricity needs of RB for renewable electricity.

- **Replacing short-haul flights:** An integral part of RB's sustainability objectives is to serve as an efficient alternative to short-haul flights in the region. By providing a rapid, reliable, and environmentally friendly mode of transport, RB aims to enable the limitation of these flights, leading to a further decrease in carbon emissions.

In conclusion, **objectives defined for RB serve as critical cornerstones for the CBA framework.** They provide essential dimensions against which the project's effectiveness and impact can be measured. This alignment ensures that the CBA is not just a financial evaluation, but a comprehensive assessment of how well Rail Baltica meets its intended goals and contributes to broader objectives. This approach underscores the project’s commitment to delivering a financially viable project fulfilling its strategic objectives while generating tangible added value for the region.

The **next chapter on RB's project specification** defines how the project is planned and structured to achieve the objectives outlined above, detailing its key components, phases, and resources.

7 Project Specification

This chapter provides a detailed **overview of the key project specifications** required for fulfilling the objectives outlined in the previous chapter, across five key dimensions. Project specifications encompass the analysis of the governance structure, ensuring effective management and accountability throughout the project lifecycle. Further, the geographic scope details the areas covered by the project, while technical design description lays out the infrastructure and technology integral to operational success. A project timeline and phased delivery approach is outlined to establish a clear progression roadmap. Finally, detailed section plans and information on ongoing developments is provided, informing about continuous advancements.

7.1 Project Governance

The governance structure of Rail Baltica, a complex, cross-border project jointly implemented by Estonia, Latvia, and Lithuania, plays a pivotal role in its execution. The project's **governance framework includes beneficiaries, a central project coordinator, and national implementing bodies**, reflecting the intricate collaboration between the three Baltic states (please see the following figure).

Project beneficiaries consist of the respective ministries of each country namely the Estonian Ministry of Climate, the Latvian Ministry of Transport and the Lithuanian Ministry of Transport and Communication.

In 2014 the Baltic ministries established a joint venture, **RB Rail AS, to act as the central project coordinator** in charge of ensuring the successful completion of RB. The shares of RB Rail AS are divided equally between Estonian OÜ Rail Baltic Estonia, Latvian SIA "Eiropas Dzelzceļa līnijas" and Lithuanian UAB RB Statyba owned by Lietuvos Geležinkeliai AB. Estonian OÜ Rail Baltic Estonia is a 100% state-owned capital company, represented by the Ministry of Climate of the Republic of Estonia. SIA "Eiropas Dzelzceļa līnijas" is a 100% state-owned capital company, represented by the Ministry of Transport of the Republic of Latvia. Lietuvos Geležinkeliai AB (LTG) is a state-owned group of cargo, passenger transport and infrastructure management companies in Lithuania, 100% owned by the Republic of Lithuania, represented by the Ministry of Transport and Communications of the Republic of Lithuania.

Rail Baltic Estonia OÜ in Estonia, SIA "Eiropas Dzelzceļa līnijas" in Latvia, and LTG Infra AB[36] in Lithuania are the **national Implementing Bodies**. All construction carried out by implementing bodies is done under the supervision of RB Rail and is based on common procurement principles, rules and contract templates.

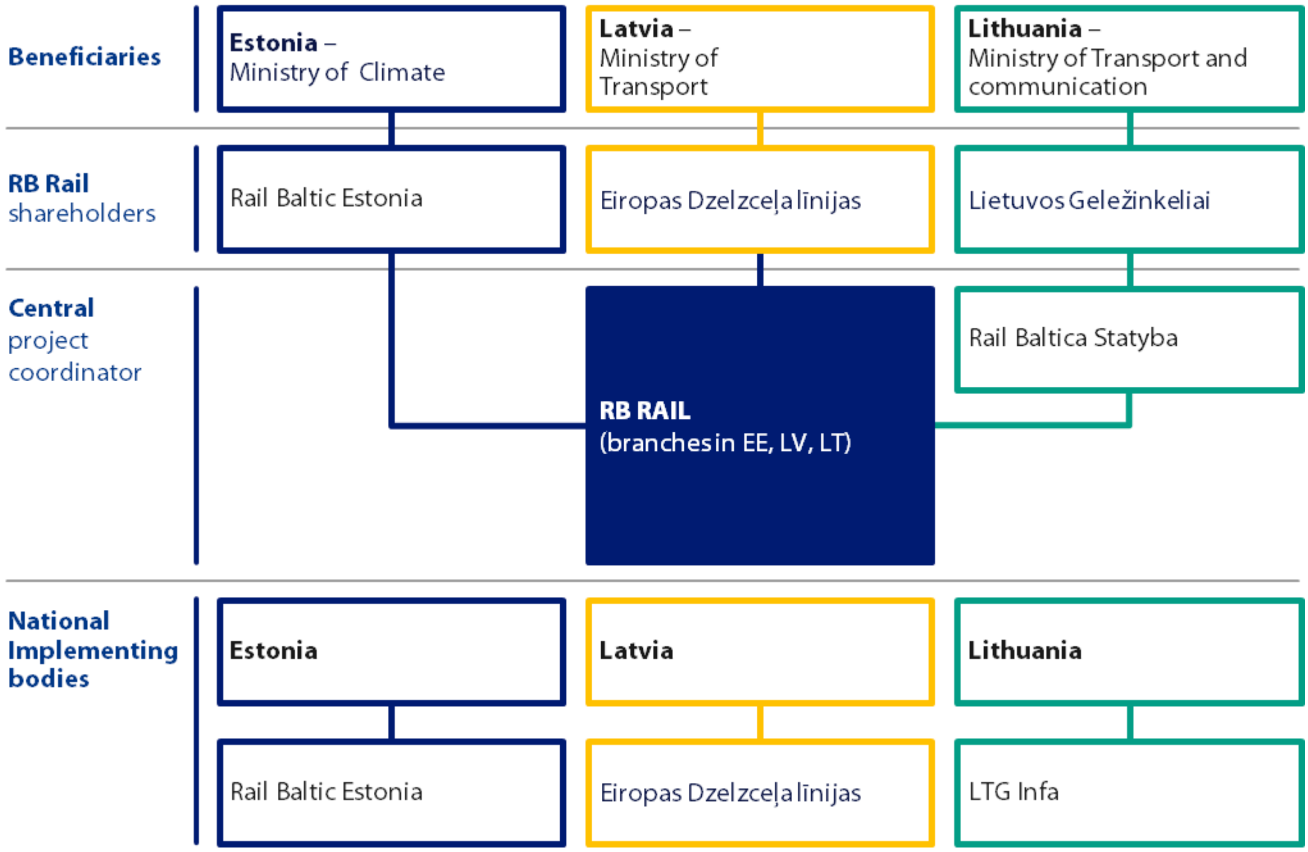


Figure 43: RB governance structure

In conclusion, understanding the governance structure of RB is crucial for grasping the project's collaborative and operational dynamics. The outlined governance structure enables implementation though adapting to the complex, cross-border geographic scope of the project. The next section is identifying the geographic scope of the project within the Baltic region.

7.2 Geographic Scope

Building on the understanding of Rail Baltica's governance structure from the previous chapter, **this section defines the project's geographic scope**. The geography of Rail Baltica is not only a physical demarcation of its reach but also a reflection of its strategic objectives and operational planning within the governance framework. While RB is planned to extend from Tallinn to Warsaw, this study specifically focuses on the Rail Baltica Global Project, which refers exclusively to the sections within the Baltic states as the European standard rail infrastructure is missing from these countries.

[36] LTG Infra AB is also 100% state-owned and associated company of Lietuvos Geležinkeliai AB (LTG).

The Rail Baltica Global Project spans Estonia, Latvia, and Lithuania, connecting major cities such as Tallinn, Pärnu, Rīga, Panevėžys, Kaunas, and Vilnius. In Phase 1, the project will achieve the core of this goal through also including an indirect connection via existing 1520mm gauge lines to Vilnius, for which the direct 1435mm connection is planned for Phase 2. The main objective of Rail Baltica is to integrate the Baltic states into the European standard railway system by transitioning from the current 1520 mm gauge to the 1435 mm standard gauge on the Rail Baltica line, a change that will already be implemented in Phase 1, though primarily with a single-track line solution. **In the following, this section is summarizing the scope related to Phase 1.**

To provide access to the line for passengers and freight, project is expected to include **the construction of 5 international (and the utilization of existing international passenger station in Kaunas) and 21 regional passenger stations[37], as well as 1 freight terminal[38],** enhancing connectivity and fostering economic development across the region. Each country is expected to have over 10 stations upon reaching full scope, and already more than five stations in Phase 1, significantly enhancing both international and regional integration. Below are the passenger stations, freight terminals, as well as depots and infrastructure maintenance facilities for each country in Phase 1:[39]

Estonia:

- International passenger stations (2): Ülemiste (Tallinn) and Pärnu
- Regional passenger stations (12): Assaku, Luige, Saku, Kurtna, Kohila, Rapla, Järvakandi, Kaisma, Tootsi, Kilksama / Urge, Surju, and Häädemeeste
- Freight terminal (1): Muuga
- Depots and Infrastructure maintenance facilities (3): Ülemiste (Rae) rolling stock maintenance facility, IMF Pärnu, IMF Soodevahe

Latvia:

- International passenger stations (2): Rīga Central (RCS) and Rīga Airport (RIX)
- Regional passenger stations (5): Salaspils, Iecava, Bauska, Salacgrīva, and Skulte,
- *Freight terminal (1 in the Extended Scenario): Salaspils*
- Depots and Infrastructure maintenance facilities (3): IMF Iecava, IMF Skulte, Jaunmārupe Rolling Stock Depot

---

[37] Additionally, there is a facility located at the Lithuania-Poland border. However, it is not classified as a passenger station, as it does not allow passengers to board or disembark.

[38] Besides the construction of Muuga freight terminal, RB will benefit from already existing freight terminals (e.g., in Kaunas) and will construct sidings for freight service at Salaspils.

[39] Additional PTOs in the Extended Scenario are also shown in the list in Italics

Lithuania:

- International passenger station (2): Panevėžys, Kaunas (existing station utilized)
- Regional passenger stations (4+1): Joniškėlis, Pasraučiai[40], Jonava stop, Palemonas, and the Polish border station[41], *Marijampolė, Kaunas Airport (KUN)*
- *Freight terminals (3 in the Extended Scenario): Marijampolė, Kaunas and Panevėžys*
- Depots and Infrastructure maintenance facilities (2): IMF Kaunas, IMF Panevėžys

Overall, the outlined geographic scope of RB clearly demonstrates its ambitious goal to connect the Baltic states with the larger European rail network. Consequently, the next section details the technical design of RB across its mainline and point type objects.

7.3 Connectivity to Adjacent Transport Infrastructure

Building on the outline geographic scope of RB, this section analyzes the connectivity of the new railway line to adjacent transport infrastructure. **Links to rail, air, water and road transport** enable stations and terminals to integrate with surrounding networks, creating multimodal hubs that enhance connectivity and efficiency for passengers and freight.

The Rail Baltica line features nine **freight terminals** spread across three countries when achieving full scope, and 1 already built in Phase 1. Additionally, the Phase 1 line includes **37[42]** (and one additional Polish border station) **passenger facilities**, encompassing international and regional passenger stations.

Regarding **Rail-to-Rail connectivity,** desktop research and input from the RB Rail team have confirmed that several cities where Rail Baltica plans to establish stations and freight terminals (in both Phase 1 and the full scope) already have existing rail infrastructure. According to current plans, 2 freight terminals and 6 stations are expected to connect to existing rail networks in the full scope. Additionally, through further research and alignment with the RB Project team, 4 more freight terminals and 12 additional stations have been identified with Rail-to-Rail connectivity potential, bringing the total to 6 freight terminals and 18 passenger stations with such potential. **In Phase 1, with fewer operational freight terminals and passenger stations, 1 freight terminal and 9 passenger stations are expected to have Rail-to-Rail connections.** Connectivity potential is assessed based on other train stations or terminal availability within the same city; however, distance from RB stations is not assessed.

Rail-to-Air connection is analyzed based on the availability of airports in the cities served by Rail Baltica. In the full scope of the project, 4 passenger stations—Tallinn, Rīga, Vilnius, and Kaunas—will offer flight connectivity opportunities. At the time of evaluation, only Rīga Airport had a direct connection between the airport and railway terminals, enabling seamless Air-to-Rail service. While Vilnius Airport has similar potential, its realization will depend on future development plans. Handling air cargo and its subsequent rail transport is feasible in all 3 Baltic countries. In Estonia, Soodevahe dry port, located near Tallinn Airport, can be used for this purpose. Similar to

[40] Pasraučiai is excluded from the Extended Scenario

[41] Additionally, there is a facility located at the Lithuania-Poland border. However, it is not classified as a passenger station, as it does not allow passengers to board or disembark.

[42] Including existing passenger station at Kaunas

Rail-to-Rail connectivity, Rail-to-Air connectivity is also impacted by the project's phasing. **In Phase 1, Rīga Airport Station (RIX) and Ülemiste International Passenger Station will have air connections.**

Rail-to-Water connectivity is researched based on the availability of ports in the cities under review. Based on this assumption and the assessed potential, there are 2 freight terminals - Muuga and Pärnu - with water transportation connectivity opportunities, and 3 passenger stations - Pärnu, Salacgrīva, and Skulte - in the full scope plans of Rail Baltica. Rīga Central Station also has potential for a water connection, but it is not considered in the current plans. In Phase 1, all of these facilities will be operational, meaning the connectivity potential will remain unchanged.

Regarding **Rail-to-Road connections**, all stations and freight terminals are assumed to have the potential to be reached by road-based transportation methods. On the long term, the assumption is taken that infrastructure for road transportation can develop and adapt to the routes and stops of Rail Baltica. In Phase 1, overall connectivity is affected by the smaller number of operational facilities, but the assumption remains that all of these facilities have a Rail-to-Road connection potential.

The **connectivity map for Rail Baltica outlines the integration potential** at planned freight terminal(s) (Muuga is being developed in Phase 1 in Estonia, while two sidings are being constructed at Salaspils in Latvia to support freight service potential. In Lithuania, the existing freight terminal at Kaunas is being upgraded and utilized.) and passenger stations, revealing a strong capacity for linking with existing rail networks. This analysis not only identifies current stations and terminals in cities where Rail Baltica will have a presence, but also highlights the need for further evaluation to ascertain the feasibility, cost-effectiveness, and benefits of establishing these connection points. By effectively leveraging this potential, Rail Baltica could significantly enhance long-term demand for the line and notably improve mobility across the region.

The figure below represents the connectivity potential of stations and terminals operational in Rail Baltica Global Project Phase 1, **further details on the list of facilities can be found in the *Geographic Scope* section.**

Figure 44: Phase 1 connectivity of Rail Baltica

In addition to bolstering local connections, RB places a significant emphasis on **establishing seamless international connectivity** to fully realize its infrastructural potential. Several key aspects are crucial in achieving this goal. Firstly, operational harmonization is essential, particularly in aligning standards with neighboring countries such as Czechia, Slovakia, and Poland. Physical connectivity is another critical factor, encompassing the alignment of track gauges and train control systems, along with ensuring the interoperability of electrical systems between countries. Digital integration also plays a vital role, especially in providing unified customer information and ticketing services, and in achieving technological consistency across national borders for a seamless passenger experience. Additionally, the simplification and streamlining of customs processes are imperative to facilitate the smooth transit of freight and passengers across international boundaries. By focusing on these areas, RB can enhance its connectivity and maintain operational consistency with other countries, strengthening its position as an effective transport corridor in the region.

Exploring the expansive connectivity goals of RB highlights the project's potential impact on regional integration and growth. The *Technical Design* section that follows provides an overview of the design elements critical to making this vision a practical and innovative reality, while taking into account the key limitation of Phase 1 compared to the full scope of the Rail Baltica Global Project—primarily the construction of a single-track rail line for approximately 66% of the route in Phase 1.

7.4 Technical Design

To understand the details of the constructed infrastructure with respect to the geographic scope of Rail Baltica Phase 1, this chapter explores how the **technical design is intricately linked to the geographic dimensions** outlined in the previous sections. The technical design is a crucial component that ensures project feasibility and efficiency across its extensive geographic spread, addressing infrastructure, technology, and operational aspects of Rail Baltica's successful implementation.

RB Phase 1 is engineered to **extend approximately 763 km route length and 933 km track length across four countries**, featuring a design speed of 249 km/h for passenger trains and 120 km/h for freight trains. This railway adopts the 1435 mm European standard gauge and incorporates a mainly single-track (~66% of the total route length) electrified rail system operating at 2x25 kV AC[43].

In **addition to the mainline, the technical design of RB Phase 1 includes a variety of structural elements** such as bridges, tunnels, and Point Type Objects (PTOs). PTOs encompass key infrastructure components like international passenger stations, regional passenger stations, freight terminals, and infrastructure maintenance facilities including depots.

The project's technical designs are subdivided into 11 sections (Vilnius – Kaunas triangle provisionally). The following section will examine the **specifications of these designs on a country-by-country basis** to better understand the current state of development.

Estonia

Rail Baltica Phase 1 crosses **Estonia over approximately 218 km**, comprising 28% of the railway's entire length. The Estonian section includes 14 operational passenger stations and 1 operational freight terminal, with

[43] Alternating current at 25 kilovolts

international stations in Tallinn and Pärnu, alongside one freight terminal and three infrastructure management facilities.

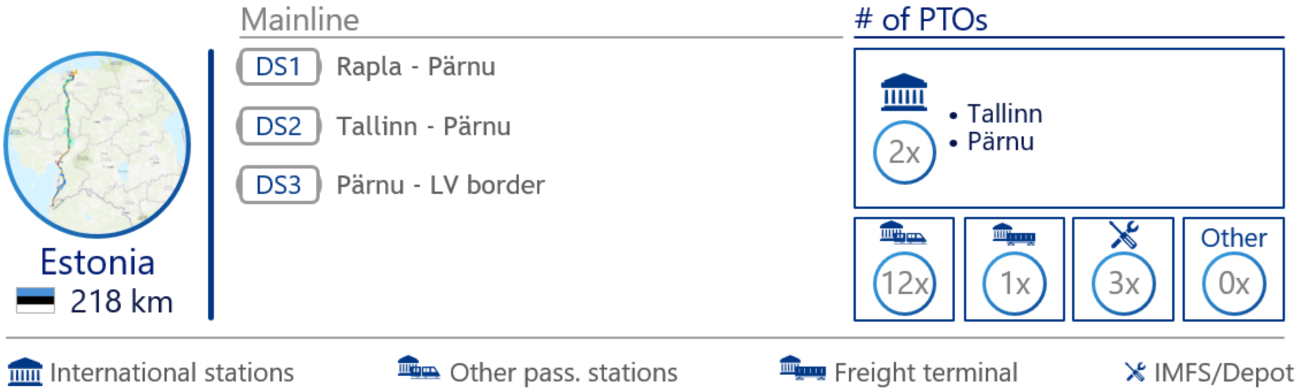


Figure 45: Estonia technical design overview (RBR Project Controls Estimation Team input)

Latvia

Rail Baltica Phase 1 spans 253 km through Latvia, constituting 32% of the railway's total length. This section includes 7 operational passenger stations, featuring 2 operational international stations in Rīga and Rīga Airport, along with three infrastructure management facilities (2 infrastructure maintenance facilities and 1 depot).

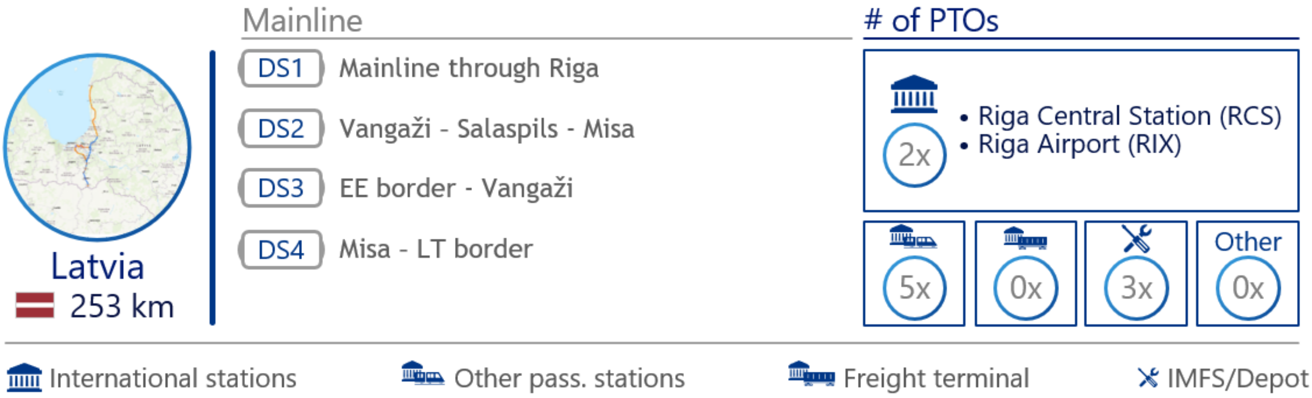


Figure 46: Latvia technical design overview (RBR Project Controls Estimation Team input)

Lithuania

The remaining **292 km of Rail Baltica Phase 1 crosses through Lithuania**, making up 40% of the railway's total length. This section features 6 stations, including two international in Panevėžys and Kaunas. Additionally, Lithuania two infrastructure management facilities.

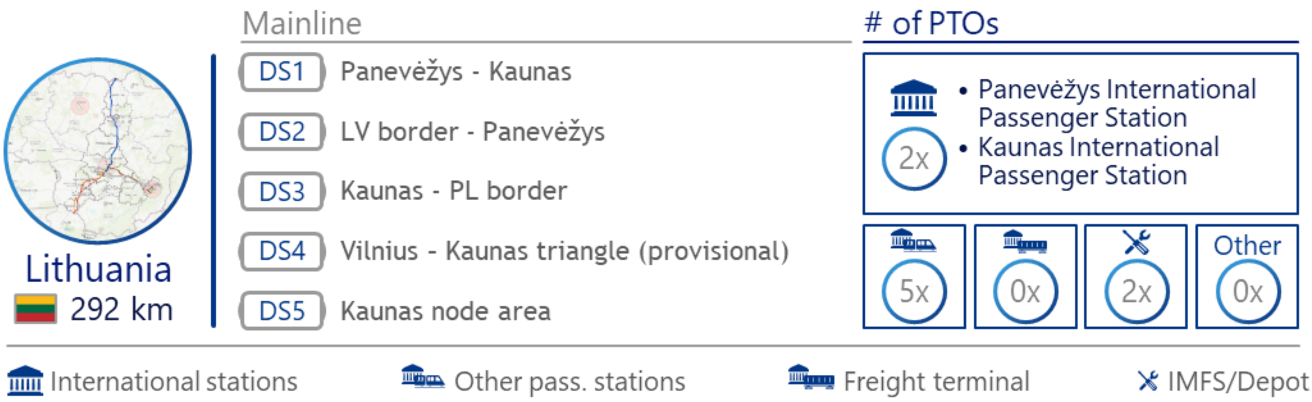


Figure 47: Lithuania technical design overview (RBR Project Controls Estimation Team input)

To understand the details of implementing the infrastructure described in this section, the next section focuses on construction timeline and phased delivery.

7.5 Timeline and Phased Delivery Implications

Following the overview of the technical design, this chapter outlines the **scheduled timeline and the structured phases of construction**, essential for the physical implementation of the project's technical planning. The timeline for the project is structured into six distinct st eps, each representing a key phase in the process: front-end activities, procurement, design, land acquisition, construction (differentiated between mainline and PTO construction), and testing and commissioning (see figure below).

Front-end activities phase encompasses all preliminary activities required to set the foundation for the subsequent project phases. These activities focus on conducting feasibility studies, securing necessary permits, and establishing project objectives. On average, front-end activities for RB take around ~4 years and often run parallel with other preparatory stages, including the early stages of procurement and design.

Procurement phase includes the selection of manufacturers and suppliers and the finalization of contracts, ordering materials for timely delivery. On average, for RB, it takes ~3 years and partially can take place parallel with other activities, such as design or land acquisition.

Design phase transforms the initial concepts into engineering blueprints and provides technical specifications for the railway infrastructure, laying the groundwork for construction. For RB it takes on average ~5 years, however, similarly to the earlier mentioned procurement activity it can overlap with other activities and can take place in parallel with them.

Land acquisition involves a detailed and extended process, encompassing thorough site surveys and negotiations for land procurement. This process ultimately leads to obtaining legal clearance, ensuring compliance with regulatory standards. On average, it takes ~4 years.

The key phase within the construction period is the **construction phase** itself, which includes site preparation, establishing essential infrastructure and facilities, and laying the groundwork for the operational setup of the railway. On average, this phase takes ~6 years, and as all other listed phases, it may also overlap with other steps.

Finally, the last phase is **testing & commissioning**, which includes comprehensive system testing and safety checks, culminating in operational trials and the final commissioning of the railway, upon satisfying all regulatory criteria. This is one of the shortest phases, on average it takes ~2 years.

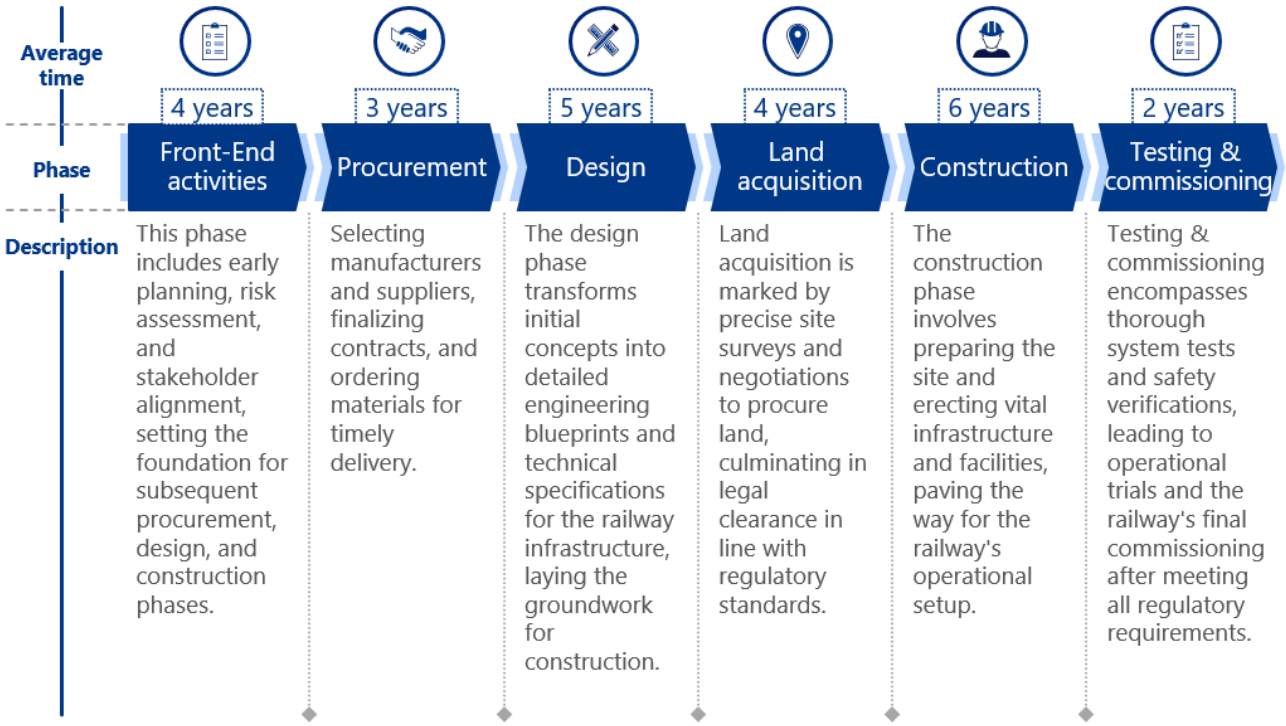


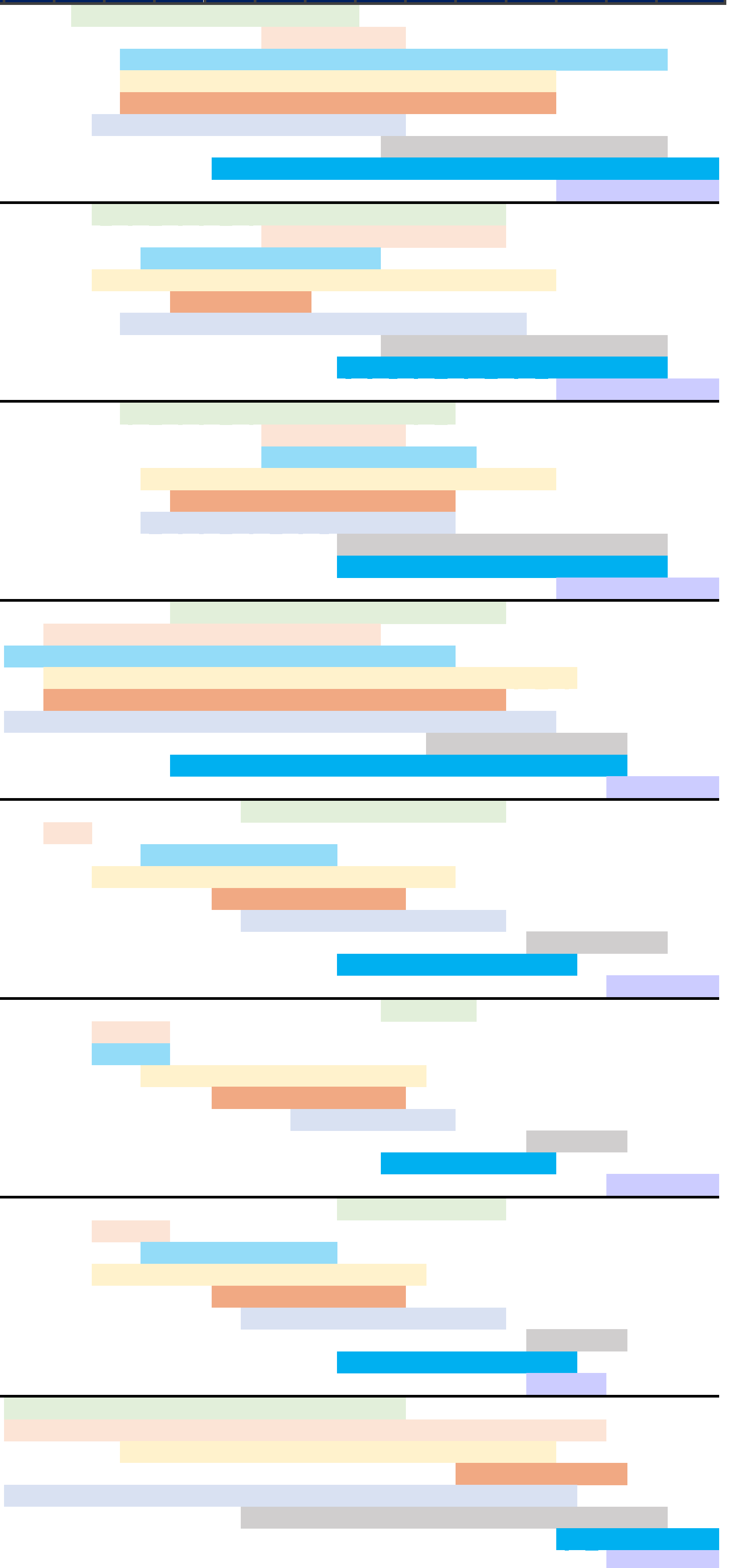
Figure 48: Project phases and their average duration (based on RBR CMR department)

As several activities are carried out in parallel, this makes the project delivery shorter, than the sum of average years within the construction period. Therefore, overall completion is expected by 2030.

After understanding the key phases during the construction period, on the following figure the proposed project completion timeline is introduced for providing an overview on the project phases on section level breakdown.

The proposed project timeline is outlined in the figure below.

Section			Construction phases		Year
Country	From	To	#	Construction activity	2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030
EE DS1	Rapla	Pärnu	1	Front-End Activities	
			2	Mainline procurement	
			3	PTO procurement	
			4	Mainline design	
			5	PTO design	
			6	Land acquisition	
			7	Mainline construction	
			8	PTO construction	
			9	Testing & commissioning	
EE DS2	Tallinn	Pärnu	1	Front-End Activities	
			2	Mainline procurement	
			3	PTO procurement	
			4	Mainline design	
			5	PTO design	
			6	Land acquisition	
			7	Mainline construction	
			8	PTO construction	
			9	Testing & commissioning	
EE DS3	Pärnu	LV Border	1	Front-End Activities	
			2	Mainline procurement	
			3	PTO procurement	
			4	Mainline design	
			5	PTO design	
			6	Land acquisition	
			7	Mainline construction	
			8	PTO construction	
			9	Testing & commissioning	
LV DS1	Mainline connecting Rīga		1	Front-End Activities	
			2	Mainline procurement	
			3	PTO procurement	
			4	Mainline design	
			5	PTO design	
			6	Land acquisition	
			7	Mainline construction	
			8	PTO construction	
			9	Testing & commissioning	
LV DS2	Vangaži	Salaspils/Misa	1	Front-End Activities	
			2	Mainline procurement	
			3	PTO procurement	
			4	Mainline design	
			5	PTO design	
			6	Land acquisition	
			7	Mainline construction	
			8	PTO construction	
			9	Testing & commissioning	
LV DS3	EE/LV Border	Vangaži	1	Front-End Activities	
			2	Mainline procurement	
			3	PTO procurement	
			4	Mainline design	
			5	PTO design	
			6	Land acquisition	
			7	Mainline construction	
			8	PTO construction	
			9	Testing & commissioning	
LV DS4	Misa	LV/LT Border	1	Front-End Activities	
			2	Mainline procurement	
			3	PTO procurement	
			4	Mainline design	
			5	PTO design	
			6	Land acquisition	
			7	Mainline construction	
			8	PTO construction	
			9	Testing & commissioning	
LT DS1	Kaunas	Panevėžys	1	Front-End Activities	
			2	Mainline procurement	
			3	Mainline design	
			4	PTO design	
			5	Land acquisition	
			6	Mainline construction	
			7	PTO construction	
			8	Testing & commissioning	
Section			Construction phases		Year



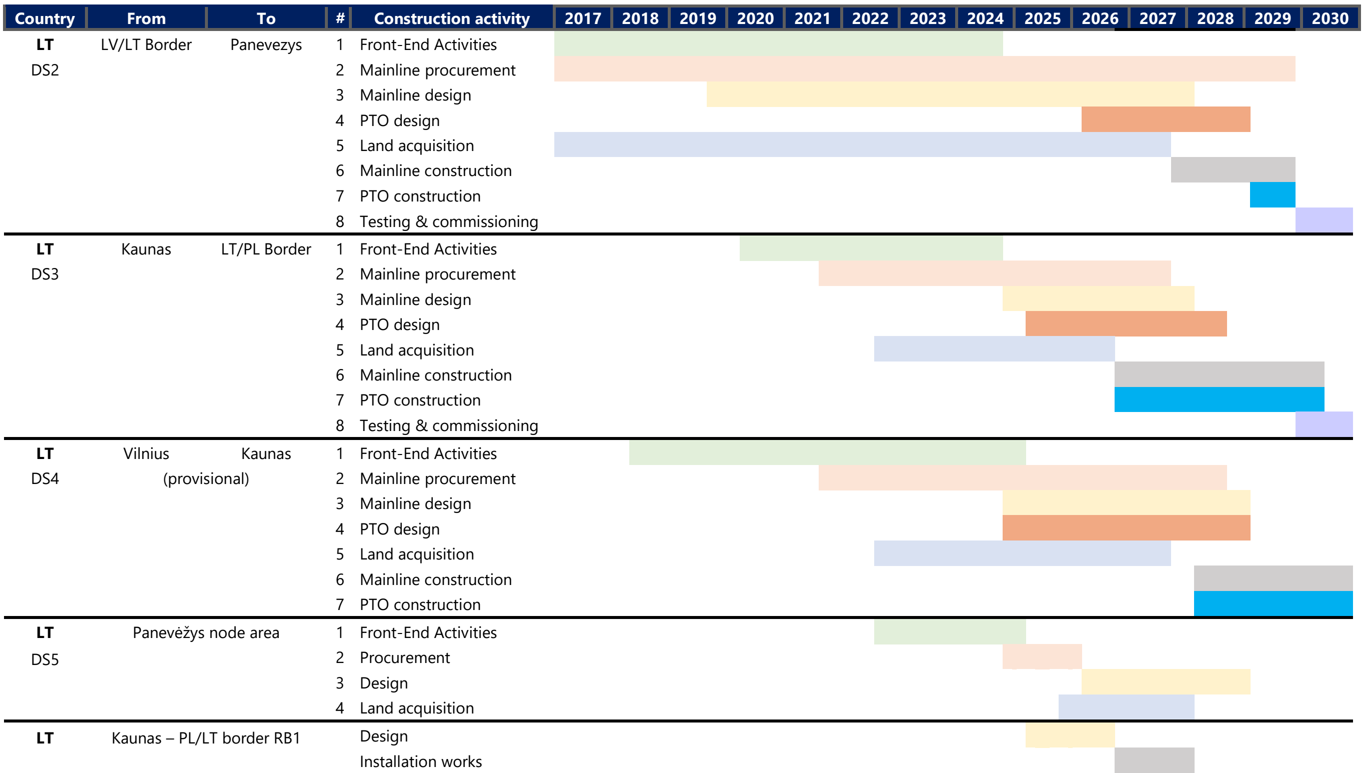


Figure 49: Proposed project completion timeline (based on RBR CMR department)

The present timeline outlines the planned schedule for the RB project, **targeting the full completion of the Rail Baltica Phase 1 by 2030**. For the subsequent analysis in this document, it is assumed that operations will start concurrently across the entire line from 2031. In practice, RB's construction follows a phased approach, where different segments of the project will be completed at different stages before the overall project's completion in 2030. The capital expenditures are distributed over a nine-year period, from 2022 to 2030. A detailed breakdown of this allocation can be found in the *CAPEX Phasing* subsection. Additionally, it is crucial to recognize that potential delays to construction and operation represent a great risk for RB. This risk is discussed in greater detail in the *Risks and Mitigation* section within the *Risk and Regulatory* chapter.

Concluding the chapters on project context, objectives, and specification**, the first part of the report provided a foundational understanding of the project's environment**, aims, and structural plans. These elements form the basis for the next chapter on CBA assumptions, closely connected to RB's characteristics as previously outlined, providing a critical framework for evaluating the project's feasibility and impact. This connection ensures the CBA is grounded in the project's specifics, allowing for an accurate and meaningful assessment of RB's potential benefits and costs.

8 Assumptions

Building upon insights from the previous chapters regarding project context, objectives, and specifications, **this chapter introduces assumptions** for the parameters representing this environment in the traffic demand model and the cost-benefit analysis (CBA) for Rail Baltica. These assumptions adhere to EU guidelines where relevant and are grounded in context-specific research, including proprietary databases, benchmarking, interviews, and insights from industry experts.

Key assumption categories for the CBA include core, operational, financial, socio-economic, transport mode characteristics, and environmental assumptions. Each category is essential in providing a comprehensive and realistic framework for the CBA, ensuring that the analysis is both robust and reflective of the project's unique context and objectives.

Assumptions used for traffic demand forecasting, and financial and economic analyses are also provided in the report's respective chapters.

8.1 Core Assumptions

This section outlines **general input definitions employed to establish the CBA framework**, including price level assumptions, discount rates, reference period, geographic scope, and catchment area.

8.1.1 Price Levels

All prices applied in both the financial and economic analyses are **real prices in euros** as of the end of 2023, in alignment with EU guidelines (European Commission, 2021a).

8.1.2 Financial Discount Rate

When assessing investment opportunities in the Baltic states, applying **a region-specific financial discount rate is essential**. The graph below illustrates the key components involved in calculating the financial discount rate (FDR) for Estonia, Latvia, and Lithuania.

The cost of debt is influenced by factors such as the corporate tax rate and the cost of debt itself, resulting in an after-tax cost of debt of 4.8%. The cost of equity is derived from parameters including the 10-year bond yield, country-specific risk premium, default spreads, equity risk premium, and the beta. Furthermore, the FDR calculation considers the capital structure, with debt constituting 6.1% (D/(D+E)) and equity representing 93.9% (E/(D+E)). This leads to a nominal Weighted Average Cost of Capital (WACC) of 10.42% and a real WACC of 8.23%

ensuring a more accurate and regionally relevant valuation of investments in the Baltic states, accounting for their unique financial landscapes.

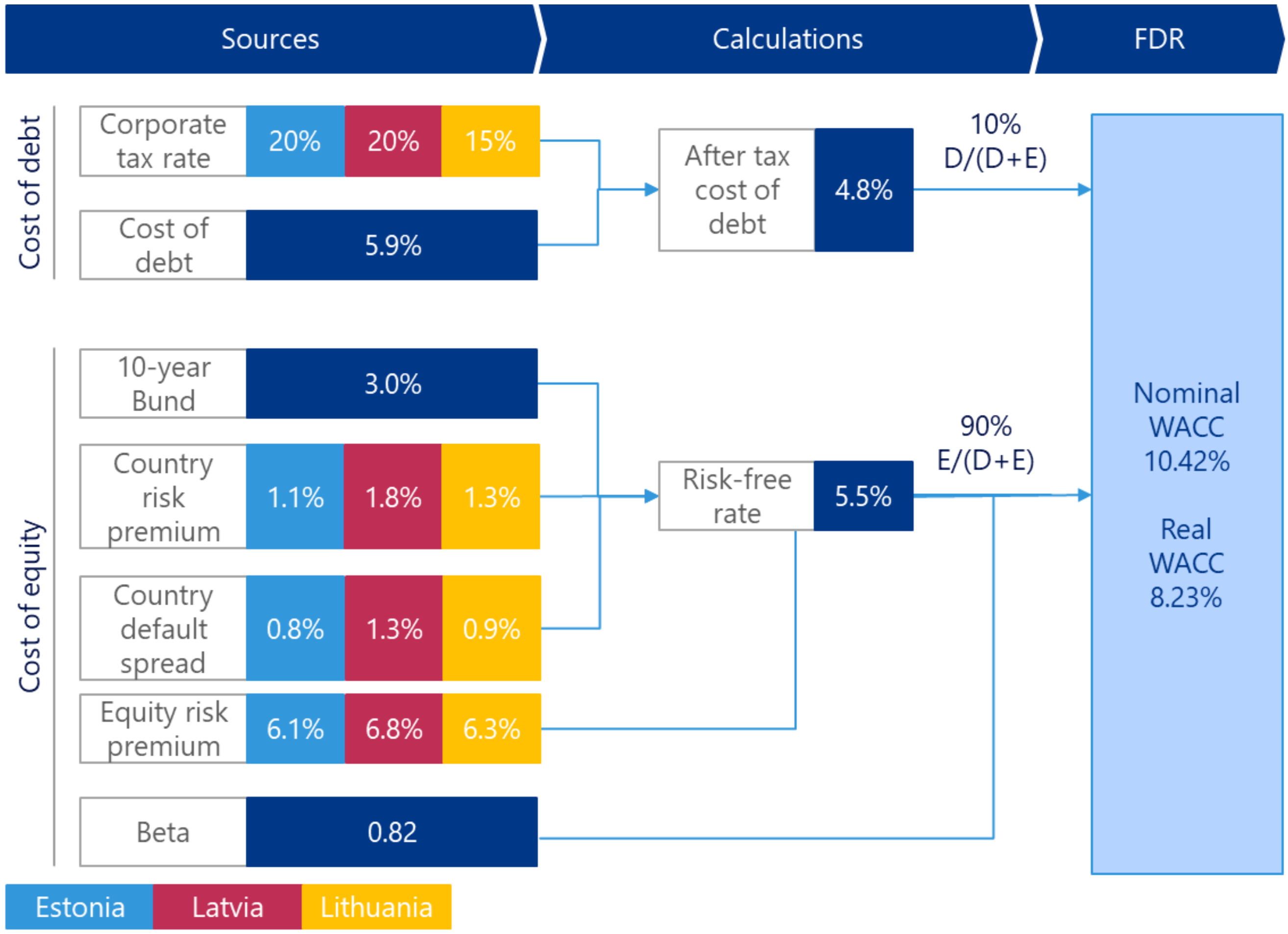


Figure 50: RB financial discount rate

8.1.3 Social Discount Rate

The social discount rate (SDR) is a concept used in economic analysis to assess the intertemporal value of future costs and benefits. It reflects the **opportunity cost of capital from a societal perspective**, and thus represents the social view of how future benefits and costs should be valued relative to present ones. Consequently, any discount rate entails a judgment about the future and affects the weight given to future benefits or costs.

If the social discount rate is set to zero, it is assumed that the utility derived from an investment is independent of the time of occurrence. Consequently, this means that consumption today is valued in the same way as consumption tomorrow. Alternatively, if the discount rate employed is positive, this entails a preference for present over future consumption. The opposite is true for negative social discount rates.

From a **theoretical standpoint**, under equilibrium in a perfectly competitive economic environment, the social and financial discount rates are equal and equate to the interest rate observed in financial markets. Nevertheless, this is not the case in practice given the distorted nature of financial markets. The discount rate employed in this report is outlined in this subsection alongside the corresponding methodological approach.

Selected SDR

The **social discount rate employed** to assess the present value of costs and benefits generated by RB Global Project Phase 1 is **4.45%**. This value is estimated by adopting the social rate of time preference (SRTP) approach (Catalano & Pancotti, 2022) proposed by the Guide to Cost-Benefit Analysis of Investment Projects (European Commission, 2014) and Economic Appraisal Vademecum (European Commission, 2021a). The **SRTP approach follows the formula** from the Ramsey economic growth model (1928) outlined below:

$$SRTP = p + e * g$$

where $\boldsymbol{p}$ indicates the pure time preference, $\boldsymbol{e}$ is the marginal utility of consumption and $\boldsymbol{g}$ is the expected consumption growth rate per capita. The model reflects the lower value of future vis-à-vis present consumption through the consumption growth variable and the pure time preference.

The **pure time preference (p)** employed for the RB project is the annual crude death rate for each of the Baltic countries, namely Estonia, Latvia, and Lithuania in 2019. This year is selected to avoid the idiosyncratic shock of the COVID-19 pandemic as it is believed to be a more accurate proxy of the future mortality rate in the region.

The **elasticity of marginal utility with respect to consumption (e)** analyzes the evolution of consumers' utility over time, derived from national taxation preferences. More specifically, it captures the decreasing marginal utility of consumption as wealth increases. For RB, the elasticity for each of the Baltic countries in 2019 is employed to ensure consistency with the estimate employed for the pure time preference parameter.

Expected **consumption growth per capita (g)** is estimated for the reference period of the RB project, taking as a proxy the GDP per capita growth of each country, in alignment with the Guide to Cost-Benefit Analysis of Investment Projects (European Commission, 2014). Applied forecasts refer to S&P Capital IQ estimates as of September 2023, representing an up-to-date projection on per capita GDP growth (S&P Capital IQ, 2023b).

For each of the Baltic countries, the formula above is applied, resulting in a country-specific estimate of the SDR. Consequently, the three estimates are combined to have a Baltic SDR for the project via the weighted average of the respective catchment area GDPs.

Alternatives to the Employed SDR

Several **potential alternatives to the SDR employed** in the study are considered in the process of identifying an appropriate rate for the project.

The **2017 CBA report for RB Global Project** employs 5.00% as SDR based on a European average rate proposed by the Guide to Cost-Benefit Analysis of Investment Projects (European Commission, 2014).

To reflect varying economic conditions in the EU, **the Economic Appraisal Vademecum** (European Commission, 2021a) outlines that in absence of national values a generalized 3.00% SDR can be employed. This rate is applied in several similar studies, such as the cost-benefit analysis of the Three Seas Initiative in Poland (2023) or the Naples – Bari railway project in Italy (Venezia, 2023).

Furthermore, to account for the regional context when calculating the discount rate, the Economic Appraisal Vademecum also proposes the usage of **social discount rates defined at the national level**. The study provided by the document (Catalano & Pancotti, 2022) estimates an average SDR for the Baltic states at 7.37%. This rate, however, is based on the mortality rate for 2020, which is affected by the impact of the COVID-19 pandemic, and a relatively high historical GDP per capita growth (2002-2021), ranging between 4.00% and 5.00% across the Baltic countries.

The **European Investment Bank**, for projects within the EU, typically references a real social discount rate of between 3.50% and 5.50%, adjusted to the maturity and growth rate of the national economy. While these rates are country-specific, deviations can be justified if national circumstances warrant it. However, project-specific characteristics alone do not justify a deviation from this 3.50% to 5.50% range.

In this context, the approach for RB is developed to reflect GDP per capita forecasts for the project's reference period, as detailed in the preceding chapter, to determine the most suitable SDR for this analysis. The **applied SDR is strongly supported by both relevant guidelines and similar infrastructure project benchmarks**.

8.1.4 Useful Economic Life and Reference Period

The **reference period for the economic appraisal of RB** is set at 81.2 years, spanning from 2024 to 2105, based on the weighted average useful life of the railway infrastructure. Specifically, costs and benefits for RB are modeled over a 50-year operational period until 2080 and a 7-year construction period (2024-2030), with subsequent cash flows aggregated and discounted for the remaining years.

The determination of this reference period follows EU guidelines and is **derived from the useful life of assets (73.7 years)**, influenced by capital expenditure (CAPEX) distribution and life expectancy assumptions specific to RB. These assumptions include:

- civil assets worth EUR 8.6 bn with a 100-year lifespan,
- other railway system assets valued at EUR 4.5 bn with a 40-year lifespan, and
- technical components worth EUR 1.7 billion expected to last 30 years.

8.1.5 Residual Value

The residual value of the RB project assets is calculated using the **depreciation formula outlined in EU guidelines**. This involves adjusting the asset value by adding back all maintenance costs and deducting depreciation from the expected book value at the end of the assets' useful life. The original real value of the assets is considered fully preserved at the end of the useful life due to the balance achieved through asset renewal (49%) and maintenance (51%). As a result, depreciation is effectively offset, ensuring that the asset's value at the end of its useful life equates to 100% of its original real value. This approach to calculating residual value is integral to the overall economic assessment of the RB project. Furthermore, as the infrastructure is forecasted to generate negative cashflows, all future cashflows are added until the end of the useful lifetime alongside economic benefits, also in line with applied CBA guidelines of the EU.

8.1.6 Geographic Scope and Catchment Area

Geographic Scope of CBA Study

The **geographic scope of the study** is defined to enable the accurate measurement of the impact of RB Phase 1, based on passenger and freight flows within the Baltic countries. In particular, the approach allows the measurement of local benefits and the impact of integrating the Baltic rail network with Poland and Europe, while RB trips occurring within Poland are not considered to be reflected in the scope of RB Phase 1.

The framework to define the boundaries of project impact in the transport ecosystem is **tailored to the characteristics of passenger and freight transportation**. Passenger trips are considered if either the origin or the destination is in Estonia, Latvia, or Lithuania. Freight flows, due to modeling considerations, are estimated based on a territorial principle: only traffic (measured in ton-kilometers) occurring within the geographic boundaries of the Baltic states is included in the benefit calculations. To accurately capture these flows, the traffic demand model accounts for RB passengers and freight movements from all origins and destinations globally, with estimation granularity adjusted by distance from the focus region. These data are then post-processed and filtered to align with the boundaries of cost-benefit analysis (CBA) calculations.

Passenger catchment areas are defined on three layers to understand the geographic characteristics of the underlying passenger market. The boundaries of the catchment area are highly dependent on distance and the willingness of people to travel in order to gain access to a certain service (Guerra, Cervero, & Tischler, 2011). The local catchment area includes potential passengers in the direct proximity of stations, while the regional catchment area includes a wider range of population within driving distance from stations. The international catchment area represents urban hubs in Europe with connectivity to RB through Warsaw, Kaunas, or Tallinn.

Finally, a **broader interpretation of the freight catchment area is outlined** to provide insights into freight corridors with the highest potential for the North-South axis.

Local Passenger Catchment Area

This area encompasses the **main urban areas with RB stations and the surroundings of the smaller regional stations** connected by RB. For cities with regional stations and a population exceeding 25,000, the entire population is included in the catchment area, while in smaller cities, a 4.8 km radius is used, regarding this as a feasible distance to travel on foot or by bicycle (depending also on weather conditions). This methodology is further supported by academic studies (Brinckerhoff, 1996; Upchurch, 2004) detailing the use of a Euclidian surface buffer around stations to delimit the catchment area by estimating a reasonable distance people are willing to commute.

The **combined local catchment area** encompassing all station stops is projected to reach a population of 528,852 for Estonia, representing 39% of the total population, 653,202 for Latvia, representing 35% of the total population, and 421,172 for Lithuania, representing 14% of the total population. This yields a total local catchment area of 1,603,226 people for all three Baltic states combined accounting for 27% of the total population.

The following table presents a summary of the local catchment area for each country, including the aggregated population of cities as of the end of 2023.

Estonia		Latvia		Lithuania	
City	**Population**	**City**	**Population**	**City**	**Population**
Tallinn	453,864	Rīga	614,987	Kaunas	305,120
Pärnu	52,362	Salaspils	17,702	Panevėžys	87,913
Saku[44]	11,510	Bauska	9,792	Jonava	27,134
Kohila[44]	7,726	Iecava	5,365	Joniškėlis	977
Rapla	5,353	Skulte[44]	2,867	Pasraučiai[44]	28
Häädemeeste[44]	4,677	Salacgrīva	2,489		
Luige[45]	1,337				
Tootsi[44]	774				
Assaku[44]	481				
Kilksama[44]	421				
Kurtna[44]	314				
Surju[44]	286				
Kaisma[44]	106				
Sub-total	**528,852**		**653,202**		**421,172**
% of country	39%		35%		14%
Total Baltics			**1,603,226**		
% of Baltics			27%		

Figure 51: Share of population within local catchment area (Statistics Estonia, National Statistical System of Latvia, Statistics Lithuania, City Population, 2023)

Regional Passenger Catchment Area

The second level considered for the purpose of defining a catchment area encompasses a **wider area surrounding RB stations in the three Baltic states,** with a commute of up to 1 hour by car, bus, or train. This is deemed as a reasonable commute for underserved areas and thus in line with the Euclidian buffer methodology. Further, while not directly included within the Euclidian buffer, Vilnius area is partially considered in the catchment

[44] Population data refer to the rural municipality.

[45] As of 2021, being the most recent available data.

area to reflect the significance of the population's access to RB Phase 1 via 1520 mm services connecting in Kaunas[46].

The regional catchment area within the Baltic states has an estimated population of around 4.5 million people, representing approximately 74% of the total population. Of this total, 34% live in the cities of Rīga, Tallinn, Kaunas, Panevėžys, and Pärnu excluding their suburban and metropolitan areas. The remaining 67% live in the suburban and metropolitan areas of these larger cities, as well as in smaller cities and rural areas.

A country-by-country breakdown of the population is presented in the table below:

Country	In rural areas	In metropolitan areas	In total catchment	% of total population
Estonia	591,355	494,092	1,085,447	79%
Lativa	555,375	660,187	1,215,562	66%
Lithuania	1,391,737	773,358	2,165,095	75%
Total	**2,538,468**	**1,927,637**	**4,466,105**	**74%**

Figure 52: Share of population within regional catchment area, Consultant team analysis based on Eurostat (2024c)

[46] Vilnius county is considered with a 64% weight in the regional catchment area to reflect the impact of RB Phase 1 on the area through the existing 1520 mm connection. Weighting is determined with proportion to the modal shift and induced demand realized in RB Phase 1 (compared to full scope demand modeled by RB).

Consequently, the **regional catchment area of RB Phase 1 accounts for 76% of the GDP**[47] of the three Baltic states.

Figure 53: Catchment area for RB Phase 1 considering a Local and Regional level, Consultant team analysis based on Eurostat (2023b)[48]

International Passenger Catchment Area

The **third level of the passenger catchment area** covers countries connected to RB via adjacent rail connections through Warsaw, Kaunas, and Tallinn, including Finland, Poland, Germany, Belgium, the United Kingdom, the Czech Republic, Slovakia, and Austria.

The following table shows that RB will be connected to a railway network (plus a connection to Helsinki) of major cities with a metropolitan population of approximately 72 million people. For trips longer than ~500km, air travel starts to become more attractive for select passenger segments. However, rail travel is often preferred for shorter trips due to its convenience, affordability, and environmental benefits. This international catchment area is also

[47] The GDP-contribution of Vilnius is partially considered to reflect

[48] Rīga is connected through shuttle services via Rīga Airport and Salaspils

important for the freight segment, as it will facilitate the transportation of goods between the Baltic states and the EU.

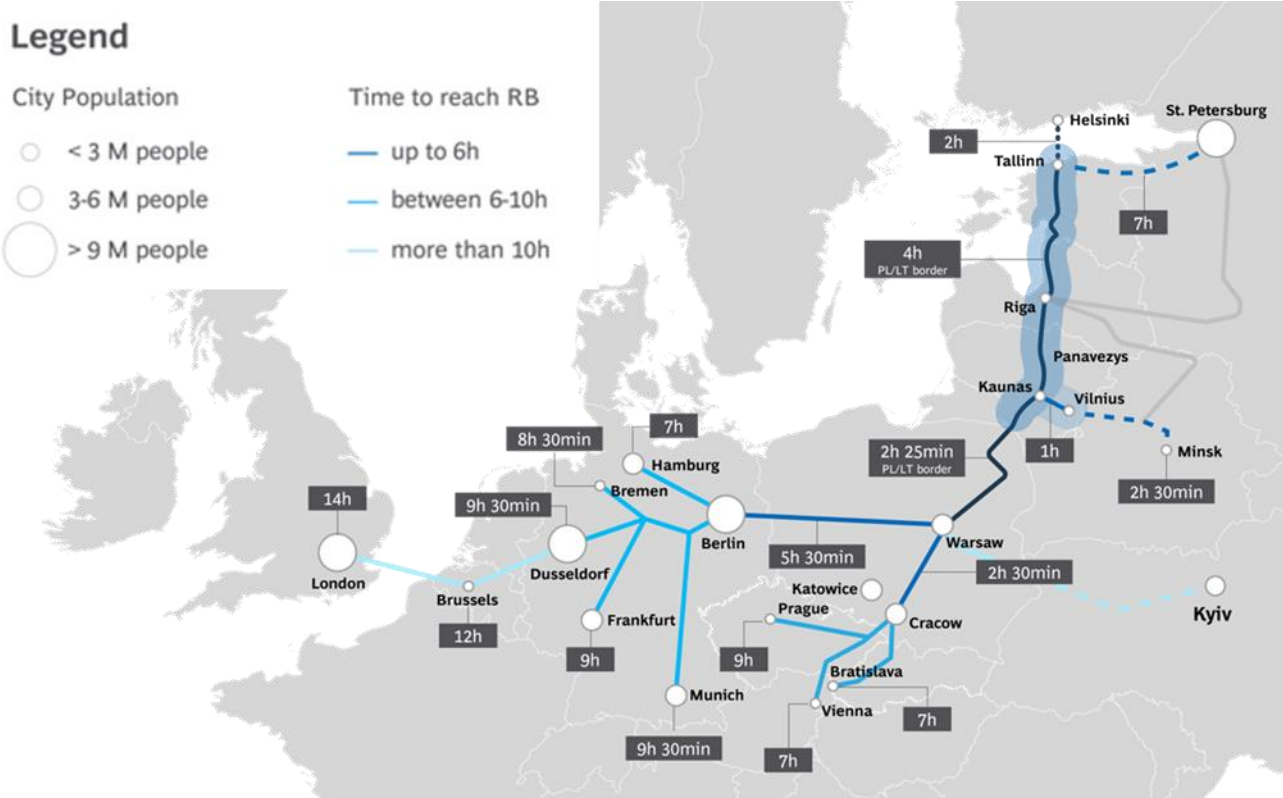


Figure 54: International catchment area of RB Phase 1 (Consultant team analysis)

Freight Catchment Area

RB's **catchment area for freight transportation is defined by strategic transport corridors** that are integral to the Baltic region's economic framework. These corridors facilitate the efficient transport of a wide range of goods and commodities, with potential to transit through the Baltic states along the North-South axis.

Key corridors in the RB catchment area include:

- Intra-Baltic Corridor
- Baltics – Eastern Europe/Asia Corridor
- Baltics - Scandinavia Corridor
- Baltics – Southern Europe Corridor
- Baltics - Western Europe Corridor
- Scandinavia - Southern Europe Corridor
- Scandinavia – Western Europe Corridor

Characteristics and traffic analysis of each freight corridor are provided in *Traffic Demand Forecasting* chapter.

Overall, while catchment areas are crucial for understanding the most likely users of RB, it is important to note that **trips originating from outside these defined areas are also considered in the analysis**.

8.2 Operational Assumptions

The following chapter elaborates on the operational assumptions of Rail Baltica Phase 1, more precisely the service offering across both passenger and freight services.

High-speed trains offer daytime express services for long-distance (international) routes, operating at the maximum line speed. **Night services** cater to overnight long-distance passengers, while **regional trains** provide passenger service within individual countries, and where relevant, they also facilitate cross-border regional passenger service. Additionally, **shuttles** operate as part of the **regional trains** to service high demand between RCS, RIX and Salaspils as a feeder line to other services. These outlined shuttles would operate on already existing 1520mm railway infrastructure.

On top of the scheduled unitised freight services, RB is expected to accommodate a significant amount of demand-driven freight train transport, with more details provided in the *Traffic Demand Forecasting* chapter.

The following table presents the service concept for services:[49]

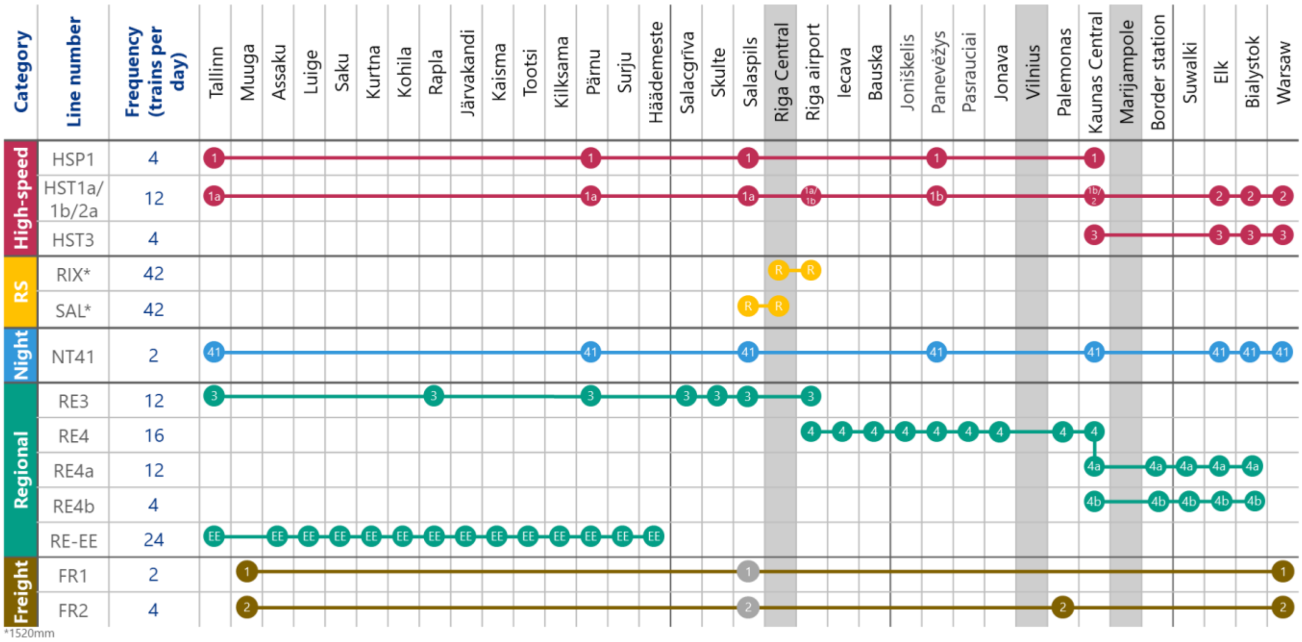


Figure 55: Service concept for train lines (RBR Project Team Input, 2023)

[49] The presented frequency is bidirectional. The service lines are still under development; thus, it is subject to change. Furthermore, two sidings at Salaspils are being constructed to support freight service potential, despite lack of terminal construction. Impact of and stops at Salaspils are considered in the *Phase 1 Extended Scenario*. SAL shuttle service is not included in the financial model, as it will operate on an existing track, which is not part of the current assessment.

8.3 Financial Assumptions

The following section describes assumptions that underpin the revenues and costs estimated in the financial analysis. The assumptions listed below encompass inputs related to the main components of the financial analysis, namely capital expenditure, future operation revenues, and the value of the infrastructure.

Category	Assumptions
Financial - operating model assumption	Each country will be assigned one Infrastructure Managers (IM) to oversee their respective domains, and to foster cooperation and coordination. The establishment of a potential corridor management model or entity is still in the decision-making phase and is currently an assumption made for modelling purposes. Once implemented, its structure is expected to mirror the existing RB Rail framework, with enhanced functions for maintenance and operation. Furthermore, every participating country is slated to have local operations and maintenance units. The specifications for these functions have been derived from the Operations Plan of 2018 as per instructions by RB, considering necessary adjustments.
Financial - passenger services	High-speed trains offer mainline daytime express services for long-distance (international) routes, operating close to maximum line speeds. Night services cater to mainline night-time long-distance (international) express passenger needs. Regional trains provide passenger service within individual countries, and where relevant, they also facilitate cross-border regional passenger service.
Financial - sections mapping	All sections are assumed to be completed by 31st of December 2030.
Financial - labor cost evolution	The evolution of the labor cost of the RB employees is assumed to differ by country every year and is calculated by considering the average nominal wage index equal to 100 in 2010 and then accounting for variations net of CPI.
Financial - electricity evolution	Electricity evolution, measured in EUR/MWh, is derived from consultant expert analysis. It is treated separately for every country, and is assumed to steadily decrease until year 2048, when there are no future changes assumed.
Financial - TAC[50] bench-marks for passengers (transport modes)	TAC benchmarks for alternative transports methods are derived from the Traffic Demand Model. The table below outlines the data segmented by country and modes, and measured in EUR/pkm:
Financial - TAC bench-	TAC benchmarks on national level are derived from the RB Infrastructure Access Policies report (Rail Baltica, 2022). Benchmarks for passengers are segmented by country (Germany, Italy,

Country	TAC (EUR/pkm)		
	Personal car	Coach	Existing train
Estonia	0.05	0.07	0.08
Latvia	0.04	0.05	0.03
Lithuania	0.04	0.07	0.06

[50] TAC = Track Access Charge

Category	Assumptions
marks for passengers	Spain, Sweden, Netherlands, and Belgium), and then the minimum, maximum, average, and median values for EUR/train-km are calculated.

Conventional passenger services:

Country	Minimum TAC (EUR/train-km)	Maximum TAC EUR/train-km)
Germany	3.18	7.02
Italy	1.44	4.21
Spain	1.24	5.71
Sweden	0.42	2.12
Netherlands	0.89	2.16
Belgium	1.85	10.36
Average	1.50	5.26
Median	1.34	4.69

HS passenger services:

Country	Minimum TAC (EUR/train-km)	Maximum TAC (EUR/train-km)
Germany	13.01	15.01
Italy	5.25	7.36
Spain	5.27	21.36
Sweden	n. a	n.a
Netherlands	13.79	14.41
Belgium	3.64	21.66
Average	8.19	15.96
Median	5.27	15.01

Category	Assumptions
Financial - TAC bench-marks (freight truck cost parameter)	TAC benchmarks for freight are derived from the Traffic Demand Model. These assumptions are segmented by demand categories (dry bulk, liquid bulk, semi-bulk, trade cars, and unitised), measured in EUR/tkm, as shown in the next figure:

Demand category	Main mode (EUR/tkm)	Feeder (EUR/tkm)
Dry bulk	0.11	0.09
Liquid bulk	0.04	0.04
Semi-bulk	0.04	0.04
Trade cars	0.34	0.34

<table>
<tr><th>Category</th><th>Assumptions</th></tr>
<tr><td></td><td><table><tr><td>Unitised</td><td>0.68</td><td>0.48</td></tr></table></td></tr>
<tr><td>Financial - TAC bench-marks (rail freight non-unitised cost parame-ters)</td><td>TAC benchmarks for freight are derived from the Traffic Demand Model. These assumptions are segmented by demand categories (dry bulk, liquid bulk, semi-bulk, trade cars), measured in EUR/tkm, as shown in the next figure:
<table>
<tr><th>Demand category</th><th>Main mode (EUR/tkm)</th><th>Feeder (EUR/tkm)</th></tr>
<tr><td>Dry bulk</td><td>0.01</td><td>0.01</td></tr>
<tr><td>Liquid bulk</td><td>0.01</td><td>0.01</td></tr>
<tr><td>Semi-bulk</td><td>0.01</td><td>0.01</td></tr>
<tr><td>Trade cars</td><td>0.13</td><td>0.13</td></tr>
</table></td></tr>
<tr><td>Financial - TAC bench-marks for freight (alternative transport methods)</td><td>TAC benchmarks for alternative transports methods are derived from the Traffic Demand Model. Variable costs are divided between unitised and non-unitised, and assumed among the three Baltic states as follows:
Unitised:
<table>
<tr><th>Country</th><th>Existing rail (EUR/tkm)</th><th>Truck (EUR/tkm)</th></tr>
<tr><td>Estonia</td><td>0.04</td><td>0.14</td></tr>
<tr><td>Latvia</td><td>0.04</td><td>0.14</td></tr>
<tr><td>Lithuania</td><td>0.04</td><td>0.14</td></tr>
</table>
Non-unitised:
<table>
<tr><th>Country</th><th>Existing rail (EUR/tkm)</th><th>Truck (EUR/tkm)</th></tr>
<tr><td>Estonia</td><td>n.a</td><td>0.68</td></tr>
<tr><td>Latvia</td><td>n.a</td><td>0.68</td></tr>
<tr><td>Lithuania</td><td>n.a</td><td>0.68</td></tr>
</table></td></tr>
<tr><td>Financial - Adjusted FTE estimations</td><td>RB is assumed to employ 549 FTEs (full-time employees) divided per country, and per functions or per qualifications, based on RB operational plan (2018).</td></tr>
<tr><td>Financial - Operations staff</td><td>RB is assumed to employ 160 FTEs (full-time employees) working at the satellite operations control center, segmented per country, based on the RB operational plan (2018)</td></tr>
<tr><td>Financial - HQ staff</td><td>RB HQ is assumed to employ 121 FTEs (full-time employees), 7 at the central operational control center, and another 114 in adjacent functions, based on the RB operational plan (2018).</td></tr>
<tr><td>Financial - Materials</td><td>It is assumed that 10% of the operational costs and another 10% of the HQ costs are allocated to materials, according to the RB operational plan (2018).</td></tr>
</table>

Category	Assumptions	
Financial - Utilities (electricity consumption)	Electricity consumption (measured in kWh per train-km) is based on data from the RB 2018 Financial Model. It is categorized for passenger and freight trains, and further broken down according to the specific train type.	
	Passenger transport mode	**Electricity consumption (kWh/train-km)**
	High-speed	7.4
	Night	7.4
	Regional	7.4
	Freight transport mode	**Electricity consumption (kWh/train-km)**
	Unitised	15.0
	Non-unitised	15.0
Financial – IT expenses	IT expenses are assumed to account for 2% of revenues, based on consultant expert analysis.	

8.4 Socio-Economic Assumptions

Assumptions presented in this section are used to **model RB's socio-economic environment**. While each assumption is derived from a cited source, it is crucial to acknowledge that socio-economic assumptions are inherently subject to a degree of uncertainty. Therefore, a sensitivity analysis is incorporated into the calculations to address this inherent uncertainty.

Real GDP

Real GDP and GDP-per capita projections are derived from S&P Capital IQ (2023b), with data after 2053 extrapolated from the last five years of available forecasts. See graph below for real GDP projections.

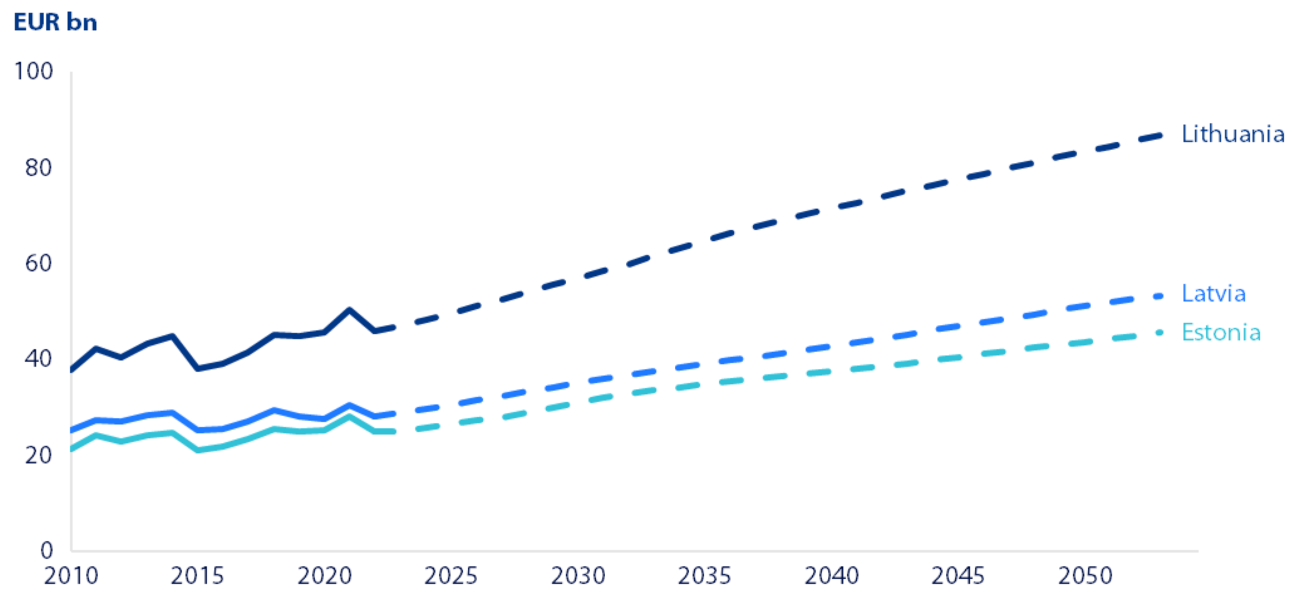


Figure 56: Real GDP forecast (S&P Capital IQ (2023b) & Consultant team analysis)

Recent Socio-Economic Developments

Recent socio-economic developments, such as Covid-19, the war in Ukraine, and the cost-of-living crisis have been considered for their impact on forecasted real GDP as of 2023. Regarding transport patterns, the model does not project significant changes attributable to recent events in its long-term forecasting period. This approach is supported by the absence of sufficient evidence to draw long-term conclusions based on observations from several volatile years.

In this context, passenger transport patterns are already converging to pre-Covid trends as evidenced in the figure below (Road Transport Administration of Latvia), further supporting the reasoning behind a model of low sensitivity to outliers.

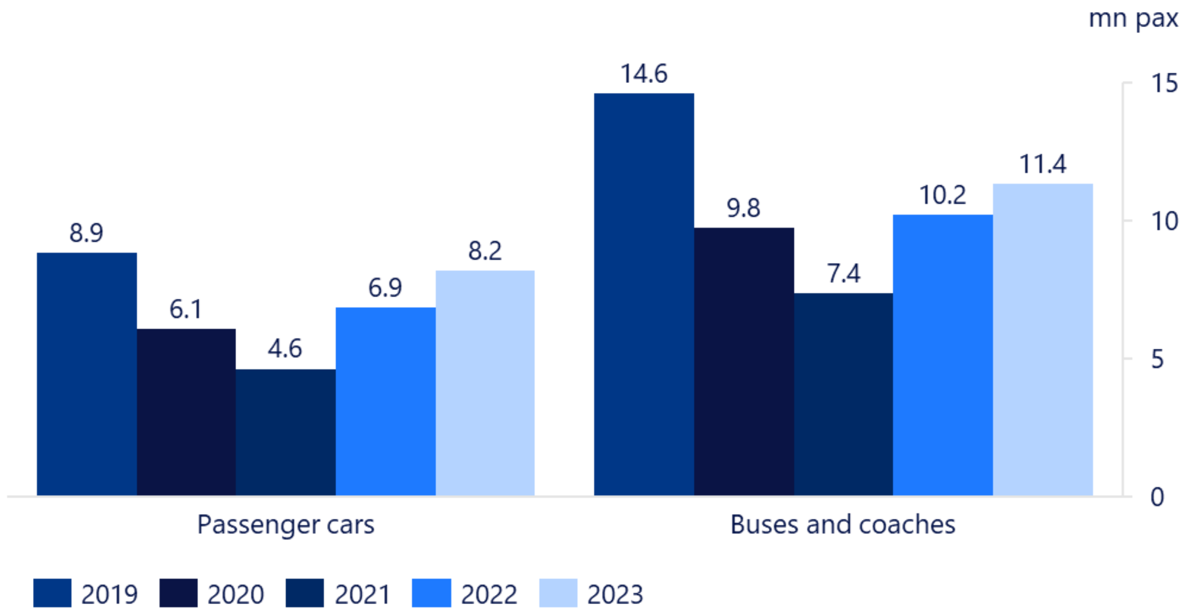


Figure 57: Rebound of commuting traffic following COVID-19 in Latvia, mn pax (Road Transport Administration of Latvia, 2023)

Trade Development

Freight demand is linked to trade growth assumptions, derived from the MDS Transmodal World Cargo database, accounting both for regional GDP growth, international trade trends, and a long-term analysis of correlation between GDP and trade growth.

Commuting Trip Purposes

It is assumed that 85% of the **commuting population** travels for work, and 15% for educational purposes, based on the distribution of the population and the likelihood of using public transport for these purposes.

Shadow Wages

Shadow wages are calculated with wage data from each country’s respective national statistics offices, compared to the average RB salary.

Category	Annual gross salary (EUR)
Unemployed	0
Lower salary	16,979
Same salary	25,065

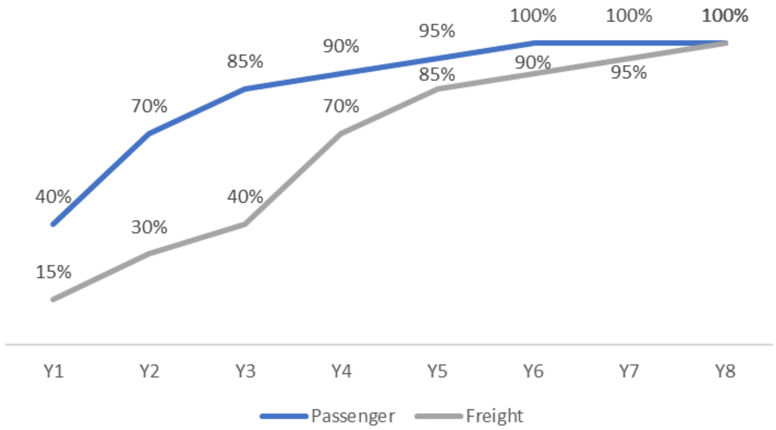
Working-age citizens are segmented based on their earnings compared to the wages RB offers. The percentage of the unemployed is sourced from national statistics offices. The proportion of workers earning more or less than the RB salary is determined through consultant expert analysis.

Category	Share of workers (%)
Unemployed	4.3%
Lower salary (70% of RB)	45.7%
Same salary	50.0%

8.5 Transport Mode Characteristics

The following table outlines the assumptions made regarding transport mode characteristics. These assumptions are mainly used as inputs for traffic-model forecasting and economic analysis, facilitating the calculation of passenger and freight demand, the impact of the modal shift, and induced demand.

Category	Assumptions	
Sensitivity to GDP growth	Passenger demand across different transport modes is growing as a function of GDP growth, considering both population and GDP/capita evolution. Taking into account industry benchmarks, the availability of transportation infrastructure, and the geographic characteristics of the region being modeled, GDP growth elasticities have been defined for each mode of transportation over the modeled period. After 2056, passenger volumes are expected to reach a steady state in the model to conservatively account for uncertain demand growth in the very long term.	
	Mode of transport	**Elasticity to GDP growth**
	Air	0.5
	Car	0.6
	Bus/coach	0.6
	Train (RB)	0.8

Category	Assumptions
RB traffic ramp-up	Traffic on the RB line is expected to ramp up from 40% in year 1 to full capacity from year 6 onward for passenger trains while for freight it is expected to start at 15% in year 1 and reach full capacity in year 8. This discrepancy in scaling rates can be attributed to the inherent lag in response time associated with trade dynamics. 
Travel distances and travel times	Travel distances across all modes are determined in an origin-destination matrix based on GIS data provided by the RB project team. Travel time is calculated based on the origin-destination distance matrix and travel speed using a headway-based approach, considering waiting, transit, loading and unloading times.

Category	Assumptions	
Car occupancy rate	Occupancy rate for cars is derived from RB traffic model assumptions.	
	Mode of transport	**Occupancy (number of passengers)**
	Car - commute	1.57
	Car - local business	1.57
	Car - local personal	1.78
	Car – medium-long business	1.80
	Car – medium-long personal	2.50
	Car - very long business	2.00
	Car - very long personal	3.00
Accident costs (passenger)	The external costs of accident cost per passenger transport mode are derived from the EC Handbook on external cost of transport (2019a). For the evolution of externality costs over time, an 80% rate of elasticity to GDP per capita is assumed (European Commission, 2021a).	
	Mode of transport	**Accident cost (EUR/pkm)**
	Air	0.0004
	Car	0.0642
	Coach	0.0191
	Day train	0.0035
	Night train	0.0009
	Furthermore, a linear decrease of accident rates over time is assumed because of the anticipated safety evolution of vehicle fleets. Accident rates is expected to reach 70% of the current rates by the end of the modeled period.	
Accident costs (freight)	The external costs of accidents per freight transport mode are derived from the EC Handbook on external cost of transport (2019a). For the evolution of externality costs over time, an 80% elasticity rate to GDP per capita is assumed (European Commission, 2021a).	
	Mode of transport	**Accident cost (EUR/tkm)**
	Air	0.0000
	Train	0.0020
	Truck	0.0071
	Ship	0.0000
	Furthermore, a linear decrease in accident rates over time is assumed due to the safety evolution of vehicle fleets. Accident rates are expected to reach 70% of current rates by the end of the modeled period.	

Category	Assumptions		
Passenger transport speed	Travel speed for each passenger mode is estimated using the RB traffic demand model, accounting for scenarios both with and without the inclusion of RB. Average speed is calculated as the weighted average of speed within the transport mix across all relevant origin-destination pairs, accounting for waiting and transfer times and congestion as applicable.		
	Mode of transport	**Speed with RB (km/h)**	**Speed without RB (km/h)**
	Air – medium-long business	216.1	208.0
	Air – medium-long personal	216.1	208.0
	Air - very long business	342.4	329.9
	Air - very long business	342.4	350.9
	Car - commute	46.3	46.2
	Car - local business	50.9	47.9
	Car - local personal	48.3	47.8
	Car – medium-long business	61.9	60.5
	Car – medium-long personal	62.8	62.2
	Car - very long business	51.8	51.5
	Car - very long personal	52.0	51.8
	Coach - commute	49.9	49.9
	Coach - local business	47.8	47.3
	Coach - local personal	48.5	48.4
	Coach – medium-long business	47.4	49.2
	Coach – medium-long personal	44.3	44.8
	Coach - very long business	71.2	71.1
	Coach - very long personal	71.2	71.1
	Day train - commute	55.3	55.7
	Day train - local business	58.5	55.1
	Day train - local personal	58.5	57.9
	Day train – medium-long business	97.8	63.5
	Day train – medium-long personal	97.8	63.5
	Day train - very long business	108.5	53.0
	Day train - very long personal	108.5	53.0
	Night train – medium-long business	85.2	49.4
	Night train – medium-long personal	85.2	49.4

Category	Assumptions
Freight transport speed	The travel speed for each freight mode is estimated using the RB traffic demand model. Average speed is calculated as the weighted average of speed within the transport mix across all relevant origin-destination pairs, accounting for waiting and transfer times and congestion as applicable.

Cargo type and mode of transport	Speed, with RB (km/h)
DBK - train	49.6
DBK - ship	38.4
DBK - truck	58.3
LBK - train	49.7
LBK - ship	40.6
LBK - truck	53.0
SBK - train	49.6
SBK - ship	40.6
SBK - truck	56.9
Trade Car - train	49.7
Trade Car - ship	39.8
Trade Car - truck	66.9
Unitised - air	267.4
Unitised - train	54.3
Unitised - ship	23.3
Unitised - truck	59.3

Category	Assumptions
Travel cost (passengers)	Travel costs are derived using the RB traffic demand model and information from online travel portals. For cars, the travel cost includes the total cost of ownership.

Mode of transport	Travel cost (EUR/pkm)
Air - medium long business	0,203
Air - medium long personal	0,193
Air - very long business	0,198
Air - very long personal	0,188
Car – all segments	0,136
Bus - commute	0,063
Bus - local	0,063
Bus - medium/very long	0,051
Day train - commute	0,024

Category	Assumptions	
	Day train - local business	0,076
	Day train - local personal	0,057
	Day train - medium long business	0,076
	Day train - medium long personal	0,057
	Day train - very long business	0,104
	Day train - very long personal	0,104
	Night train - medium long	0,104
Profitability (passenger transport value chain)	Profit margins in the passenger value chains are derived from Orbis for players in each transportation mode, including airlines, fuel suppliers, car manufacturing, bus operators, and passenger rail carriers. Public regional transport is assumed to be unprofitable.	
	Mode of transport	**Profit margin (%)**
	Air – medium long	0%
	Air – very long	1%
	Car	5%
	Bus commute/local	0%
	Bus medium/very long	5%
	Train – commute/local	0%
	Train – medium/very long	4%
Road damage	Assumptions for road damage caused by freight and passenger transportation, corresponding respectively to trucking and cars, is based on (Nilsson, Svensson, & Haraldsson, 2015).	
	Mode of transport	**Road damage (EUR/vkm)**
	Truck	-0.006
	Car	-0.004

Category	Assumptions
Productive share of travel time	The productive share of travel time for each transport mode is based on (Wardman & Lyons, 2015)to estimate the proportion of time spent in transit across different transportation modes that can be used effectively for work or other meaningful activities. This measure varies significantly based on the mode of transportation, individual tasks at hand, and the traveler's capability to perform these tasks while traveling. It assesses the extent to which travel time can be converted into productive time, considering factors such as focus requirements for the mode of transport (e.g., driving a car), available space, amenities, and internet connectivity.

Mode of transport	Productive share of travel time[51]
Air – short haul	7%
Air – long haul	21%
Car	12%
Coach	10%
Day train – commute/local	29%
Day train – medium/long distance	46%
Night train	46%

Category	Assumptions
Transport cost (freight)	Freight transport costs are derived from the RB traffic demand model and industry benchmarks of consultant team experts and logistics industry experts.

Cargo type and mode of transport[52]	Revenues (EUR/tkm)
DBK - train	0.028
DBK - ship	0.025
DBK - truck	0.125
LBK - train	0.028
LBK - ship	0.025
LBK - truck	0.046
SBK - train	0.040
SBK - ship	0.025
SBK - truck	0.046
Trade Car - train	0.140

[51] Share of productive travel time is assumed to stay constant over time – while there is a potential for marginal improvements such as better internet connectivity on airplanes, trains and coaches, the most significant drivers (e.g., transaction costs such as feeder travel time, waiting and boarding times, available space) are expected to remain similar to conditions observed in the referenced study

[52] DBK: dry bulk, LBK: liquid bulk, SBK: semi bulk

Category	Assumptions	
	Trade Car - ship	0.013
	Trade Car - truck	0.160
	Unitised - air	N/A
	Unitised - train	0.019
	Unitised - ship	0.007
	Unitised - truck	0.055
Profitability (freight transport value chain)	Profit margins in the freight value chains are derived from Orbis for each transportation mode player, including airlines, fuel suppliers, car manufacturing, bus operators, and passenger rail carriers.	
	Mode of transport	**Profit margin (%)**
	Train	6%
	Truck	1%
	Ship	3%
Passenger value of time	The value of time (VoT) is determined based on passenger surveys and literature reviews conducted as part of the traffic demand model. It is expected to increase in line with GDP/capita growth, exhibiting a 70% elasticity rate, based on EU guidelines (European Commission, 2021a)	
	Purpose and trip length	**Value of time (EUR/h)**
	Commuting	6.80
	Local - business	15.86
	Local - personal	8.56
	Medium long - business	23.62
	Medium long - personal	10.76
	Very long - business	28.44
	Very long - personal	10.39
Cargo value of time	Cargo value of time is derived from the traffic demand model as the weighted average of goods by transported volumes, including capital lock-up costs and the time cost component for time-sensitive goods (e.g., reefer containers).	
	Type of cargo	**Value of time (EUR/ton-h)**
	Unitised	1.44
	DBK	0.04
	SBK	0.02
	LBK	0.02
	Trade Car	0.12

8.6 Environmental Assumptions

Assumptions related to environmental impacts are used to calculate the impact on three key environmental considerations: climate change, noise pollution, and air pollution, during both the construction and operational phases. These values are subsequently aggregated to determine the total discounted benefits to the environment.

Category	Assumptions
Climate change (GHG emissions)	Climate change emission metrics have been assumed based on the EIB Project Carbon Footprint Methodologies (2023b) as follows:

Mode of transport (passenger)	CO2 emission (gCO2/pkm)
Air	183
RB	0
Other train	77
Car	128
Bus (urban)	97
Bus (coach)	23

Mode of transport (freight)	CO2 emission (gCO2/tkm)
RB freight	0
Other train freight	22
Truck	77
Ship	32

Furthermore, a linear decrease in emission rates over time is assumed due to the evolution of vehicle fleets. The emission rates are expected to reach 20% of the current rates by the end of the modeled period.
CO_2 emissions related to the construction phase have been assumed to amount to 0.83 t/10km/year based on the same suggestions.

Category	Assumptions
External costs of GHG emissions	The external costs of GHG emissions are defined based on the EIB Carbon Footprint Methodologies (European Investment Bank, 2023b)

Year	CO2 emission (gCO2/pkm)
2030	250
2035	390
2040	525
2045	660
2050	800

Category	Assumptions
Noise pollution: impacted residents during construction	Estimations for the number of impacted residents are derived from the RB Environmental Impact Assessment and national statistical data. **Country** / **Number of impacted residents** *Estonia*: 0 *Latvia*: 4,153 *Lithuania*: 1,411
Noise pollution (passenger)	External costs of noise pollution are derived from the EU handbook on the external cost of transport (European Commission, 2019a) for each transport mode. For the evolution of externality costs over time, an 80% rate of elasticity to GDP per capita is assumed (European Commission, 2021a). **Mode of transport** / **Noise pollution cost (EUR/pkm)** *Air*: 0.004 *Car*: 0.008 *Bus*: 0.004 *Train*: 0.001 Furthermore, a linear decrease in the emission rates over time is assumed due to the evolution of vehicle fleets. Emission rates are expected to reach 20% of the current rates by the end of the modeled period.
Noise pollution (freight)	The external costs associated with noise pollution for each transport mode are derived from the EU handbook on the external cost of transport (European Commission, 2019a). For trains, it is assumed that RB will account for 90% of the modal shift and induced demand. For the evolution of externality costs over time, an 80% rate of elasticity to GDP per capita is assumed (European Commission, 2021a). **Mode of transport** / **Noise pollution cost (EUR/tkm)** *Air*: 0.0000 *Train*: 0.0007 *Truck*: 0.0121 *Ship*: 0.0000 Furthermore, a linear decrease in the emission rates over time is assumed due to the evolution of vehicle fleets. Emission rates are expected to reach 20% of the current rates by the end of the modeled period.
Noise pollution (construction)	During the construction phase, the average noise pollution level is assumed at 58 db for impacted residents, based on RB EIA. The price of exposure is derived using the EC Handbook on external cost of transport (2019a), amounting to 32 EUR/db/person/year. Based on consultant expert analysis, the share of exposed time during the operation phase is estimated at 20%.

Category	Assumptions
External costs of air pollution (passenger)	The external costs of air pollution are derived from the EU handbook on the external cost of transport (European Commission, 2019a). For trains, it is assumed that RB will account for 90% of the modal shift and induced demand. For the evolution of externality costs over time, an 80% rate of elasticity is assumed to GDP per capita (European Commission, 2021a).

Mode of transport and trip length	Air pollution (EUR/pkm)
Air - medium long	0.00481
Air - very long	0.00211
Car - all lengths	0.01332
Coach - commute/local	0.00630
Coach - medium/very long	0.00602
Day train – commute/local	0.00094
Day train - medium long	0.00055
Day train - very long	0.00003
Night train – medium long	0.00038

Furthermore, a linear decrease of emission rates over time is assumed due to the evolution of vehicle fleets. Emission rates are expected to reach 20% of the current rates by the end of the modeled period.

Category	Assumptions
External costs of air pollution (freight)	External costs of air pollution for freight transport modes are derived from the EC Handbook on external cost of transport (2019a). For trains, it is assumed that RB will account for 90% of the modal shift and induced demand. For the evolution of externality costs over time, an 80% rate of elasticity to GDP per capita is assumed (European Commission, 2021a).

Mode of transport	Air pollution cost (EUR/tkm)
Air	0.00000
Train	0.00006
Truck	0.00735
Ship	0.00000

Furthermore, a linear decrease of emission rates over time is assumed due to the evolution of vehicle fleets. Emission rates are expected to reach 20% of the current rates by the end of the modeled period.

Category	Assumptions
Air pollution (construction)	External costs of air pollution during the construction phase are derived from the EC Handbook on external cost of transport (2019a).

Particle	Emissions cost (EUR/t)
PM10	70,000
PM2,5	70,000
NOx	4,400

Emissions per year for the construction period are derived from the RB EIA:

Particle	Emissions (t/year/10km)
PM10	3.60
PM2,5	1.77
NOx	28.96

9 Traffic Demand Forecasting

The previous chapter outlined **assumptions applied to model the environment of RB Global Project**. Consequently, this chapter focuses on how traffic dynamics are forecasted within this environment, generating necessary inputs for estimating financial and economic impacts of the project.

The chapter offers a detailed overview of the traffic demand model used to predict **changes in travel patterns and the resulting demand in the transport ecosystem**. This includes the definition of the objectives of traffic forecasting, emphasizing its practical importance within the CBA framework. The approach used for modeling, the validation processes undertaken, the types of data inputs required, and the expected outputs from the model are also methodically discussed, providing a comprehensive understanding of the entire process. The chapter ends with the analysis of the traffic forecasts provided by the model and their interpretation in the context of impact assessment.

9.1 Objective of Traffic Flow Modeling

Traffic demand analysis plays a key role in evaluating project viability. Considering all relevant variables, it identifies existing demand and projects it into the future. Forecasting traffic volume is an essential component of the framework, providing inputs on **passenger and freight traffic flow for the CBA and WEI calculations**.

First, **forecasting passenger and freight traffic enables the estimation of future financial revenue streams**, including track access charges and ancillary revenues. These forecasts directly influence the financial analysis by providing critical inputs for the calculation of the project's financial viability and potential profitability.

Second, **traffic flow volumes play a fundamental role in driving economic impact**. The movement of passengers and goods through the rail system plays a direct role in generating the economic impact modeled in the ECBA. Additionally, this movement facilitates broader economic benefits, including an increase in tourism, a boost in trade, and expanded business opportunities.

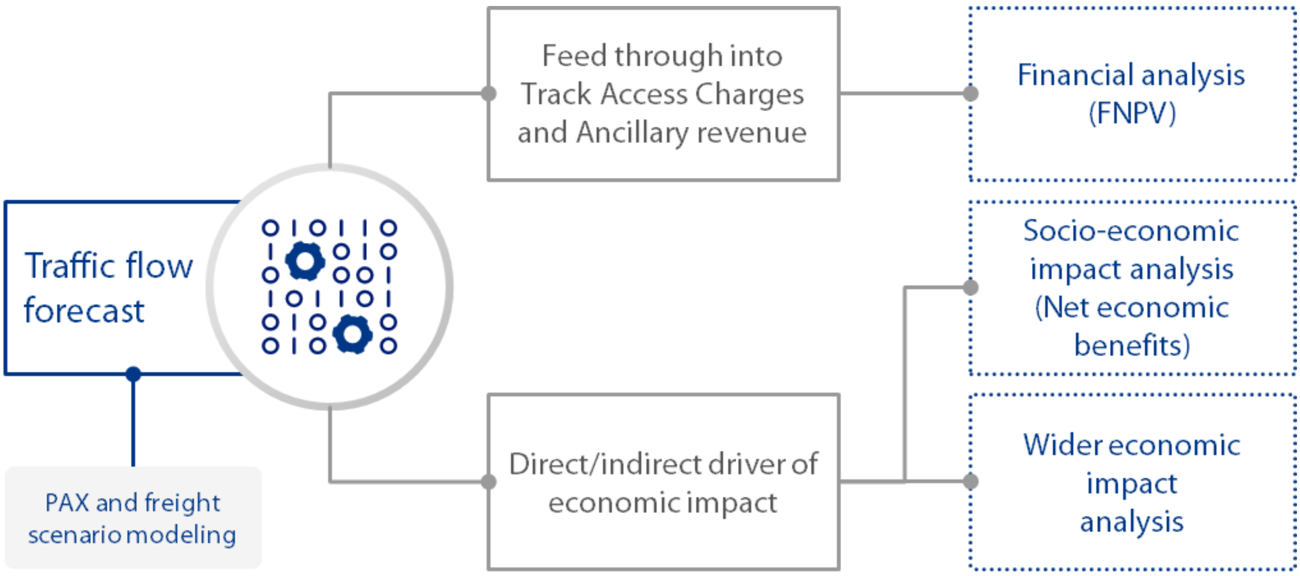


Figure 58: Traffic flow forecasting in the Economic Appraisal process

9.2 Modeling Approach

Traffic demand forecasts are modeled in **RBM, RBR's traffic demand model**. RBM is a multimodal transport network model property of RB built in PTV Visum, a commercial software for transport modeling. The model is calibrated for 2019[53] as the base year and provides projections for 2031, 2046, and 2056. For the period between 2056 and 2080, it is assumed that demand will reach a steady state. For interim years, demand is interpolated to provide a continuous projection.

RBM includes three distinct modules relating to three primary aspects of the RB project, namely **passenger demand, freight demand, and the infrastructure network**. On a geographic level, the model's location-specific emphasis is set on the Baltic Corridor, spanning from Tallinn to Warsaw.

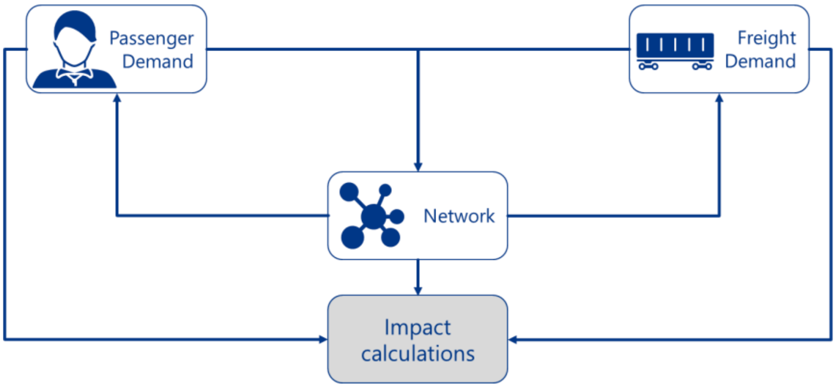


Figure 59: Modular structure of the transport model

As a transport network model, the RBM specifies an impact area and calculates demand by the integration of feedback loops. These loops encompass **four stages:** an estimation of generated demand, origin/destination distribution, modal split, and assignment to a multimodal network. This process is then iteratively repeated until equilibrium is reached.

The **demand generation phase** divides modeled geographies into zones at NUTS-3/county level and determines trip rates by purpose and length based on national and European travel surveys in the passenger model. For freight, country-to-country trade flows serve as the basis of the model. Trip rates are sensitive to GDP/capita and trade growth for passenger and freight transport, respectively, and to the introduction of new transportation modes (i.e., RB).

In the next step of the modeling process, **passenger trips are distributed to destinations in a gravitational model**. Passengers are distributed according to the characteristics of the set of destinations matching their trip purposes and trip length criteria, while freight flows are attributed considering NUTS-3 level economic activity. In the **freight model, country-to-country trade flows are assigned to zones** considering economic activity (production and consumption).

---

[53] The selection of 2019 as reference year allows the assessment of long-term traffic patterns without the disruption effects of Covid-19 and the war in Ukraine. While these factors influence transport networks and demand in the short term, the base-case model scenario assumes limited impact in the modeled period (2031-2105).

Lastly, all **passenger trips and freight flows are assigned to transport modes** in the modeled network based on a modal choice function considering factors such as transport costs, time, capacities, and further utility factors.

In this context, the **assignment of public transport trips to the network is unconstrained** – while passenger and freight modal choices depend on the frequency and capacity of services, the demand for these services is not constrained by the capacity, i.e., the model can estimate higher volumes for certain services than they can accommodate. Capacity utilization is monitored to offer opportunities for demand-driven service offering as necessary. For private transport modes (i.e., car and truck), capacity constraints are considered and influencing modal choice through congestion feeding into travel times.

9.3 Validation of the RBM Demand Model

To provide reliable traffic forecasts for the CBA and the financial plan, **RB's traffic demand model is analyzed and validated across three output components** – baseline traffic, induced demand and modal shift, and growth projections as per the following figure.

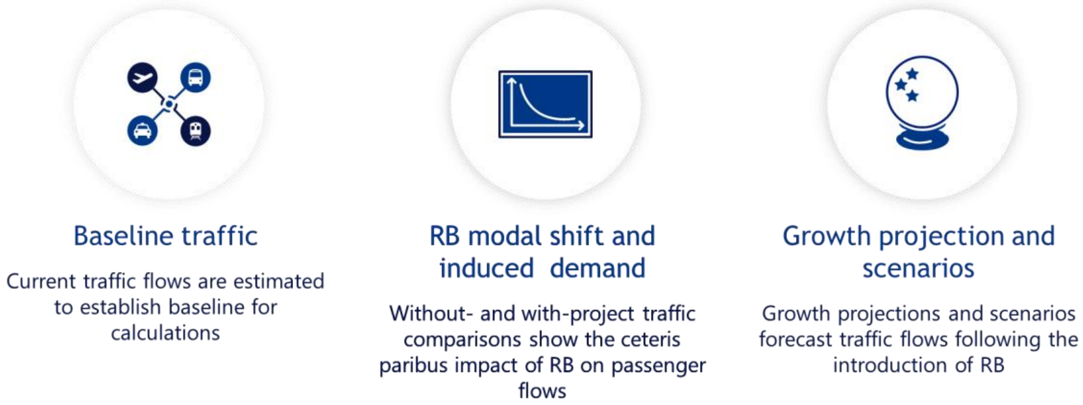


Figure 60: Overview of analyzed output components

In each dimension, **target intervals are set based on official sources and industry best practices**. Consequently, output gaps are established between the benchmark employed and RB model data to check the validity of the model.

More precisely, **current traffic flows** are analyzed to validate the baseline for calculations, with 2019 as the reference year. The selection of 2019 as the reference year allows the assessment of long-term traffic patterns without the disruption effects of Covid-19 and the war in Ukraine. While these factors influence transport networks and demand in the short term, the base-case model scenario assumes limited impact in the modeled period (2031-2105). **Modal shift and induced demand** for RB are compared, considering scenarios both with and without RB, thus showing ceteris paribus the impact of the new railway on traffic flows. Lastly, **growth projections** are employed to forecast the traffic flows following the introduction of RB.[54]

[54] Outputs of the traffic demand model (incl. modal shift and induced demand) are detailed in section 8.5.

The validity of the model's forecasts for both passenger and freight transport **is affirmed** by aligning them with established benchmarks.

9.4 Model Inputs and Assumptions

RB's traffic demand model is built on various assumptions to estimate future demand in the region for both freight and passenger traffic. More specifically, it relies on assumptions for the **macroeconomic environment, current infrastructure network in the region, microeconomic implications, and mobility trends**. For a detailed specification of the assumptions listed below, please refer to the assumptions chapter in this report.

9.4.1 Macroeconomic Environment

When assessing the macroeconomic environment, four main components are taken into account: real GDP, traffic growth elasticity to GDP growth, recent socio-economic developments, and trade development.

Real GDP

Real GDP and GDP-per capita projections are derived from S&P Capital IQ (2023b), with data after 2053 extrapolated from the last five years of available forecasts. See graph below for real GDP projections.

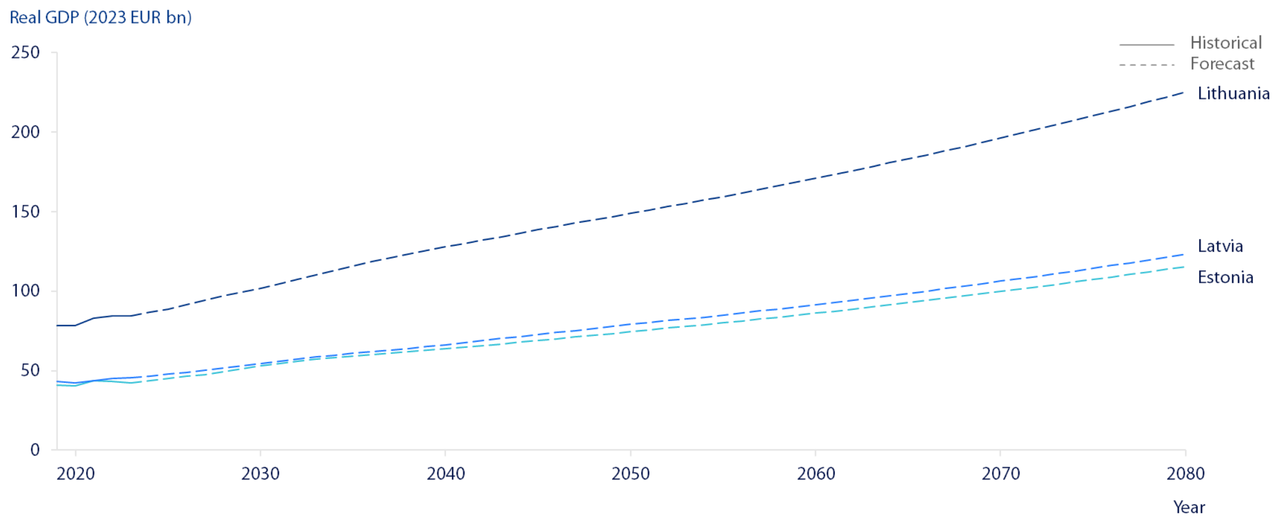


Figure 61: Real GDP forecast (S&P Capital IQ, Consultant team analysis)

Traffic Growth Elasticity to GDP Growth

Passenger demand across different transport modes grows as a function of GDP growth, considering both population and GDP/capita evolution. Accounting for industry benchmarks, the availability of transportation infrastructure and geographic characteristics of the modeled region, GDP growth elasticities are defined for each transportation mode throughout the modeled period. After 2056, passenger volumes are expected to reach a steady state in the model to conservatively account for uncertain demand growth in the very long term.

Mode of transport	Elasticity to GDP growth
Air	0.5
Car	0.6
Bus/coach	0.6
Train (RB)	0.8

Figure 62: Elasticities to GDP growth (Consultant expert analysis)

Recent Socio-Economic Developments

Recent socio-economic developments such as COVID-19, the war in Ukraine, and the cost-of-living crisis are taken into account for their impact on forecasted real GDP as of 2023. In terms of transport patterns, no significant changes are attributed to these events in the very long-term forecasting period of the model due to a lack of evidence to draw long-term conclusions from several years of very volatile conditions. As seen on the figure below, public transport developments are converging to pre-Covid trends, which further supports the argument to limit model sensitivity with respect to outliers.

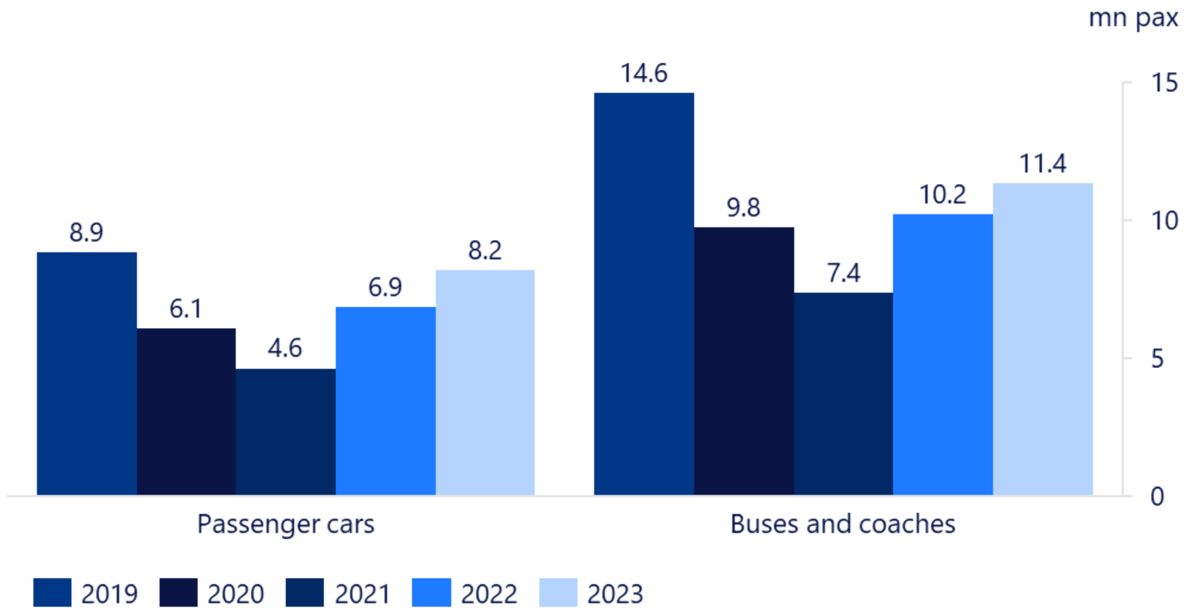


Figure 63: Rebound of commuting traffic following COVID-19 in Latvia, mn pax (Road Transport Administration of Latvia, 2023)

Trade Development

The evolution of freight demand is based on trade growth assumptions sourced from the MDS Transmodal World Cargo database, accounting for regional GDP growth, international trade trends, and a long-term analysis of the correlation between GDP and trade growth.

While each assumption draws from specific data sources, it is important to acknowledge that socio-economic projections carry an inherent degree of uncertainty. To address this, a sensitivity analysis is incorporated into the calculations, allowing for adjustments that account for potential variability in these assumptions.

9.4.2 Infrastructure Network

The representation of the infrastructure network in the region is a key element to estimate both induced demand and the modal shift to RB. The main assumptions regarding the infrastructure network in the Baltic region have been collected by **analyzing map databases, projected supply data and data from transport operators**.

The primary **map databases** used for this project are Open Street Map and the HERE database. Open Street Map provides detailed data on rail infrastructure, including stations, transportation hubs, rail links, and existing railway connections. The HERE database on the other hand offers comprehensive road network data, categorized by functional road hierarchies, and including attributes like spatial mapping, legal speed limits, and capacity indicators like lane numbers on links and junctions.

The information pertaining to transport operators is collected from operators publishing their own services and via the **General Transit Specifications databases (GTFS) on Google**. The latter is available for Estonia, Latvia, and Poland. For Lithuanian regional and long-distance rail, online booking portal information is employed. For coach services, data is collected from the **operators' websites**. Information on planned infrastructure and services is provided by RBR.

9.4.3 Rail Baltica Services

Within the described infrastructure framework, special emphasis is placed on **modeling services operating on the RB Phase 1 infrastructure**. RB expects future carriers to operate high-speed, night, regional and freight services on the infrastructure.

The following service plans outline routes and frequencies, serving as inputs for the traffic demand model, determining the attractiveness of RB Phase 1 toward passengers and freight shippers. Services are defined based on RB project team inputs, and are not responsive to demand (i.e., frequency and capacity do not increase if demand increases). Capacity utilization is monitored to ensure an appropriate balance with demand on the line.

High-Speed Passenger Services

Figure 64: High-speed passenger services on RB Phase 1 (RB project team input)

Regional Passenger Services

Figure 65: Regional passenger services on RB Phase 1 (RB project team input) [55]

Night Passenger Services

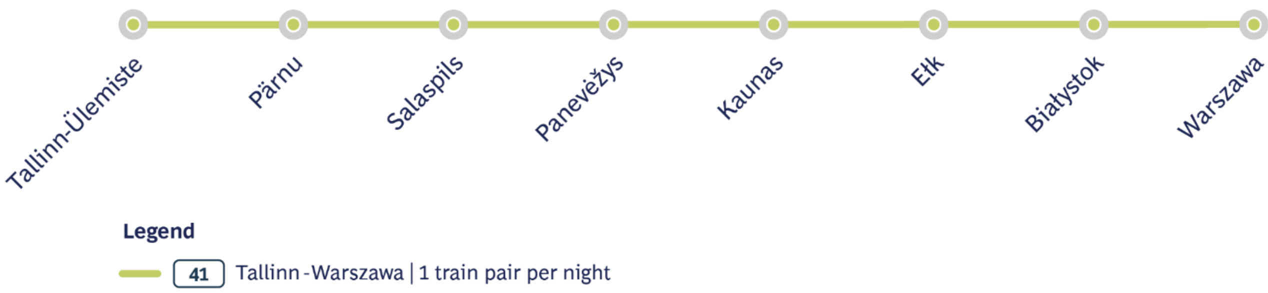


Figure 66: Night passenger services on RB Phase 1 (RB project team input)

[55] The hypothesis of a seamless shuttle service RIX-RCS-Salaspils was tested. The results from the demand model shows that this service would have a positive impact on the Salaspils station (10%) and RIX station (7%) shuttle service passenger turnover. However, the improved alternative has a negative impact on the Misa-RIX Rail Baltica section, with passenger volume on the section dropping by 9%. The difference in overall Rail Baltica travelled passenger km in Latvia is insignificantly negative (1% drop), (RBR Project Team Input, 2024). SAL shuttle service is not included in the financial model, as it will operate on an existing track, which is not part of the current assessment.

Freight Services

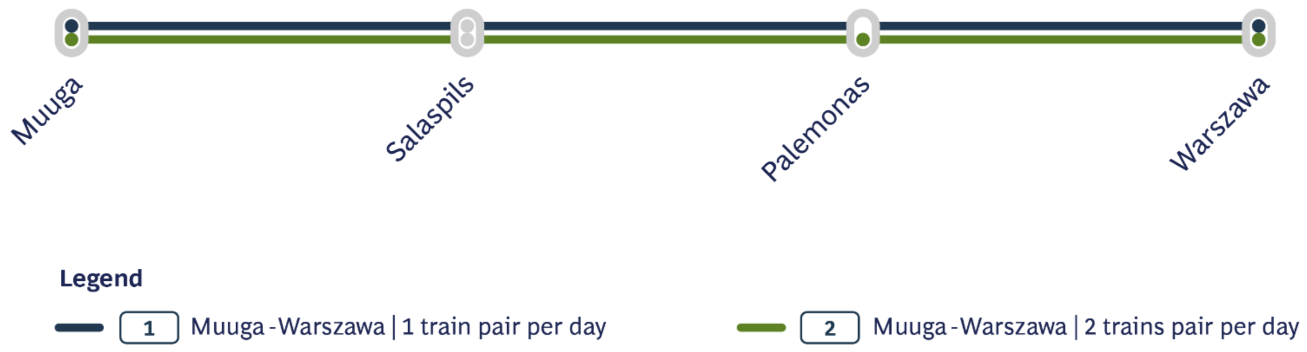


Figure 67: Freight services on RB Phase 1[56] (RB project team input)

9.4.4 Microeconomic Assumptions

The model is developed based on several microeconomic assumptions ranging from the respective cost of each transport mode to the value of passengers' time. Microeconomic assumptions employed in the traffic demand model are listed below, with further details provided in chapter *Assumptions*.

- **Passenger transport costs** are segmented in the model by transport mode and demand segment. This segmentation includes trip length (local, medium-long, and very long) and purpose (commute, business, and non-business).
- **Freight transport costs** are modeled based on transport mode and cargo type, including dry bulk, liquid bulk, trade cars, and unitised goods.
- **Value of passenger travel time** is derived from passenger preference surveys conducted in Estonia, Latvia, Lithuania, and Poland between April and June 2021. This value is expressed in EUR/h for each country, varying with trip duration (local, medium-long, and very long) and purpose (commute, business, and non-business).
- **Cargo value of time** is determined for each cargo type, using data from the MDST database.
- **Occupancy and load factors** are used to convert numbers into passengers and tons. Car occupancy factors, expressed in passengers/car, are segmented by country and demand segment, including trip length and purpose. For truck and rail, load factors, expressed in tons/vehicle, are segmented by cargo type.
- **Travel time and distance:** Travel times are calculated from infrastructure network data, considering distances traveled, speed per transport mode, road capacity, and waiting and transit times for both passenger and freight, including loading and unloading at terminals.

To ensure the robustness of traffic forecasts, assumptions have been validated against benchmarks, including data from official and proprietary databases as well as insights gathered from interviews with industry experts.

[56] FT-6, FT-7 and Salaspils terminal are not included in traffic demand model as they do not provide unitised freight services. Non-unitised freight trains are modeled on a demand-driven basis (instead of service-driven approach for unitised freight).

Trends

Technological advancements in transportation, which significantly influence both emissions and energy consumption, are factored into the model. This consideration is especially important give the EU's commitment to achieving net-zero emissions by 2050 and its related incentivization of electric mobility, as evidenced by the goal to ensure all new road vehicles are zero-emission by 2035.

Each country's **projected composition of road fleets** is based on ASTRA, a proprietary model developed by TRT, in alignment with the European Commission's handbook on the external cost of transport (2019a). Under the base scenario, the average share of non-internal combustion engine cars (gasoline and diesel based, including non-plug-in hybrids) is projected to increase from 12.3% in 2031 to 46.7% in 2056. Among the Baltic countries, Estonia is anticipated to boast the highest proportion of non-internal combustion engine (non-ICE) cars in 2056, with an expected 50.7%.

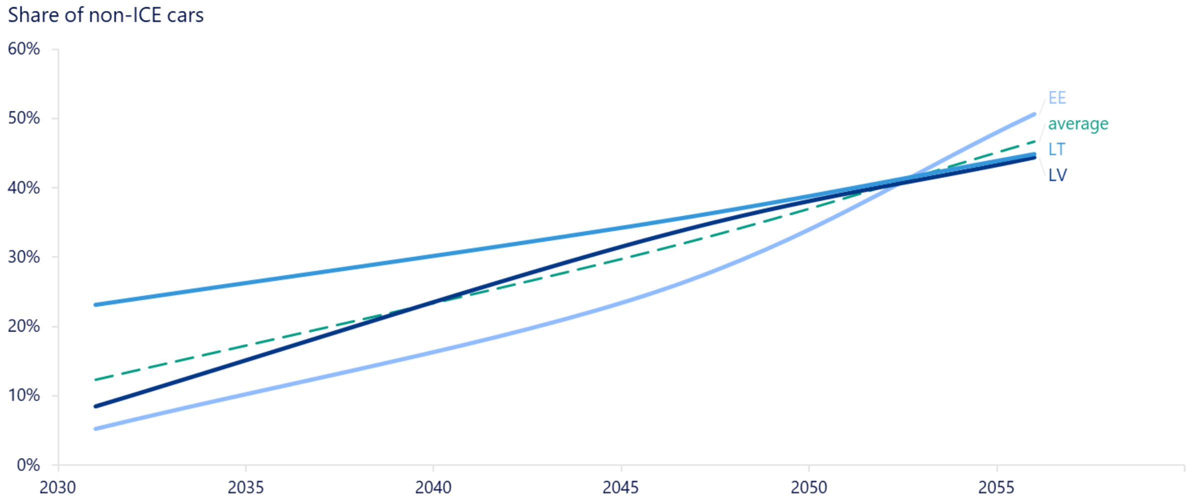


Figure 68: Non-ICE share of cars in the Baltics (2031-2056) (ASTRA, 2019)

Assumptions detailed in this chapter all feed into the traffic demand model to provide the analysis with accurate forecasts. Consequently, the next chapter analyses and interprets key model outputs to understand traffic dynamics and thus the underlying traffic assumptions of the CBA.

9.5 Output Analysis

Results of the traffic demand model form the foundational basis for the calculations conducted in both the financial and economic analyses. The following chapter outlines the results of the traffic forecasts for both **passenger and freight demand**, analyzing both modal shift and induced demand.

Modal shift refers to people or goods transitioning from other forms of transportation, such as cars and airplanes, trucks, and ships, to rail. An example of this is people opting for RB for their daily commutes instead of driving. Such a shift significantly reduces travel times and road congestion and enhances environmental outcomes.

Induced demand arises when the expansion of rail services or infrastructure results in an increase in rail usage beyond initial demand. For instance, the construction of a new rail line may not only attract existing commuters but also inspire more people to travel, people who may not have done so before. This leads to an overall increase in travel, rather than merely a redistribution of other modes. Induced demand thus enhances the accessibility of both the passenger and freight network.

9.5.1 Passenger Demand

This chapter is dedicated to **forecasting passenger demand for RB**. It begins by providing insights into the anticipated traffic on the RB line, emphasizing the characteristics of typical passengers and analyzing the distribution of traffic along the line and at various stations. The chapter then examines the impact on modal share, comparing scenarios both with and without RB. This analysis involves assessing shifts among all relevant transport modes in the corridor to determine how RB influences travel choices. Finally, the concept of induced demand is explored to understand how the introduction of RB is expected to create additional travel demand.

Forecasted RB Traffic

Demand for passenger services on Rail Baltica is projected to experience consistent growth from 2031, stabilizing into a steady state by 2056. The distribution of passenger kms across services is homogenous throughout the modeled period, with regional and HSR services driving most of the traffic.

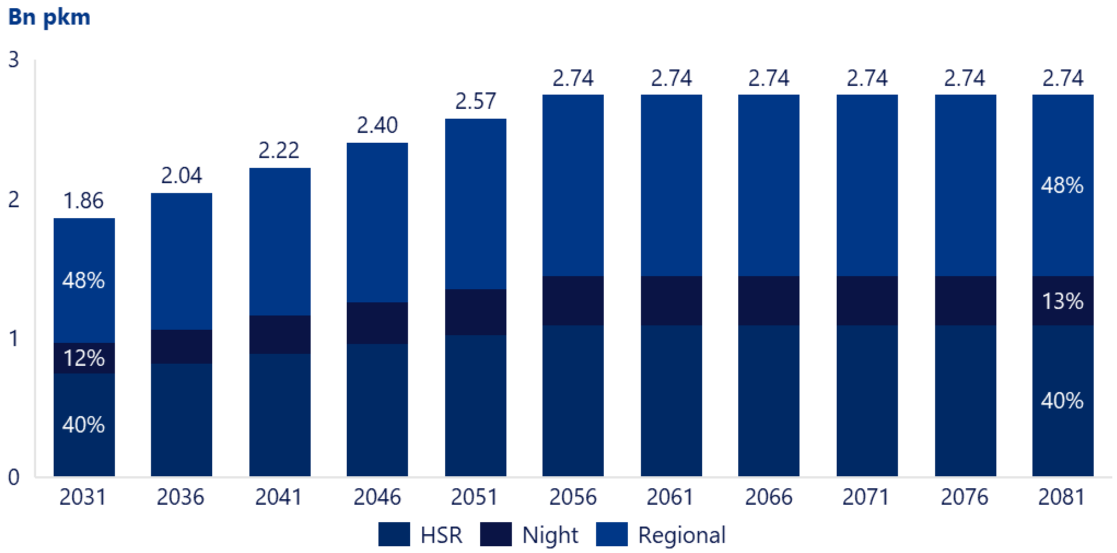


Figure 69: Forecasted passenger traffic on RB Phase 1 services without ramp-up (Rail Baltica TDM, 2024)

In terms of individual passengers, **RB Phase 1 is expected to reach 14.8 mn trips** by 2046 across three main passenger segments (see following figure). Non-business passengers constitute the majority of the traffic on RB across all types of services, accounting for 10 mn trips annually. Commuters particularly contribute to the demand for short trips on regional services, whereas business passengers tend to prefer longer routes and HSR services.

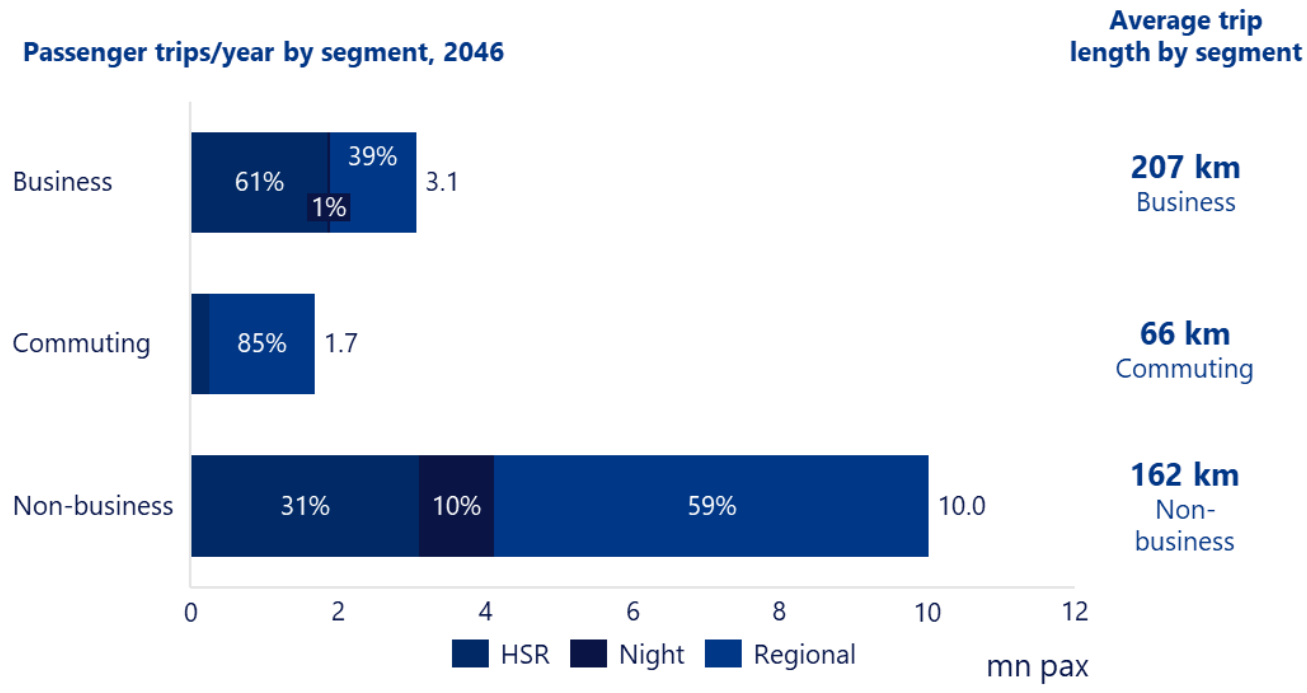


Figure 70: Passenger trips/year across demand segments in 2046 (Rail Baltica TDM, 2024)

To understand the characteristics of passenger demand on a more granular level, the following chart outlines the distribution of passenger traffic (pax) across key RB sections in 2046, highlighting a strong concentration of traffic on the RCS-RIX section (served by 1520 mm shuttle services) and Kaunas-PL border sections. This distribution underscores the necessity for high-frequency services around and between urban hubs.

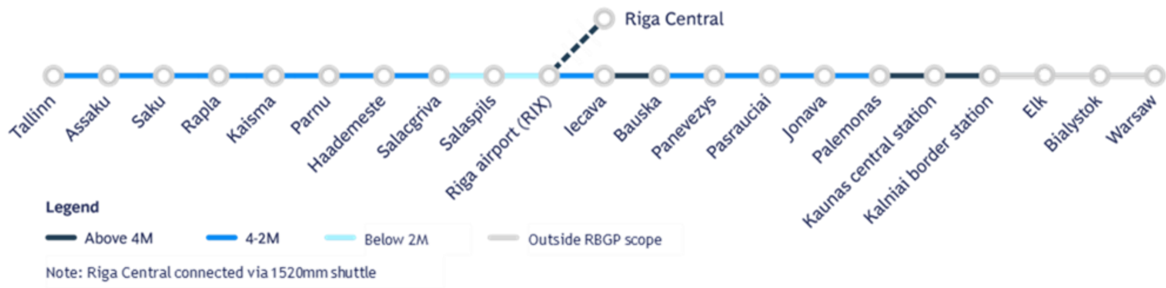


Figure 71: Yearly traffic on RB Phase 1 sections[57] in 2046, mn pax (Rail Baltica TDM, 2024)

Additionally, the model projects the daily traffic at RB Phase 1 stations, accounting for both the arriving and departing passengers. This projection is particularly important for benchmarking the project against other European rail infrastructures and estimating the potential demand for businesses to be located inside or near the

[57] Schematic map of sections shows a limited number of stations to provide an overview of travel patterns at an aggregate level.

stations. The chart below illustrates the expected **daily passenger traffic at the main RB Phase 1 stations in the steady state**, in line with traffic distribution by sections shown in the previous figure.

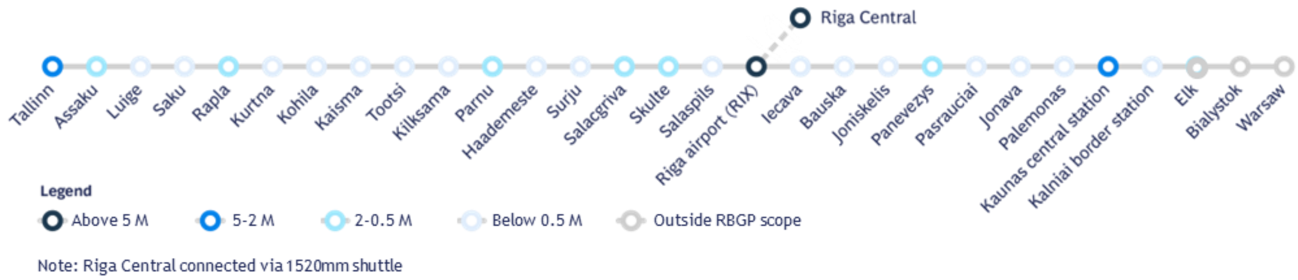


Figure 72: Yearly traffic at RB Phase 1 stations 2046[58], mn pax (Rail Baltica TDM, 2024)

The outlined passenger traffic volumes are expected to be captured by RB from both modal shift from other transport modes and induced demand.

Impact on Modal Share

In the Baltic region's passenger travel market, **RB is forecast to capture about 1.9% of total passenger volumes** (in pkm) by 2031, significantly increasing the formerly existing market share of railways. RB's increased attractiveness is due to its cost-effectiveness and reliability, making it a superior alternative to flights, and offering advantages in speed and comfort over cars.

This shift is part of a broader **trend toward greater public transportation usage**. Public transport's growing popularity is expected to contribute to an overall increase in its use, with bus modal share is also expected to see

[58] Schematic map shows only stations explicitly modeled in the traffic demand model.

a rise by 0.3 pp by 2031. This shift aligns with RB's sustainability and congestion reduction goals, contributing to a wider movement towards public transport and decreasing reliance on air and car travel.

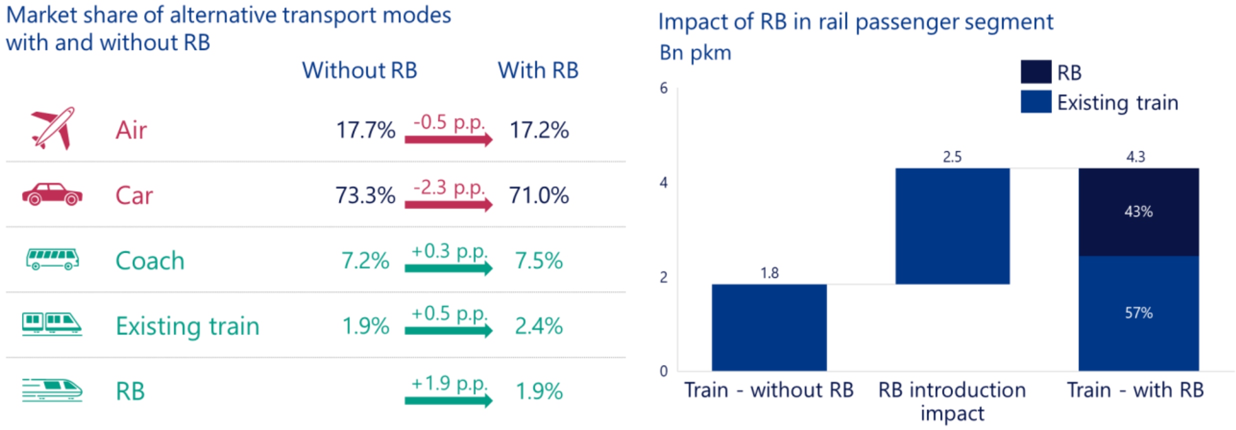


Figure 73: Modal share of transport within the Baltic states with and without RB in passenger transportation in 2031, bn pkm (Rail Baltica TDM, 2024)[59]

The **modal share impact is evaluated in several O/D segments** across the North-South corridor in the following figure. This analysis aims to assess the impact of the various transport modes' value propositions across varying distances. While there is only a moderate potential to capture modal share in domestic transport markets, primarily due to the low density of the existing rail transport network and the predominance of cars, the model forecasts underscore the impact of new cross-border services and high-speed infrastructure. Notably, rail travel is expected

[59] Sum of parts might not add up to the subtotals and totals due to rounding.

to attract the most demand away from cars due to e.g., low-quality road infrastructure along the North-South axis. In contrast, air travel, being well-established and affordable, is likely to lose less of its share.

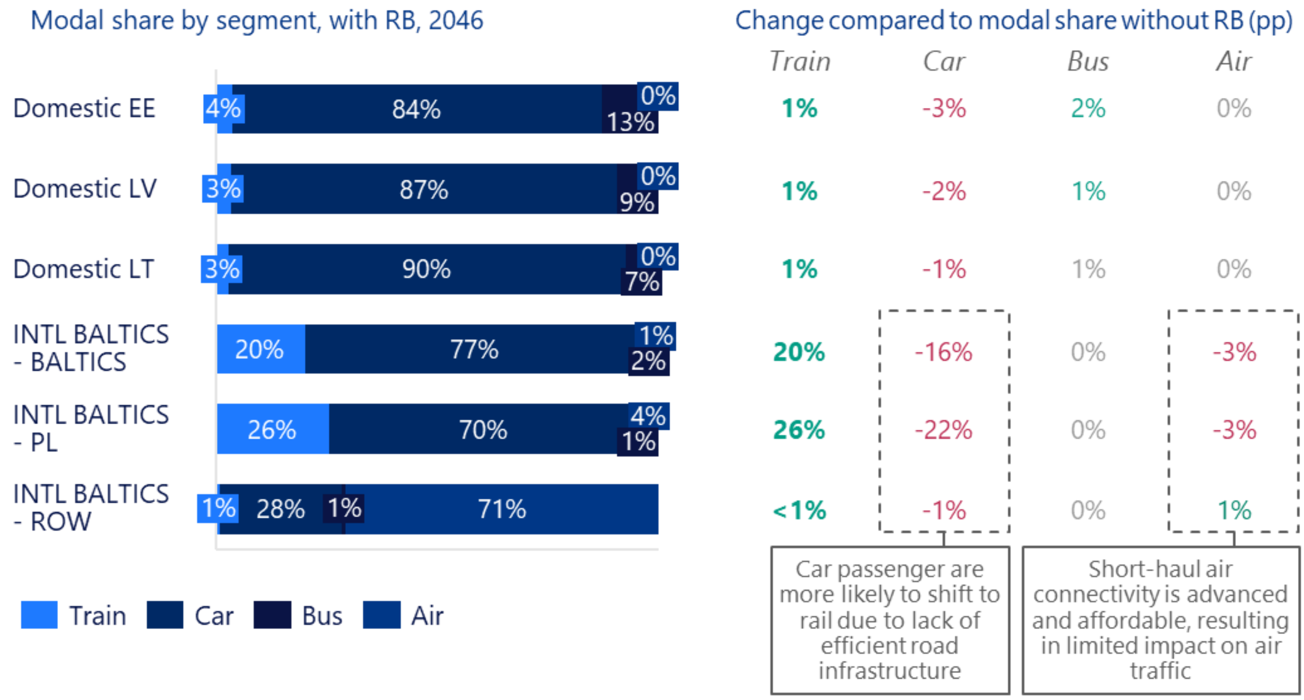


Figure 74: Modal share impact of RB Phase 1 in O/D segments (Rail Baltica TDM, 2024)

Induced Demand

Besides the modal shift from other forms of transportation, **induced demand also plays a key role in driving passenger volumes** on RB services, thereby leading to additional socio-economic benefits. Induced demand describes the increase in passenger transportation directly attributable to the new RB infrastructure. It accounts for additional passengers who choose to travel due to the availability of RB, who otherwise might not have opted to travel in the absence of RB.

In 2031, the RB project is expected to **induce an additional 0.9% in total passenger demand** (see following figure). This surge is due to the availability of the new infrastructure and is calculated by comparing scenarios with and without RB, while factoring in GDP per capita growth and demographic changes, such as a population decline. These factors somewhat limit induced demand as they affect the segment of the population that would travel solely because of RB.

The **peak of this induced demand** is predicted to occur by 2046, when the induced demand is expected to reach 1.2% of total pkm, in the Baltics followed by a stabilization at 1.0% from 2056 onwards. This trend indicates a moderate but sustained impact of RB on passenger travel patterns over the long term, with a gradual stabilization as the market adjusts to the new infrastructure.

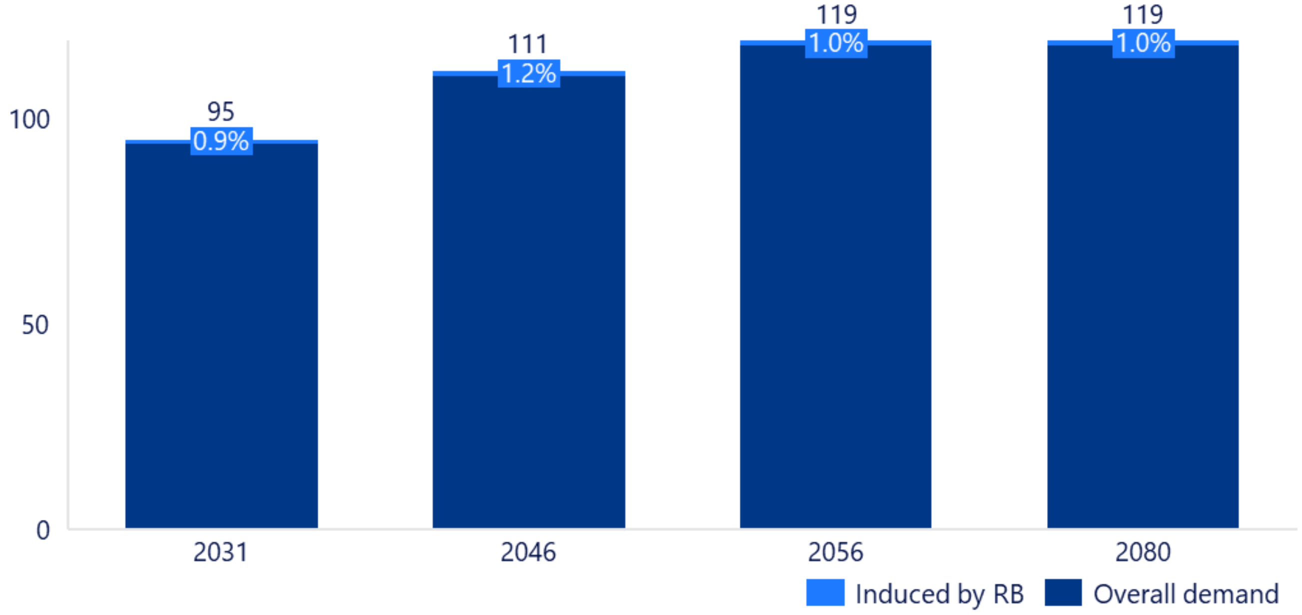


Figure 75: Overall passenger transport demand and demand induced by RB Phase 1 without ramp-up (Rail Baltica TDM, 2024)

Both modal shift and induced demand play a crucial role in boosting traffic volumes for RB, directly impacting its financial performance and the social benefits it brings to the passenger transport sector. Modal shift attracts travelers from various transport modes to RB, while induced demand generates new passenger journeys due to RB's availability. The upcoming subsection will examine RB's impact on the freight transport sector in a similar manner to provide a comprehensive understanding of both markets. This analysis will then conclude the groundwork for estimating the project's financial and socio-economic impact.

9.5.2 Freight

This chapter offers a **comprehensive forecast of freight traffic on Rail Baltica**, estimating the projected traffic on the Rail Baltica line, characteristics of typical cargo, and the traffic distribution across the various sections and stations. The chapter then assesses the impact on modal share by comparing scenarios with and without Rail Baltica, examining shifts among all relevant transport modes in the corridor. Additionally, the chapter explores induced demand to understand how Rail Baltica's introduction is expected to generate additional freight demand.

Forecasted Traffic on RB

Freight demand on the RB network is projected to grow steadily from 2031 onward and reach a steady state by 2056. In this period, freight traffic will be predominantly driven by unitised goods, which account for 64% of the freight ton-kilometers, underscoring their importance in the RB freight system. Non-unitised goods comprise the remaining 36%, contributing significantly but to a lesser extent versus unitised freight.

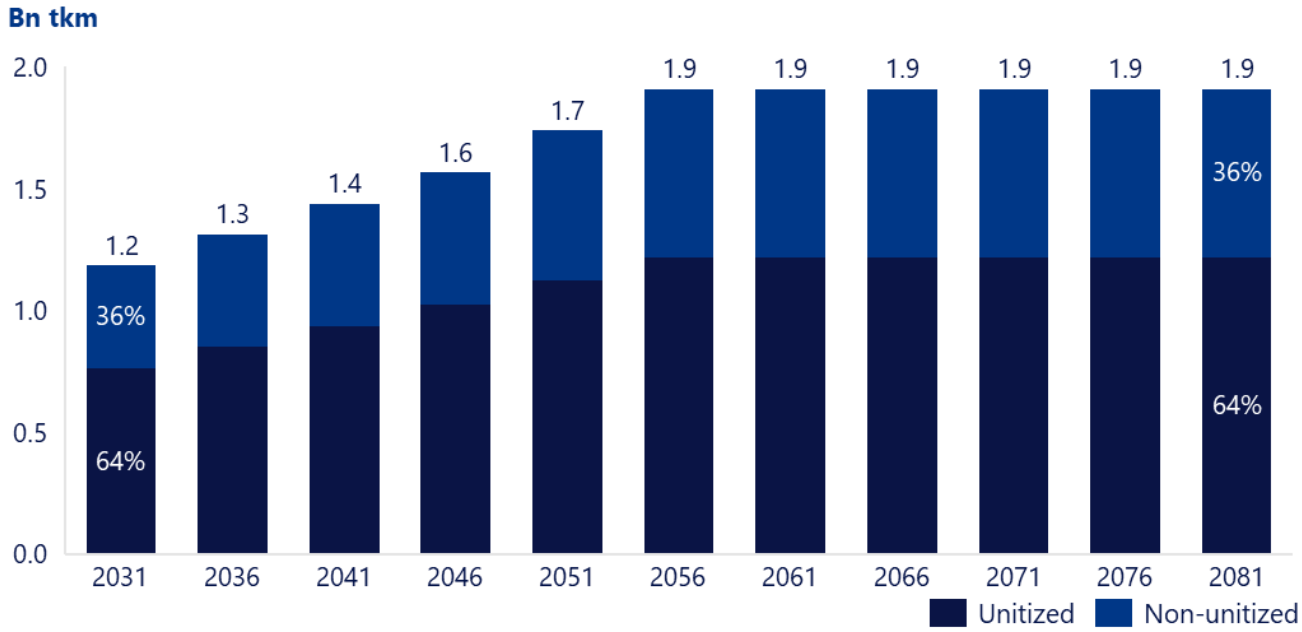


Figure 76: Forecasted freight traffic on RB Phase 1 services without ramp-up, bn tkm (Rail Baltica TDM, 2024)

In terms of freight volume on the RB Phase 1 network, it's expected to **handle 9.2 million tons of cargo annually by 2046** across two main freight types. While non-unitised (bulk) goods represent a higher volume with 7.3 million tons, reflecting their significance in terms of unique tons transported, unitised goods are still the primary revenue drivers with longer distances but lower, 1.9 million tons of cargo annually. Their importance is underscored by longer average trip distances and generally lower weight per shipment. This contrast highlights the varied cargo profile on the RB network, where unitised goods are key for efficiency and revenue despite non-unitised goods having a larger volume.

Analysis of the **sources of these freight volumes and load distribution** on the RB network shows that most cargo is directed towards Europe. The southern flank of the mainline bears a heavier freight load, indicative of the substantial volume of cargo originating from this region. However, significant freight movement is also noted towards the northern part of the line, indicating that the RB network plays a crucial role in channeling cargo from all three Baltic states towards European destinations. To accommodate freight flow dynamics, the number of freight trains is expected to vary by segment (see figure below).

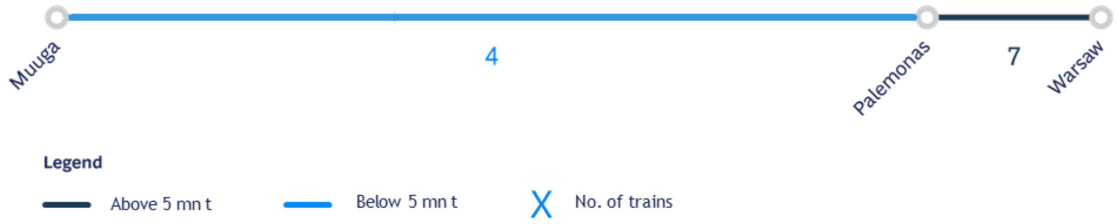


Figure 77: Freight volumes and number of trains on RB Phase 1 sections in 2046, tons (Rail Baltica TDM, 2024)

To understand **freight dynamics driving traffic volumes on the RB network**, the next figure provides insights into the share of key origin-destination regions within freight volumes captured by RB. Movements between the Baltic states, Asia and Eastern Europe contribute 78% to total freight volumes, followed by flows connecting the

Baltics with Western Europe and Scandinavia. While these flows are dominated by bulk commodities, RB also plays an important role as a transit facilitator of unitised goods, between Eastern Europe and Asia in particular.

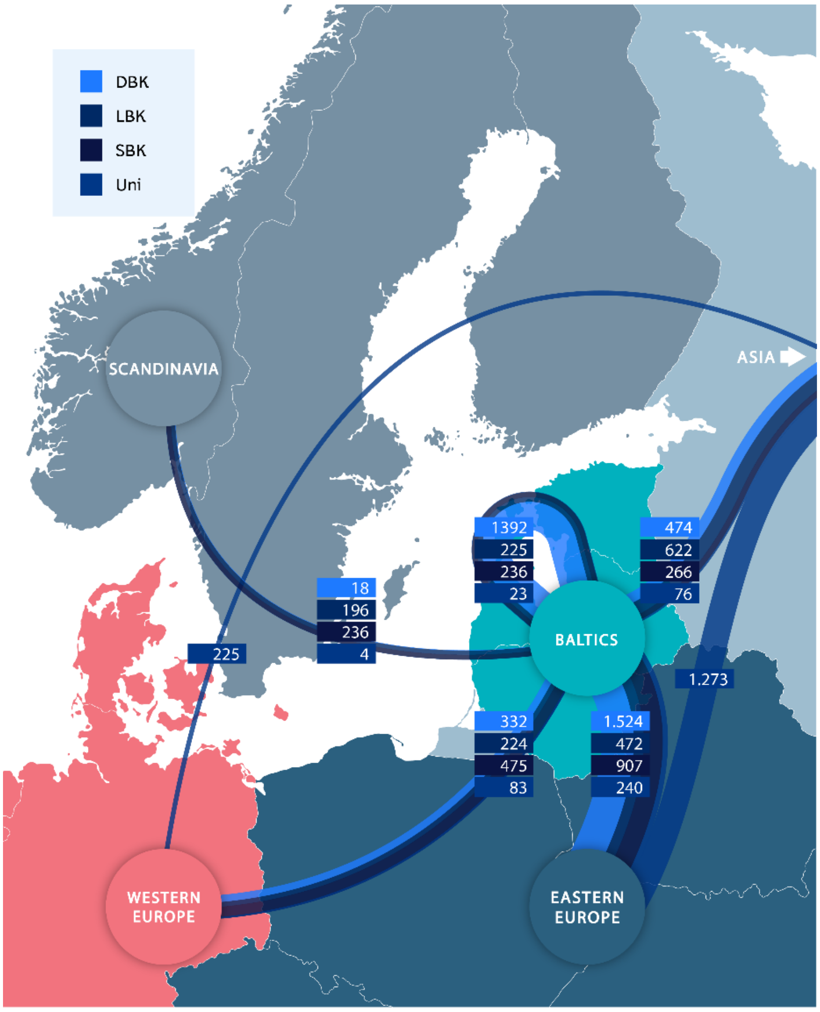


Figure 78: Annual RB Phase 1 freight volumes by origin and destination[60], bidirectional, 2046, k tons (Rail Baltica TDM, 2024)

Freight **flows captured by RB Phase 1 are part of regional freight corridors** with a potential to transit through the Baltic states. In this context, the next section analyzes major routes and markets served by RB. Subsequently, an assessment of modal share and induced demand is undertaken to determine how RB affects transportation choices and boosts freight volumes. This analysis will offer a comprehensive picture of RB's impact on both regional and international trade.

Corridor Analysis

Trade in the Baltic region is channeled through several key transport corridors enabling the efficient movement of diverse goods and commodities. A close examination of cargo volumes and types across these

[60] Western Europe includes European countries west from Germany, Austria and Italy, as well as Americas. Asia includes Russia, Turkey and all countries eastwards.

routes offers insights into the region's trade dynamics. Notably, RB's potential is derived from a combination of intra-Baltic trade and pass-through traffic. In this chapter, each corridor is analyzed, emphasizing their importance and the predominant commodities they handle.

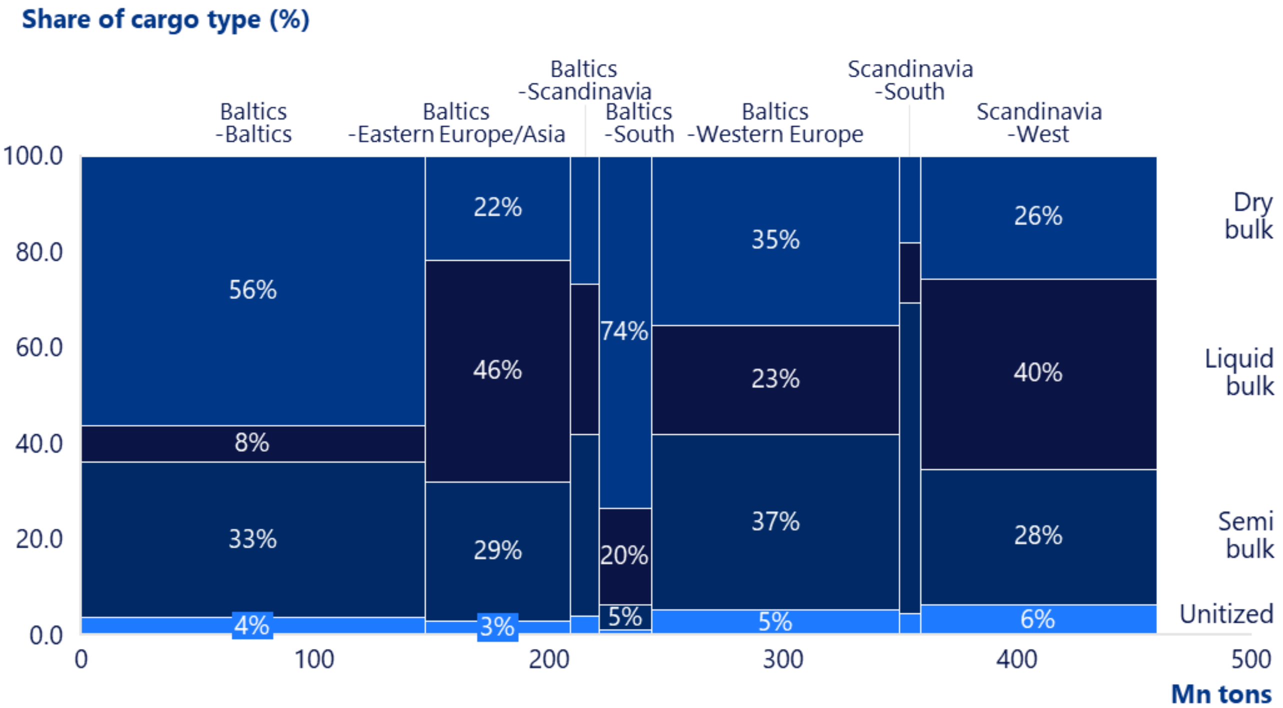


Figure 79: Trade flows across relevant corridors and share of cargo types in 2046, including both RB traffic and other transport modes (Rail Baltica TDM, 2024)[61]

The **Intra-Baltic corridor,** handling approximately 147 mn tons of cargo annually, is predominantly characterized by dry bulk commodities, accounting for 56% of its volume, making it responsible for a significant portion of the trade. Additionally, the presence of semi-bulk cargo, comprising 33% and including machinery, construction equipment, and packaged goods, highlights the vibrant internal trade within the Baltic region. In the context of intra-Baltic trade, RB services have a high potential to contribute to the movement of freight along the North-South axis.

The **Baltics – Eastern Europe/Asia corridor**, handling around 62 million tons annually, leans heavily towards liquid bulk commodities at 46% of its volume, implying a substantial exchange of resources such as fuels, oils, or chemicals between the Baltics and the Eastern regions. Dry bulk at 22% of the overall volume further diversifies the corridor due to the extensive transportation of minerals or grains, reflecting the corridor's importance in resource exchange. In this corridor, RB is expected to serve as a connecting/last-mile/first-mile segment.

Handling a volume of approximately 13 million tons annually, the **Baltics - Scandinavia corridor** stands out with its dominant semi-bulk share at 38% of its volume, indicating frequent movement of large containers or packaged goods, possibly encompassing machinery or electronics. While volumes across the Baltics – Scandinavia corridor

[61] Sum of parts might not add up to the subtotals and totals due to rounding.

are limited, the geographic layout and the share of unitised and semi-bulk freight support the potential positive impact of modern rail infrastructure along the North-South axis.

At 22 million tons annually, the **Baltics – Southern Europe corridor** is primarily an axis for the trade of dry bulk commodities, constituting 74% of the trade, driven by essential dry commodities like grains, coal, or ores, which are frequently transported, marking the corridor's role as a primary route for crucial Baltic imports and exports. RB can contribute to delivering goods through Poland without changing gauges at the PL/LT border, increasing the competitive edge of rail transport along the corridor, as well as feeding deep-sea routes through Baltic port connections.

Handling about 106 million tons annually, the **Baltics - Western Europe corridor** displays a balanced trade portfolio. With semi-bulk leading at 37% of its volume, it is likely that goods such as machinery or equipment are predominant. The added presence of dry and liquid bulk further indicates a balanced exchange of varied goods, making the corridor a bridge connecting the Baltics with Western regions.

The Scandinavia - Southern Europe corridor with managing the trade of its 9 million tons annually in volume, is predominantly a semi-bulk route, as that accounts for 64% of its volume. Such a high share reflects the frequent movement of machinery, equipment, or other packaged items, making the corridor vital for connecting Scandinavia to the Southern markets and facilitating the trade of a diverse range of goods. While volumes across the Scandinavia – Southern Europe corridor are limited, the geographic layout and the share of unitised and semi-bulk freight support the potential for a positive impact of a modern rail infrastructure along the North-South axis.

Handling 101 million tons annually, the **Scandinavia – Western Europe** corridor is distinguished by liquid bulk commodities at 40% of its volume. That significant share reflects the transportation of fuels, chemicals, or other liquids. The corridor's dry bulk and semi-bulk components further enrich its trade profile, making it a vital passage for a balanced exchange of goods with the Western regions. Offering the possibility to connect to maritime routes and the 1520 mm network in Muuga/Tallinn, RB would enhance freight routes between the two regions.

While bulk commodities dominate in volume across Baltic trade corridors, the **importance of unitised cargo in the RB context** is undeniable. Although smaller in volume, unitised cargo often carries higher-value goods that demand speed, security, and careful handling. Businesses favor unitised cargo for its efficient transportation and quick turnaround at ports, which aligns with the demands of fast-paced international trade. This type of cargo, offering logistical ease, particularly benefits shipping operations.

The next chapter on modal share explores how these types of cargo influence transportation choices in the freight market. With RB's introduction, understanding these preferences is key for assessing potential shifts in the regional freight market.

Impact on Modal Share

RB's introduction is expected significantly alter modal choices across various trade corridors and for diverse cargo types. For bulk commodities, RB offers a new, potentially dominant transportation option over ships and trucks with an efficient and faster alternative. This represents a considerable shift in bulk commodity transportation. In the case of unitised cargo, RB assumes a complementary role, acting as a feeder mode for maritime shipping. Its connections to Baltic and mainland European ports enhance maritime shipping efficiency.

This strategic integration not only facilitates the movement of unitised goods but also strengthens the entire maritime shipping ecosystem.

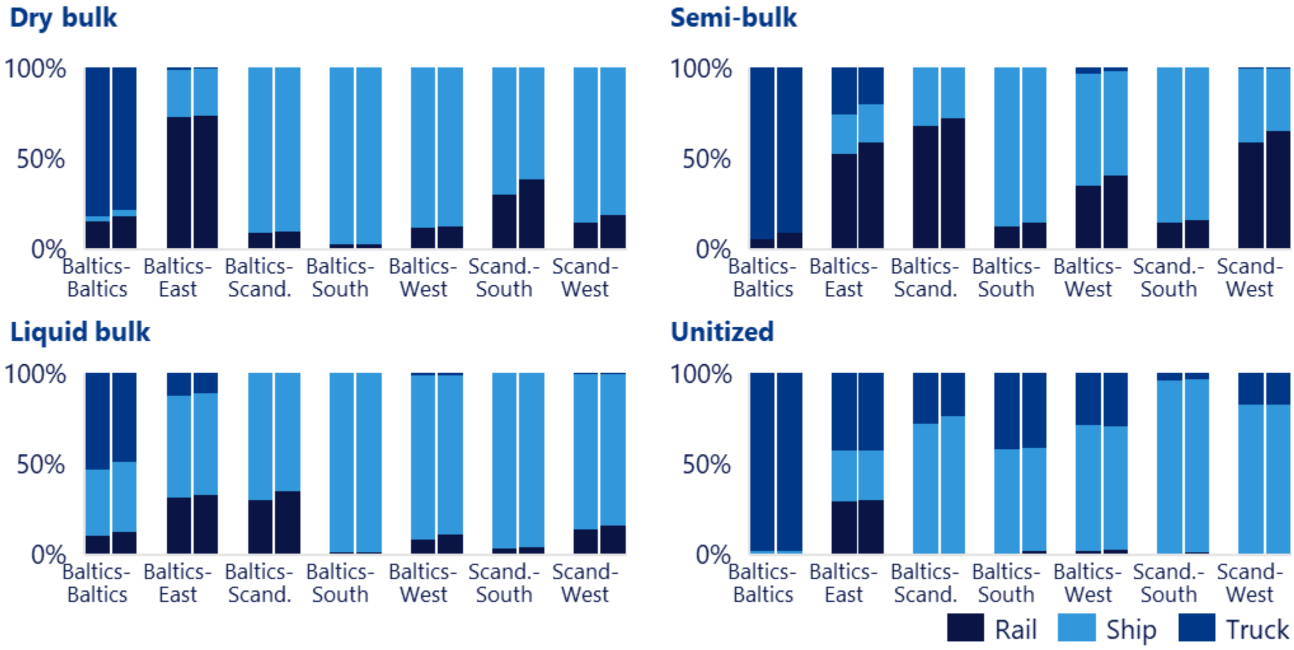


Figure 80: Modal share across cargo types and trade corridors, without (left columns) vs with (right) RB Phase 1 (Rail Baltica TDM, 2024)

As the analysis shifts from trade corridors, **RB Phase 1 is projected to capture a 0.3% share of the total freight market**, measured in ton-kilometers, within the three Baltic states. The highest market share for RB within the region is expected in Estonia at 0.6%, followed by Lithuania at 0.4%, and Latvia at 0.2%.

The market share will be predominantly drawn from ships and trucks, with existing trains also capturing additional market share by connecting to the new North-South corridor. Despite the skew in ton-kilometer measurements due to the longer distances associated with sea transport, these aspects have been accounted for in the modal share analysis for cost-benefit assessments. From 2031 to 2080, no significant changes in modal shifts are expected, indicating a consistent impact of RB on regional freight transportation.

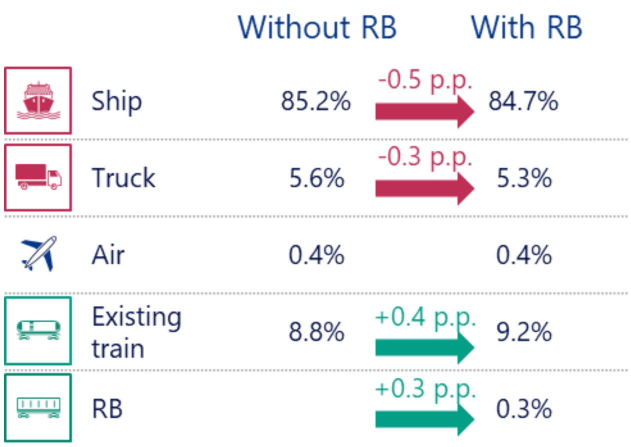


Figure 81: Market share of alternative transport modes with and without RB Phase 1 in freight transportation in 2031, without ramp-up (Rail Baltica TDM, 2024)[62]

Analyzing the **modal share impact of RB Phase 1 within the geographic boundaries of the three Baltic states**, the focus is on the modal share within land-based transportation modes, encompassing road and train. In this context, RB is expected to achieve a market share of between 1%-5% in the Baltic states' land transportation sector. Estonia, in particular, with its lowest existing share of 1520 mm rail transportation, is anticipated to experience the highest market penetration by RB. Conversely, the market share potential for RB in Latvia and Lithuania is somewhat constrained by their existing rail infrastructure.

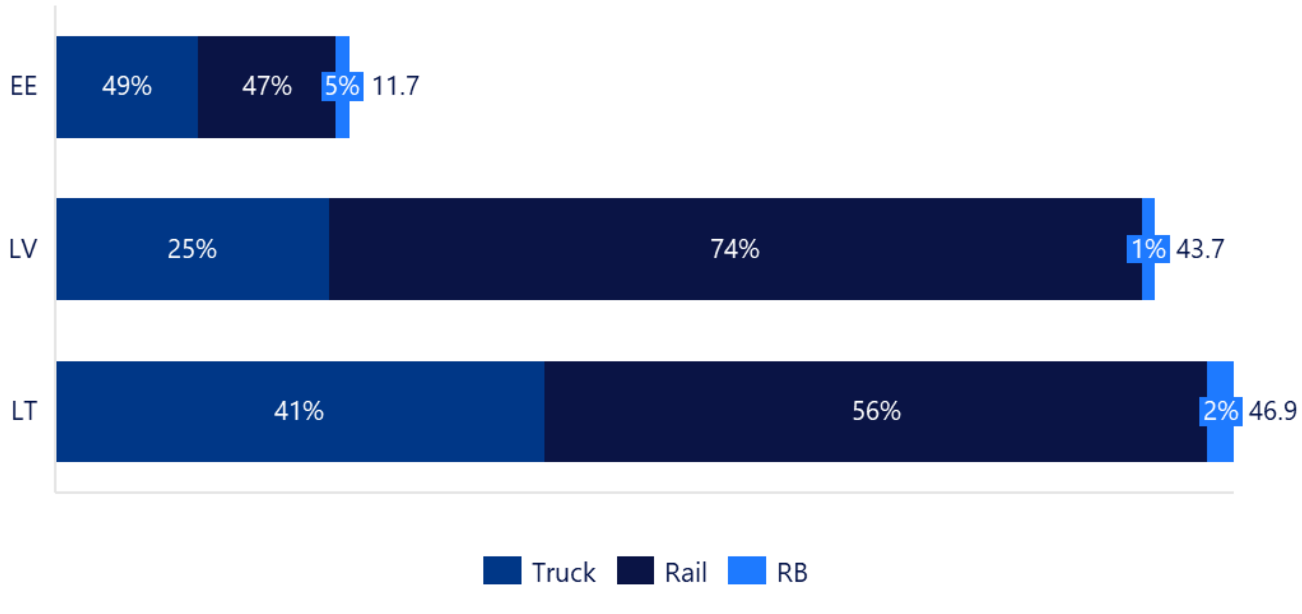


Figure 82: Yearly tkm per transport mode 2056-2080 (Rail Baltica TDM, 2024)

[62] Values might not add up due to rounding.

Induced Demand

Beyond influencing modal shifts in existing trade flows, RB Phase 1 is also anticipated to generate additional demand for **land-based freight transportation**. Analysis of this induced demand indicates that RB Phase 1 will increase land freight market volumes. Upon the start of operations, **an induced demand of 0.6% is expected**, increasing to 2.5% by 2056. These projections collectively highlight the positive impact RB is likely to have on freight market volumes in the region.

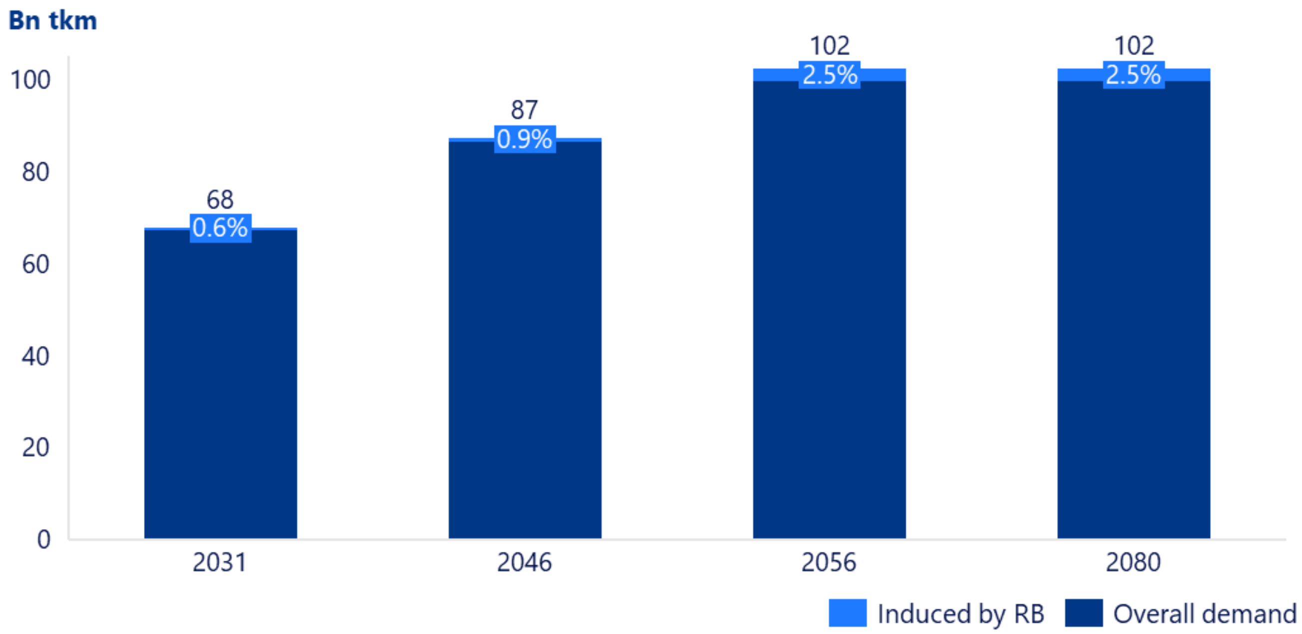


Figure 83: Induced demand from RB Phase 1 on the land freight transportation market – in bn tkm (RB, 2023)

Following the demand analysis providing a clear understanding of freight volumes and modal shifts, including intra-Baltic, Baltic to/from external countries, and traffic between external countries transiting through the Baltics, the **next chapter presents the financial analysis of RB** within the CBA framework. This assessment will translate projected demand into specific financial outcomes and benefits.

10 Financial Analysis

The *Financial Analysis* chapter provides insight on the fiscal dynamics, offering a comprehensive overview of the financial health and performance of its core components. This chapter explores three pivotal dimensions of RB's landscape: passenger services, freight services, and the facilities that underpin its operations. All figures in this chapter come from financial cost-benefit analysis unless stated otherwise.

10.1 Infrastructure Manager Financial Analysis

The IM financial analysis provides a comprehensive overview of the project's financial landscape, consolidating all revenue and cost elements associated with passenger and freight services, as well as facility operations. This holistic approach allows for a detailed examination of the project's financial performance across all service lines and infrastructure components. A particular focus is placed on the *Asset Renewal & Maintenance* subsection, as it plays a pivotal role in shaping costs. Additionally, the calculation of the track access charges is thoroughly explored, given its significant influence on revenue.

The financial analysis of RB evaluates the operating profit generation of the project from the perspective of the IM. The operating profit is a financial indicator that reflects the health and sustainability of operations. In all years, operating profit is negative, which reflects the impact of numerous influencing factors on revenue and OPEX, such as minimum break-even TACs being higher than prices charged to shippers / end users both in passenger and in most of the freight segment, lack of terminal revenues due to only one freight terminal operating under RB ownership. Operating profit does not consider interest expenses and asset renewal costs. This profit arises from the efficient utilization of assets, effective maintenance, and the consistent delivery of railway services. During regular years, the IMs strive to keep the operating profit positive.

The revenue and cost components are detailed to reflect the most realistic picture of the operations, including passenger & freight service lines and passenger station & freight terminal management. Each component of cost is modelled separately to ensure transparency and visibility.

The operating expenses (OPEX) components are the following:

- Personnel costs
- Cost of materials & Maintenance
- Utilities
- ICT

Operating cost elements such as personnel expenses, cost of materials & maintenance, utilities, and ICT expenses are modeled at a country level, reflecting the practicality and accuracy of this approach. However, due to the complexity of allocating these costs directly to specific service lines, a more technical methodology is employed. All operating expenses are allocated based on the number of train kilometers per each service line within each country. This allocation method offers a transparent and equitable way to distribute costs, ensuring that each service line contributes proportionally to the expenses incurred within its respective country, aligning with operational realities and resource management in the railway project.

The notable peaks in OPEX can be primarily attributed to the structured asset renewal and maintenance schedule. These planned maintenance activities, while essential for ensuring the longevity and reliability of the railway infrastructure, often result in concentrated expenditures during specific periods – in RB's case, these would occur in 5-year periods, from 2048-2052 and 2068-2072. The spikes in OPEX, therefore, reflect the project's proactive approach to asset upkeep and safety, underlining the significance of strategic asset management in maintaining the overall operational integrity of the railway network. Further details can be found in the *Asset Renewal & Maintenance* subsection. The major investment events are spent across 5 years which results in higher maintenance cost in those years.

The following graph shows the revenue generated and OPEX on an annual basis for the IM.

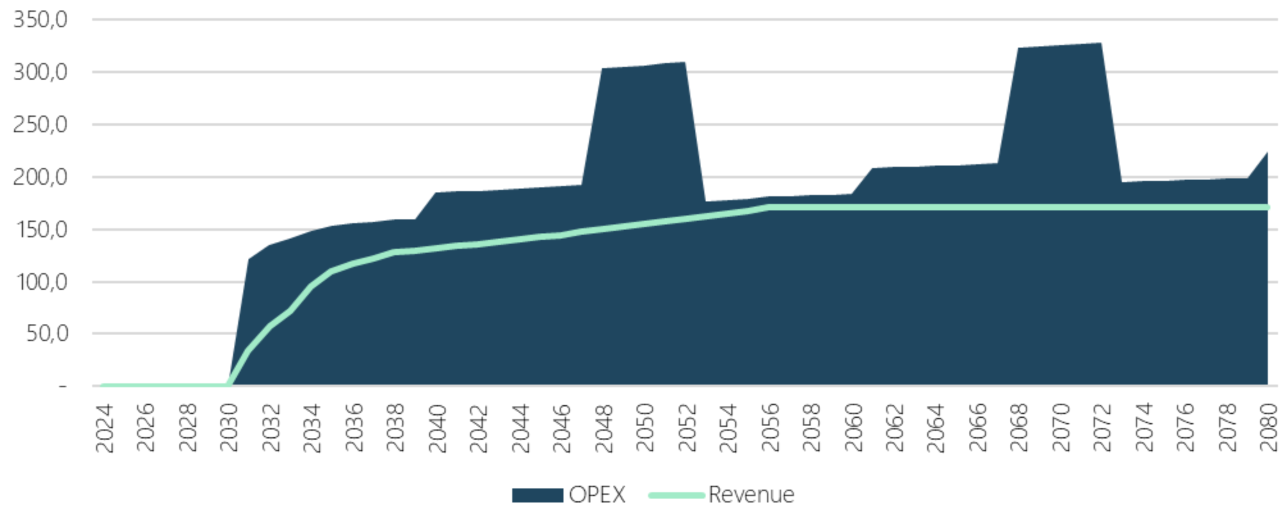


Figure 84: RB infrastructure manager cash flow components, EUR mn

In 2039, the ramp-up of each service line is completed, becoming the first steady-state year, forecasted to bring in EUR 129.5 mn in revenue. Passenger services, including high-speed trains, night trains, and regional trains, play a substantial role, bringing in EUR 39.1 mn in revenue when reaching their steady state in year 2039. On the other hand, the freight segment revenue is more than 25% higher (EUR 48.9 mn) than its passenger counterpart, it contributes to the project's economic stability in a more substantial way, as it is averaging a financially profitable service throughout the operational years.

The majority of OPEX is contributable to cost of materials & maintenance (~77% of OPEX through 2080). The remaining elements, which include personnel costs, utilities, ICT, and the operational expenses tied to passenger stations and freight terminals, collectively form a group of relatively minor contributors in comparison.

An examination of the following table reveals that project revenues fall short of operational expenditures (OPEX). Further revenue increases would cause decline in demand; thus, passenger fares must remain accessible to reap not only the project's financial benefits but also the economic ones. Consequently, passenger ticket prices and freight charges will need to be subsidized by the states to ensure demand for project services.

The following figure summarizes key cash flow components.

EUR mn	2039 (steady state)	2031	2040	2050	2060	2070	2080
Revenues	**130**	**34**	**131**	**155**	**170**	**170**	**170**
Passenger track access charges	39	14	40	46	50	50	50
Freight track access charges	49	6	50	60	67	67	67
Passenger stations	4	4	4	4	4	4	4
Freight terminals	25	3	25	32	37	37	37
Ancillary revenues	4	4	4	4	4	4	4
Electricity resale	10	4	9	9	9	9	9
OPEX	**159**	**121**	**184**	**306**	**183**	**326**	**224**
Mainline	142	116	167	286	159	302	200
• Personnel costs	8	5	8	8	8	8	8
• Cost of materials & Maintenance	115	99	140	258	130	273	170
• Utilities	17	12	17	17	18	18	18
• IT	2	-	2	3	3	3	3
Passenger stations	3	3	3	3	3	3	3
Freight terminals	14	2	14	18	21	21	21
Operating profit	**(30)**	**(87)**	**(53)**	**(152)**	**(13)**	**(156)**	**(53)**

Figure 85: RB infrastructure manager cash flow components, EUR mn

10.1.1 Track Access Charge Calculation

It is important to clarify that the current document does not aim to formulate a track access charge methodology for RB. Instead, its primary objective is to assess potential track access charges from various perspectives, essentially establishing what can be regarded as a foundational, reasonable price charges to assess RB's business case.

Various approaches were considered during the financial analysis to calculate passenger and freight TACs.[63] The selected methods used in the financial analysis chapter, described below, aim to identify the TAC that the market can bear, based on TAC percentage of non-subsidized operators' revenue as benchmarked in the EU aligned to RBR's traffic demand model assumptions.

The calculation approach for passenger TAC involves the following main steps:

1. The final consumer price (price of traveling 1 km) is multiplied by the ratio of TAC incidents on revenues (the percentage of revenues paid to TAC by an unsubsidized operator)
2. Country specific final consumer prices are then calculated dividing the final consumer price by the country specific VAT
3. Country specific final consumer prices are finally converted from passenger km to train km by multiplying for the number of passengers per train (passenger km/ train km)

As the net final consumer prices can differ in each country, the minimum is used to calculate TAC for high speed and night train segments, and the passenger kilometer weighted average for the regional segment as requested by RBR.

The calculation approach for freight TAC involves the following main steps:

1. The average of alternative transport method costs (cost of transporting 1 ton on 1 km) is multiplied by the ratio of TAC incidents on revenues (the percentage of revenues paid to TAC by an unsubsidized operator)
2. The resulting freight final consumer price is then converted to train km by multiplying with the country specific number of tons transported per train (ton km/ train km)

The TAC is established within a predefined range, which is determined by benchmarking against alternative transportation modes and calculating the break-even TAC. The break-even charge is designed to cover the direct costs associated with railway infrastructure. If the break-even charge surpasses the defined range, Public Service Obligations (PSOs) may be utilized to provide subsidies, thereby balancing the attractiveness of railway transport in comparison to other modes but it is important to note that the application of PSOs is subject to local legislation.

TAC calibration is a crucial process that involves a comprehensive comparison with track access charges in various countries. By referencing charges in different regions, the aim is to fine-tune the TAC to conform with prevailing industry standards and market conditions. The overarching objective is to maintain a TAC that is not only competitive and appealing to rail users but also one that closely mirrors international benchmarks.

---

[63] For the passenger segment 4 other calculation options were investigated: Final consumer price maximum returns the TDM model inputs of maximum final consumer prices adjusted with TAC % of revenue for each passenger segment; RBR study price maximum / minimum returns the maximum / minimum benchmarked TAC from the Atkins study; the manual range selection returns the value between the maximum and minimum of benchmarked TAC from the Atkins study. For the freight segment 3 other calculation methodologies were investigated: Baltic benchmark maximum / minimum returns the maximum benchmarked TAC from the IRG rail source; Baltic benchmark range selected returns the value between the maximum and minimum of benchmarked TAC from the IRG rail source.

The customer price assumptions are set on a per-country basis for the passenger and freight segments. For the high-speed and night train segments, a uniform tariff of EUR 0.10 per pkm (EUR/pkm) is applied across all three Baltic countries. A similar uniform tariff is maintained for the freight segment as well, standing at EUR 0.26 per tkm (EUR/tkm) for each of the three Baltic states. On the other hand, the regional train prices are country specific. They are set at EUR 0.08 per pkm for Estonia, EUR 0.03 per pkm for Latvia, and EUR 0.06 per pkm for Lithuania.

Country	High-speed	Night	Regional	Unitised	Non-unitised
Estonia	0.10	0.10	0.08	0.14	0.04
Latvia	0.10	0.10	0.03	0.14	0.04
Lithuania	0.10	0.10	0.06	0.14	0.04

Figure 86: RB final consumer price assumptions, EUR/pkm; EUR/tkm

The validation of final customer prices for high-speed, night, regional, unitised and non-unitised segments involved a systematic examination of alternative transport method costs at an individual country level. For passenger services, a detailed analysis is conducted on personal car, coach, and existing train options. In the case of freight, the assessment included existing rail, truck, and ship services. The focus of the validation process is on quantifiable cost factors, considering variables such as fuel prices, maintenance, and operational expenses associated with each transportation mode.

Country	Existing regional train	Coach	Car
Estonia	0.02-0.10	0.07	0.17
Latvia	0.02-0.04	0.05	0.14
Lithuania	0.03-0.08	0.07	0.14

Figure 87: Alternative passenger transport method costs, EUR/pkm

Category	Train	Truck
Unitised	n.a	0.68
Non-unitised	0.04	0.14

Figure 88: Alternative freight transport method costs, EUR/tkm

The calculation of TAC involves adjusting the final customer prices assumed in the traffic demand model based on TAC incidents on the revenue of RUs, which are benchmarked against the index in each segment, encompassing both passenger and freight services. The objective is to establish a pricing structure that is sustainable and equitable. However, the results reveal a significant disparity in this regard.

The calculated TAC indicates that market pricing structure falls short of the break-even point in the passenger segments and in most freight segments. These insights highlight the complexities of balancing cost-recovery in passenger services while maintaining a sustainable financial footing in freight operations.

Benchmarks show the range of 19-33% TAC incident[64] for passenger services, and 26-43% for the freight segment. When applying the assume TAC incidents on revenue for both passenger and freight segments, the average is used for the most realistic scenario, 26% and 35% respectively.

Category	Minimum	Maximum	Average
Passenger TAC incidents on revenue	19%	33%	26%
Freight TAC incidents on revenue	26%	43%	35%

Figure 89: RB passenger TAC incidents on the revenue of RUs (IRG-Rail, 2022)

The calculation of TAC assumes a uniform TAC for passenger services as all service lines have cross-border routes. Furthermore, the uniform assumption serves as a measure to ensure the fluidity of services provided to potential RUs utilizing the infrastructure. In conclusion, the regional TAC for the passenger segment is the lowest (EUR 2.08), followed by the high-speed line (EUR 4.09), and finally the night line (EUR 9.80) with a TAC approximately 5 times higher than the regional line.

The following table summarizes each service line's associated TAC in the first steady-state year of the project:

Category	High-speed	Night	Regional
TAC	4.09	9.80	2.08

Figure 90: RB passenger TAC per service line in 2039, EUR/train-km

The pricing for the freight segment is significantly higher in most segments, with unitised cargo charges being higher than its non-unitised counterpart in each country. This is most likely driven by higher track occupancy times of unitised cargo. The highest unitised TAC is observable in Latvia (EUR 32.37) and lowest in Estonia (EUR 23.18). For non-unitised, the highest value for TAC is in Estonia (EUR 16.50) and the lowest in Latvia (EUR 16.20).

Country	Unitised	Non-unitised
Estonia	23.18	16.50
Latvia	32.37	16.20
Lithuania	26.20	16.31

Figure 91: RB freight TAC per service line in 2039, EUR/train-km

The TAC structure incorporates two components: a section covering direct, and a TAC mark-up, applied when the primary TAC surpasses the portion covering direct costs. This mark-up is essentially an adjustment based on the maximum rate the market can bear, aligning the pricing strategy with market conditions to optimize profit margins. This approach facilitates a flexible and market-responsive pricing strategy, adept at navigating the fluctuating market dynamics.

[64] TAC incidents on revenue (TAC cost for operators/revenue of operators) is based on international non-subsidized TAC benchmarks and expert analysis

In all countries, the break-even TAC for both unitised and non-unitised segments are the same, lowest in Estonia a with a yearly average of EUR 10.30 and highest in Latvia with EUR 38.13.

Country	Estonia	Latvia	Lithuania
TAC	10.30	38.13	30.41

Figure 92: RB freight break-even TAC yearly average, EUR/train-km

Comparing the TAC mark-ups of each country, it reveals that only the Estonian unitised segment can operate with continuous profitability, but the non-unitised segment also turns negative only during major investment events. On the other hand, it is visible from the figures below that unitised TAC mark-ups in Latvia and Lithuania turrn negative during major CAPEX events, and the average mark-up is lower than in Estonia in positive operating years. As the actual TAC is lower than the break-even, no TAC mark-up is applied for the non-unitised segment in any of the examined operational years in Latvia and Lithuania.

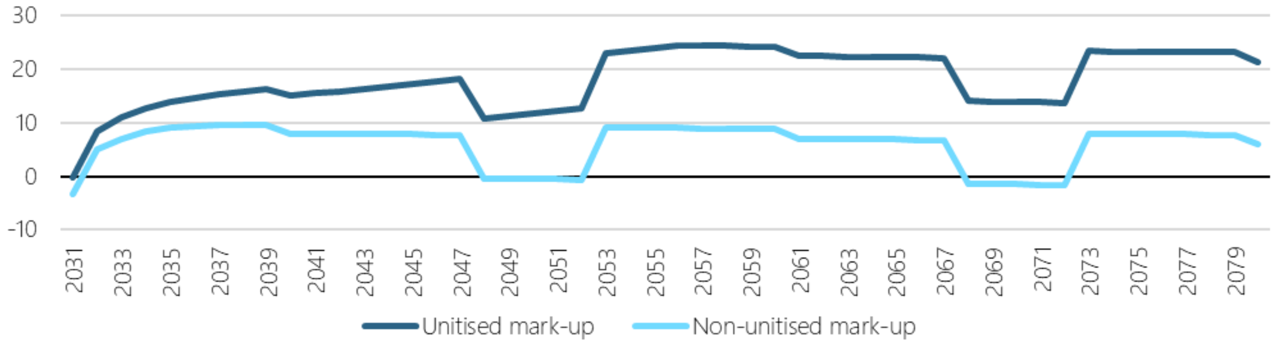


Figure 93: Estonia freight yearly TAC mark-ups, EUR/train-km

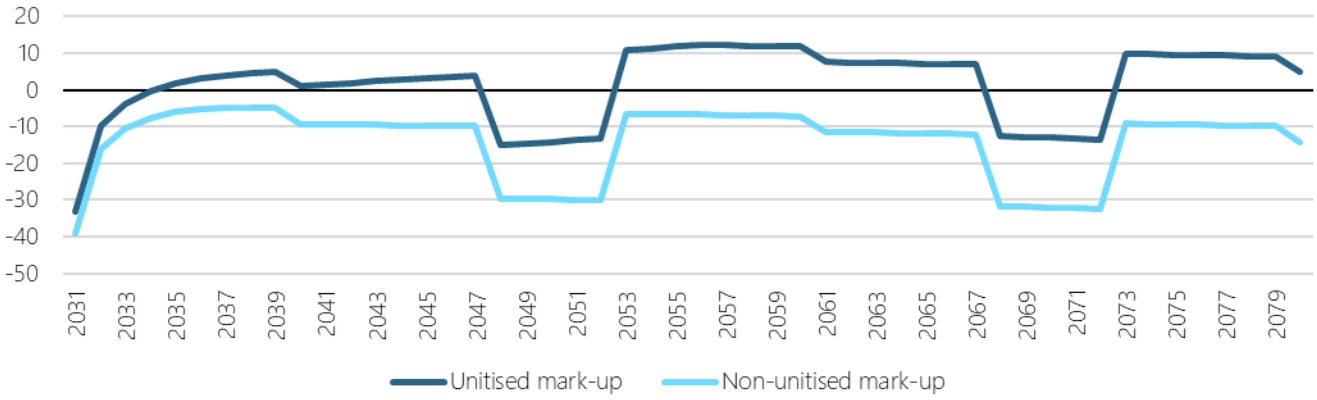


Figure 94: Latvia freight yearly TAC mark-ups, EUR/train-km

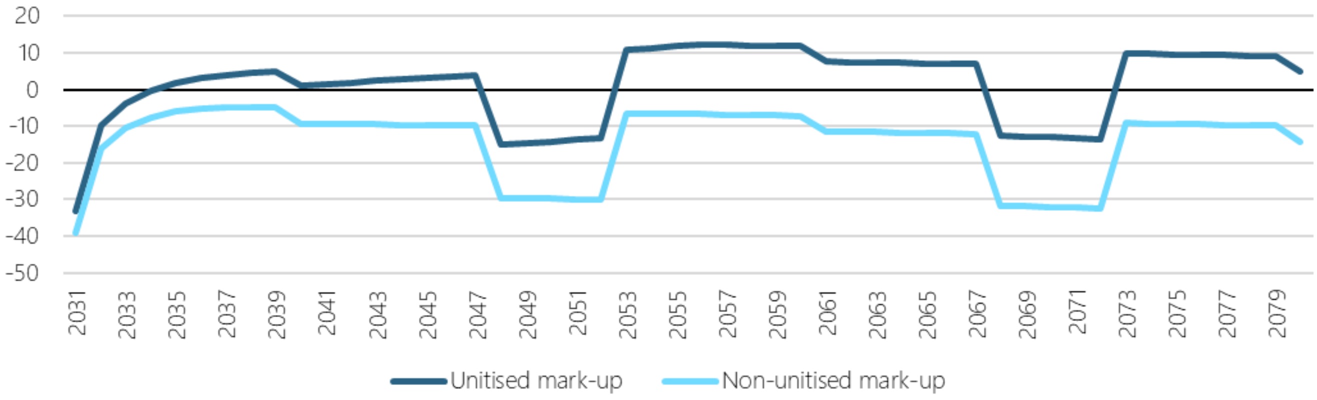


Figure 95: Lithuania freight yearly TAC mark-ups, EUR/train-km

Compensation Benchmarking

The operation of the passenger segment is forecasted to need subsidies in the current understanding. This analysis is focused on evaluating the potential strategies for allocating the subsidies between RUs and IMs. It should be highlighted that the contemplated allocation does not imply a reduction in the subsidy amount. Rather, the intention is to explore different avenues for distributing the subsidy amount between RUs and IMs, without diminishing the overall financial support extended to the project.

The following table delineates the distribution of compensation in various countries, segmented into two categories: the allocation to RUs and the allocation to IMs. On an aggregate level, the average compensation paid to RUs stands at a dominant 91%, leaving a relatively smaller share of 9% for IMs.

Category	Share of compensation paid to railway undertakings	Share of compensation paid to infrastructure managers
European average	91%	9%

Figure 96: European compensation benchmarking (IRG-Rail, 2022)

10.1.2 Asset Renewal & Maintenance

Asset renewal and maintenance of the infrastructure is a critical component of ensuring safety and efficiency. Based on constant collaboration with topic experts, the assumptions outlined are detailed below.

To effectively manage this process, it is important to categorize the Capital expenditures (CAPEX) items into three distinct buckets: civil assets, other railway systems, and technology-related components. Each of these asset categories has its own expected lifetime, and asset renewal and maintenance schedule.

Civil Assets

- Description: These are the foundational elements of the railway track, such as the tracks themselves, bridges, tunnels, and other structures. Given their long lifespan, they require less frequent replacement and extensive maintenance.
- Useful asset lifetime: 100 years
- Asset renewal schedule: Year 1-9: 0.4%, Year 10-17: 1%, Year 18-22: 2%

Other Railway Systems

- Description**:** This category encompasses components like signaling systems, electrification, and communication networks. These systems have a shorter lifespan and require more frequent updates to ensure the railway's operational safety and efficiency.
- Useful asset lifetime: 40 years
- Asset renewal schedule: Year 1-17: 2%, Year 18-22: 4%

Tech-Related Components

- Description**:** The technology aspect of railway operations, including software systems and electronic equipment, falls under this category. With rapid advancements in technology, these assets require more frequent upgrades to stay up to date and maintain operational integrity.
- Useful asset lifetime: 30 years
- Asset renewal schedule: Year 1-17: 3%, Year 18-22: 5%, Year 23-30: 3%

To maintain the railway track's optimal condition, a rigorous asset renewal and maintenance schedule is applied, that ensures the overall depreciation of the assets is consistently addressed. The key principle is that the total annual expenditures for asset renewal and maintenance should add up to 100% of the depreciation of the respective asset category in each year keeping asset quality at its maximum.

Additionally, major investment events, are now scheduled after every 20 years, spread over 5 years, with significant investment for major asset renewal and maintenance works. These events are typically substantial, involving a replacement or significant upgrade of assets, such as signaling systems, electrification infrastructure, safety equipment and others. The value of these major investment events is set at a 2%-5% range - depending on the asset category - of the total value of the assets within the specified category. These events play a critical role in ensuring that the railway remains up to date and compliant with modern safety and operational standards.

The allocation between asset renewal and maintenance costs are the result of international benchmarking of high-speed operating European countries. The split between asset renewal expenses, accounted as CAPEX, and maintenance expenses, accounted as OPEX, is 48% and 52% respectively (IRG-Rail, 2022).

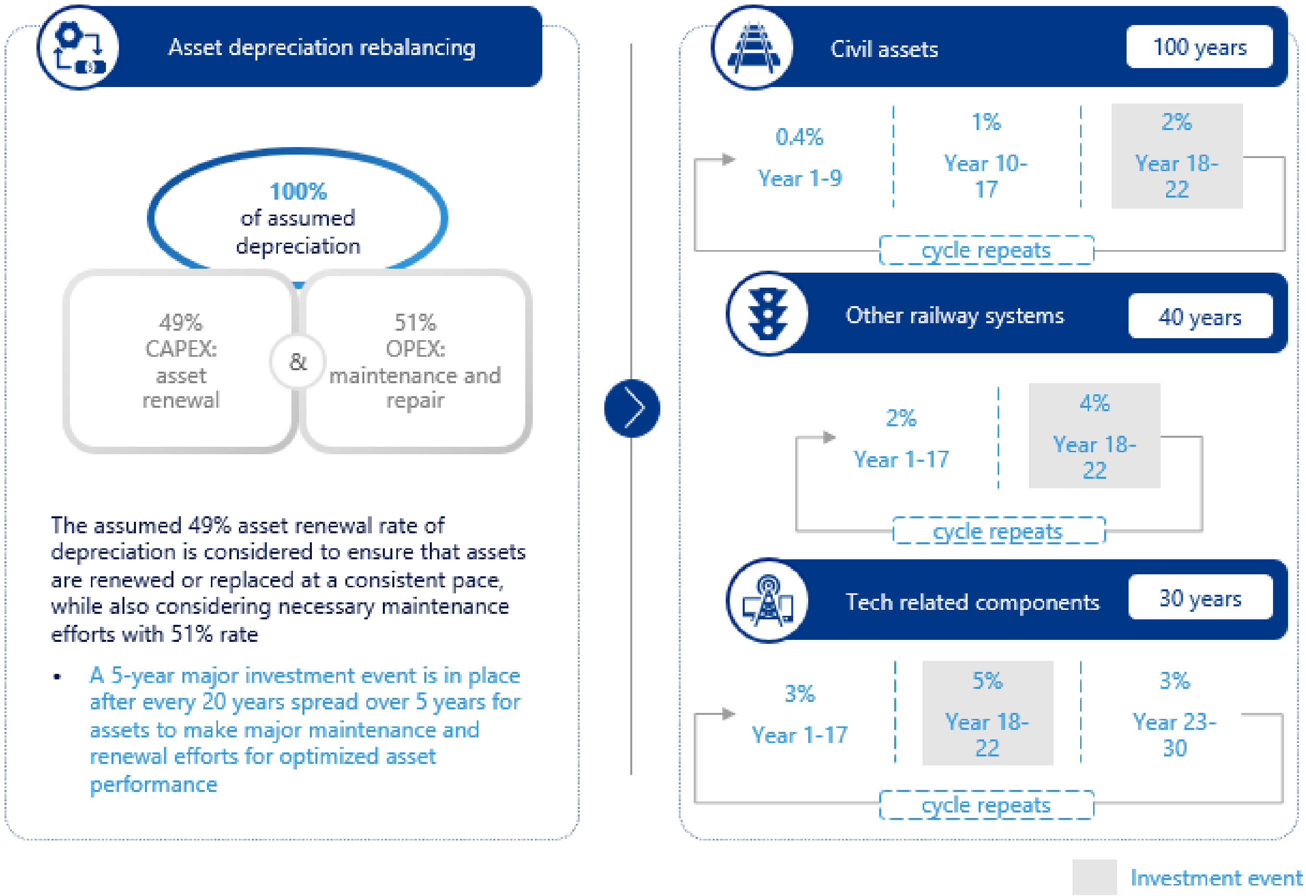


Figure 97: RB asset renewal and maintenance schedule (Consultant expert analysis)

In assessing the forecasted expenditures for RB in relation to the average high-speed maintenance and asset renewal expenditures across several European countries, it becomes evident that RB's projected costs are closely aligned with the average figures. The forecasted maintenance expenditure for RB stands at EUR 145.4 mn, which is slightly above the average maintenance expenditure of EUR 129.0 mn, but it is below of Belgium and the Netherlands. Furthermore, the asset renewal expenditure for RB, projected at EUR 137.8 mn and similar proportions can be observed with the average of EUR 122.2 mn.. This indicates a prudent yet adequate investment in asset renewal, reflecting a balanced strategy in sustaining long-term asset quality and operational efficiency.

Country	High-speed maintenance expenditure	High-speed asset renewal expenditure	Total expenditure per route kilometer
Austria	109.7 (49%)	114.3 (51%)	0.29
Belgium	183.0 (68%)	87.6 (32%)	0.35
Denmark	90.7 (62%)	56.4 (38%)	0.19
France	101.0 (40%)	149.1 (60%)	0.33
Germany	32.9 (12%)	236.9 (88%)	0.35
Italy	1.9 (3%)	58.2 (97%)	0.06
Netherlands	383.9 (71%)	153.1 (29%)	0.70
Average	**129.0 (51%)**	**122.2 (49%)**	**0.33**
RB forecast	**145.4 (51%)**	**137.8 (49%)**	**0.37**

Figure 98: Maintenance and asset renewal annual high-speed expenditure, EUR mn (IRG-Rail, 2022)

10.1.3 Train Services

The RB route after Phase 1 implementation is planned to operate 13 lines, distributed across three distinct categories: high-speed, night, and regional trains. The regional service boasts the majority with 7 lines – from which 2 lines (RIX and SAL) operating as shuttles – and leads in train frequency, as the shuttle lines and RE-EE exhibit the highest frequency with 21 and 12 train pairs daily, respectively. Following this, the high-speed category has a total of 5 lines, with lines HST1a, HST1b and HST2 being the most frequented, each having 6 train pairs per day. The night train category, however, consists of only 1 line operating 1 train pair per day.

Category	Line number	Train pairs per day
High-speed	HSP1	2
	HST1a	6
	HST1b	6
	HST2	6
	HST3	2
	Subtotal High-speed	**22**
Night train	**NT41**	**1**
Regional	RE3	6
	RE4	8
	RE4a	6
	RE4b	2
	RE-EE	12
	RIX (shuttle service)	21
	SAL (shuttle service) [65]	*21*
	Subtotal Regional	**55**
Total		**78**

Figure 99: RB train service per day (RBR project team input)

10.2 Capital Expenditure [66]

This section performs the examination of CAPEX, offering a comprehensive overview of how expenses are categorized and phased across countries. It delves into the categorization of mainline expenses per country, providing insights into the allocation of funds for infrastructure development.

Furthermore, the section explores the categorization of point-type of objects (PTO) per country (including all capital expenditures related to facilities, except for ENE and CCS expenses), shedding light on the distribution of investments in passenger stations, freight terminals, and other key elements.

Additionally, it provides a detailed analysis of the phasing of CAPEX per country, covering the construction period spanning from 2024 to 2030, and provides a qualitative summary on single-track line benefits and potential risks,

[65] SAL shuttle service is not included in the financial model, as it will operate on an existing track, which is not part of the current assessment

[66] Regarding the provided figures, the sum of parts might not add up to the subtotals and totals due to rounding.

compared to double track line. This approach ensures a thorough examination of how financial resources are allocated, reflecting the project's commitment to efficient and strategic financial planning in its development.

10.2.1 Capital Expenditure for RB Phase 1

RB CAPEX estimates for Phase 1 cover 763 km rail line with EUR 15.5 bn current expected cost (2023 mid-year price level) excluding inflation. The mentioned CAPEX and related infrastructure elements are shared across three Baltic countries and twelve design sections.

Lithuania accounts for the longest section with 292 km in length, while Latvia follows with 253 km and Estonia with 218 km length.

Estonia has two international stations, as does Latvia, while Lithuania has one (and also utilizes the existing Kaunas International Passenger Station, resulting in overall also two international stations).

Estonia also leads in the number of regional passenger stations, with a total of 12. Additionally, in Phase 1, a newly constructed freight terminal will be developed exclusively in Estonia, while a limited freight facility will be available in Salaspils, with sidings constructed.

However, to realize the full scope of Rail Baltica, including additional Point-Type-Objects (PTOs) and mainline sections, Phase 1 CAPEX already includes design, partial construction, and other preparatory cost elements. Costs associated with non-operational PTOs account for 5% of the PTO-related expenses.

The table below summarizes data received on capital expenditures, without any adjustments.

Type	CAPEX element	EE	LV	LT	Total
Mainline (ML)	ML sections, structures and elements	2 042	4 641	4 264	**10 947**
	ML Construction supervision	44	92	69	**205**
	ML Different studies	7	9	9	**25**
	Design contracts (with IVN-s)+ expertise	36	126	127	**289**
PTO	International passenger station	200	354	30	**584**
	Regional passenger station	21	33	102	**156**
	Freight terminal	84	-[67]	19	**103**
	IMF	121	98	92	**311**
	Depot	-	162	10	**172**
	Other PTO[68]	46	-	5	**51**
Global	AsBo, NoBo	2	3	2	**6**
	ENE	176	277	318	**771**
	CCS	201	220	261	**682**
	Fidic CCS and ENE	8	-	12	**20**
	Indirect cost	18	115	105	**238**
	Contingencies	80	132	110	**322**
Subtotal		**3 074**	**6 261**	**5 532**	**14 867**
Global (other)	Land acquisition	57	159	78[69]	**294**
	PISM	75	148	107	**330**
Total		**3 219**	**6 568**	**5 718**	**15 505**

Figure 100: Phase 1 CAPEX based on RB input, EUR mn (RBR project team input)

Over the past year, RB performed more comprehensive calculations and determined the total length of the project to be 951 km (route km), with 1 863 km of track, due to the double-track solution along the mainline. Phase 1;

[67] In Latvia, 2 sidings are constructed at Salaspils for freight support (EUR 8 mn allowance, included in mainline construction cost at LV DS2 DPS3 section).

[68] Other PTOs include Ülemiste Terminal infrastructure adjustment costs (from 1520 mm gauge to 1435 mm gauge) and Vilnius Airport Station related costs.

[69] Land acquisition costs for PTOs are not included, they are allocated to PTO costs.

however, aims to cover 763 km of the line with a total track length of 933 km, with the majority of the rail line being single-track. This results in a EUR 19.9 mn/rail route km estimate.

Key value categories	Estonia	Latvia	Lithuania	Total
Phase 1 length (km)	218	253	292	**763**
Phase 1 CAPEX (EUR mn)	3 219	6 568	5718	**15 505**

Figure 101: Phase 1 RBR estimated CAPEX values and railway route lengths (RBR Project Controls Estimation Team input)

Phase 1 of the Rail Baltica rail line has a CAPEX of 15.5 EUR and the scope of the project compared to the full scope target state was focused through adjustments to the mainline, primarily involving a single-track rail route and a reduction in the number of PTOs. However, the primary goal of the Rail Baltica Global Project - to connect the Baltic States with the European TEN-T rail network - remains unchanged. This objective will already be achieved with the completion of Phase 1.

The internal estimate of RB team is having a total of EUR 15.5 bn CAPEX during the construction of Phase 1 on a 763 km long railway, resulting in a EUR 19.9 mn/km CAPEX, where the majority of the line runs on a single-track. **However, considering the risk of inaccuracy and lack of clarity on assumptions taken, a review was conducted on this CAPEX estimate.** The review of RBR estimate followed the below 3 steps with the underlying adjustment drivers.

1. **Adjusting costs of significant items** based on benchmarks (ENE, CCS): **EUR 0.2 bn correction.**
    - Driven by known underestimations - costs adjusted internally and based on market benchmarks.
    - Final ENE and CCS values will be determined by finalized contracts in later project stages.
2. Conducting a **more holistic calculation**: **EUR 0.2 bn correction.**
    - By **reallocating** costs according to their nature (e.g., Mainline construction costs allocated to PTO costs were reallocated to Mainline cost bucket)
    - By **applying proportionate calculation** where there was a lack of information at mainline and global costs. However, to follow a conservative approach, if RBR assumptions had a higher value, higher values were kept.
3. Applying **correction to optimism bias (OB)**: **EUR 0.2 bn correction.**
    - Due to lack of information on PTOs and global costs, they receive OB (+15%) factor (excluding Estonian estimates, where without detailed information on the calculation methodology, but receiving the assumption of containing contingency, values were accepted.)

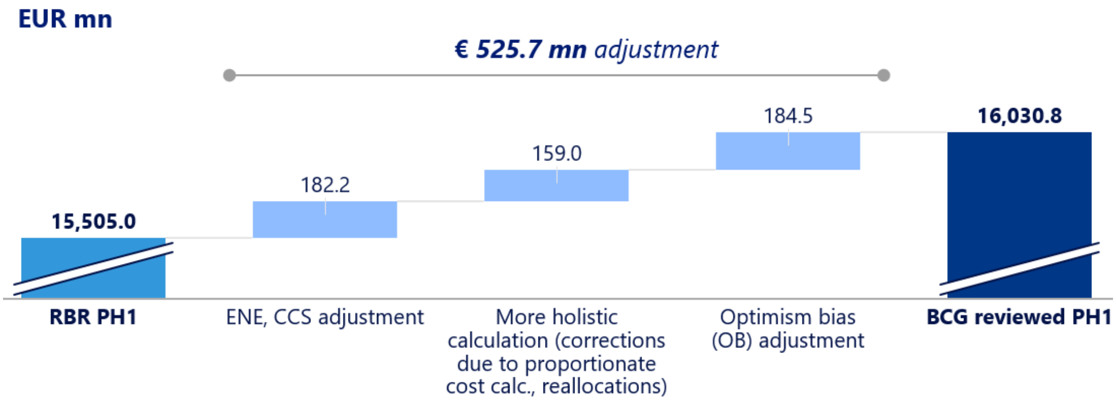


Figure 102: RB reviewed Phase 1 CAPEX and adjustments (2023 mid-year value), EUR mn (RBR Project Controls Estimation Team input; Consultant analysis)

As a result, the total adjusted Phase 1 CAPEX is estimated to be in a EUR 16.0 bn baseline value (on 2023 mid-year price levels); however, it remains to be an estimate without detailed view on estimates per country. Exact total CAPEX value remains uncertain, final cost will largely depend on factors such as[70]:

- Effective risk and cost management,
- Inflation and material costs,
- Supply chain disruptions,
- Potential project delays,
- Design modification.

RB Phase 1 CAPEX is adjusted with ENE & CCS (a net EUR 0.2 bn increase) and in optimism bias application (a net EUR 0.2 bn increase) and more holistic calculations (a net EUR 0.2 bn increase). **The resulting breakdown of the EUR 16.0 bn** after the review is listed below:

- **Mainline** CAPEX: **EUR 11.6 bn**
- **PTO** CAPEX: **EUR 1.4 bn**
- **Global project** activities CAPEX: **EUR 3.0 bn**

RB Phase 1 calculation by RBR is based on 2023 data (used for full scope CAPEX calculation and validation), therefore CAPEX values are assumed to have 2023 mid-year price levels. To be consistent with other assumptions within the cost-benefit analysis of Rail Baltica Phase 1, **CAPEX values are inflated to projected end-2023 price levels. This results in a total of EUR 16.8 bn CAPEX value** and the following values per major CAPEX categories:

- Mainline CAPEX: EUR 12.2 bn
- PTO CAPEX: EUR 1.5 bn
- Global project activities CAPEX: EUR 3.2 bn

Asset category	Estonia	Latvia	Lithuania	Total
Mainline (EUR mn)	2 287	5 142	4 731	**12 161**
PTO (EUR mn)	447	777	249	**1 474**
Global (EUR mn)	720	1 197	1 240	**3 157**
Total (EUR mn)	**3 455**	**7 116**	**6 220**	**16 791**

Figure 103: RB reviewed, end-2023 price level Phase 1 CAPEX, EUR mn (RBR Project Controls Estimation Team input; Consultant analysis)

CAPEX is dedicated to constructing the mainline infrastructure, PTO infrastructure, and other global project activities. These essential investments involve core elements such as tracks, bridges, tunnels, and signaling systems as well as passenger stations, freight terminals, maintenance depots, and others.

[70] Non-exhaustive list of factors influencing final CAPEX.

10.2.2 Mainline Capital Expenditures

The investment expenses allocated to the mainline infrastructure represent a substantial investment, with a total of EUR 12.2 bn for building the core railway elements. Of that, Estonia accounts for EUR 2.3 bn, Latvia for EUR 5.1 bn, and Lithuania for EUR 4.7 bn. These expenditures are directed towards critical components like tracks, bridges, and tunnels.

The following table presents a summary of the cost composition by asset category and country:

Asset category	Estonia	Latvia	Lithuania	Total
Mainline structures and elements	2 190	4 849	4 477	**11 516**
ML construction supervision	47	131	90	**267**
ML different studies	7	11	11	**30**
Design contracts (with IVN-s) +expertise	43	151	153	**348**
Total	**2 287**	**5 142**	**4 731**	**12 161**

Figure 104: RB mainline investments by country and asset type, EUR mn (RBR Project Controls Estimation Team input; Consultant analysis) [71]

For certain subcategories of mainline costs, proportionate calculations were (e.g., on ML different studies), along with adjustments for optimism bias (e.g., on ML design and expertise). It's important to highlight that design maturities—Preliminary Design (PD), Value Engineering (VE), Master Design (MD), and Tendering (TE)—vary across different sections. This results in some sections being in the most mature tendering phase, while others still lack contracts and designs. Latvia DS1, Lithuania DS3; DS4; and DS5 are sections, where design requirements are not defined, contracts are not secured resulting in a higher risk for later cost escalation. For the Latvia DS1 and Lithuania DS4 sections, it is important to note that a significant portion of these sections will not be constructed during RB Phase 1. As a result, the costs for those portions have not yet been included.

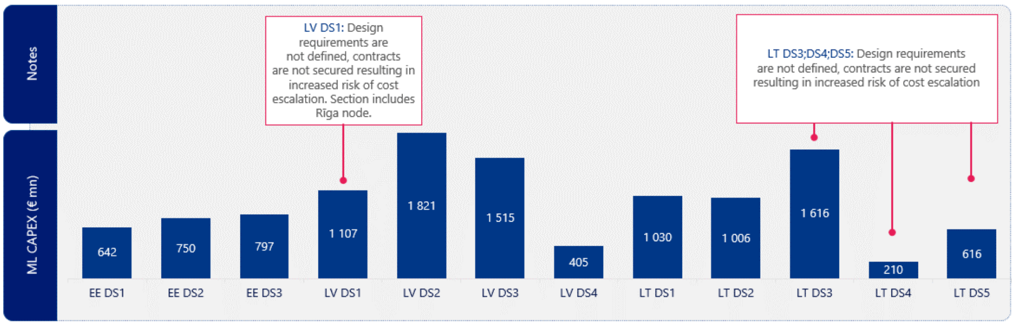


Figure 105: RB mainline construction investments per design section, EUR mn (RBR Project Controls Estimation Team input; Consultant analysis)[71]

[71] Regarding the provided figures, the sum of parts might not add up to the subtotals and totals due to rounding.

10.2.3 PTO Capital Expenditures

In addition to the mainline infrastructure, there is a substantial investment of **EUR 1.5 bn**[72] **(EUR 1 474 mn) for PTOs**. These are grouped into **six primary categories**: Major passenger stations, regional passenger stations, freight terminals, infrastructure maintenance facilities (IMF), depots, and other PTOs.

CAPEX investment in **passenger stations** encompasses modernization, expansion, and enhancement to provide passengers with superior facilities and services for existing passenger stations, and construction for new passenger stations. These include major international passenger stations and regional passenger stations, some of which will have full station buildings, while others will function as simple halts.

Freight terminals, serving as pivotal points for freight operations, will receive investment for essential upgrades of existing facilities and for the construction of new freight terminals.

IMFs are dedicated facilities used for the maintenance and repair of the rail infrastructure, while **depots** serve as storage and servicing hubs for trains. Both are critical Point-Type Objects (PTOs) that ensure the reliability and efficiency of the rail system.

The "**other PTO**" category includes costs related to specific Point-Type Objects, which in this case applies exclusively to Lithuania for the Vilnius Airport station.

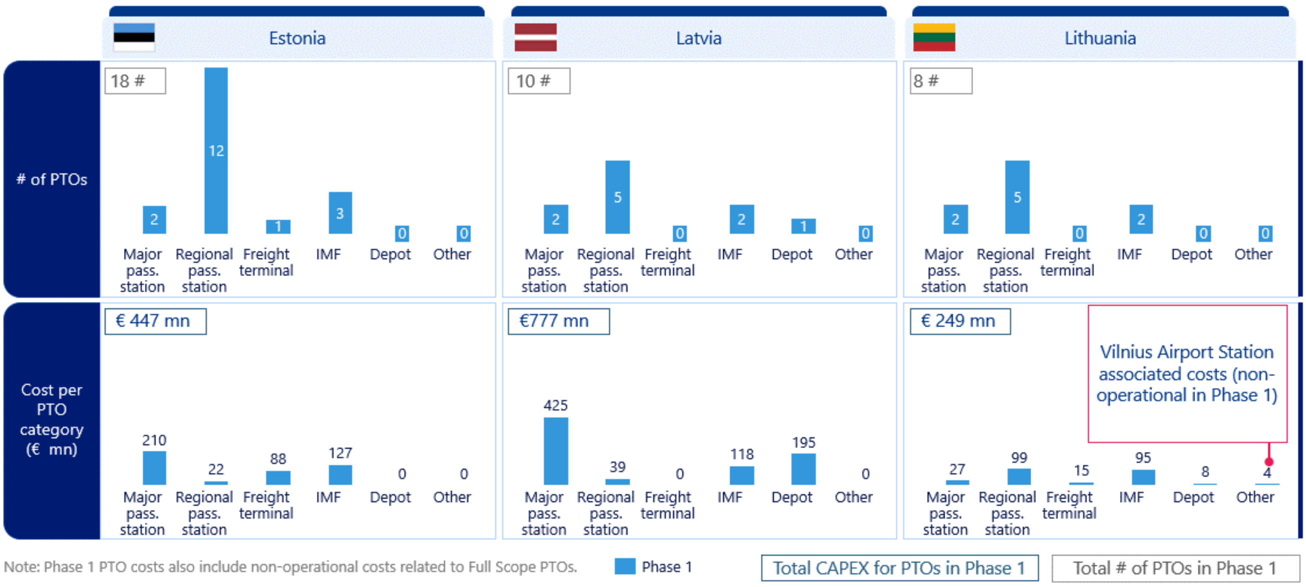


Figure 106: RB point-type object number and investments by country and asset type, #, EUR mn (RBR Project Controls Estimation Team input; Consultant analysis)

[72] Phase 1 PTO costs also include non-operational costs related to Full Scope PTOs.

The following table outlines the CAPEX required for constructing the infrastructure, broken down by each category and country. A closer examination of the individual countries reveals that the highest PTO investments will be allocated to Latvia (approximately EUR 777 mn, in comparison to EUR 696 mn combined for Estonia and Lithuania).

Asset category	Estonia	Latvia	Lithuania	Total
Major passenger station	210	425	27	**662**
Regional passenger station	22	39	99	**160**
Freight terminal	88	-	15	**104**
IMF	127	118	95	**341**
Depot	-	195	8	**203**
Other PTO	-	-	4	**4**
Total	**447**	**777**	**249**	**1 474**

Figure 107: RB point-type object investments by country and asset type, EUR mn

10.2.4 Global Project Activities Capital Expenditures

In addition to investments in the mainline infrastructure and point-type objects, there is a substantial investment need of EUR 3.2 bn for global project activities. These activities include CAPEX items such as ENE and CCS costs for signaling and energy, land acquisition, and further costs, which cannot be directly categorized as mainline or PTO infrastructure elements. In the table below, global CAPEX elements are listed for the three Baltic countries.

Asset category	Estonia	Latvia	Lithuania	Total
AsBo, NoBo	2	3	3	**7**
ENE	189	289	363	**842**
CCS	211	275	386	**872**
Fidic CCS and ENE	8	11	15	**34**
Land acquisition	69	191	115	**375**
Indirect cost	64	134	117	**315**
PISM	93	154	120	**367**
Contingencies (management reserve)	84	140	122	**345**
Total	**720**	**1 197**	**1 240**	**3 157**

Figure 108: RB global project activities investments by country and asset type, EUR mn

10.2.5 Country Comparison

To summarize, the CAPEX for Rail Baltica Phase 1 amounts to EUR 16.8 bn, distributed across the three countries: Estonia (EUR 3.5 bn), Latvia (EUR 7.1 bn), and Lithuania (EUR 6.2 bn). In each country, the CAPEX covers essential cost categories, though the specifics vary. For example, in Lithuania, a significant portion of the mainline track will be double track, while in the other countries, most of the rail line will initially operate as single-track with double embankments.

Below is a summary of CAPEX by country and cost category. Latvia has the highest CAPEX, largely due to the inclusion of complex sections and structures such as the Rīga node and the Daugava bridge. Lithuania, on the other hand, has the lowest number of PTOs operational in Phase 1 compared to the line length in the country, with the several remaining PTOs in the design and land acquisition stages. In addition, Lithuanian sections can benefit from existing stations and terminals that can be utilized thanks to the RB1 line on the Mockava-Kaunas section which is assessed in the *Extended Scenario* chapter.

Key value categories	Estonia	Latvia	Lithuania	Total
Mainline (EUR mn)	2 287	5 142	4 731	**12 161**
PTO (EUR mn)	447	777	249	**1 474**
Global costs (EUR mn)	720	1 197	1 240	**3 157**
Total CAPEX (EUR mn)	**3 455**	**7 116**	**6 220**	**16 791**

Figure 109: Phase 1 Reviewed CAPEX estimate values per country, per cost category (RBR Project Controls Estimation Team input)

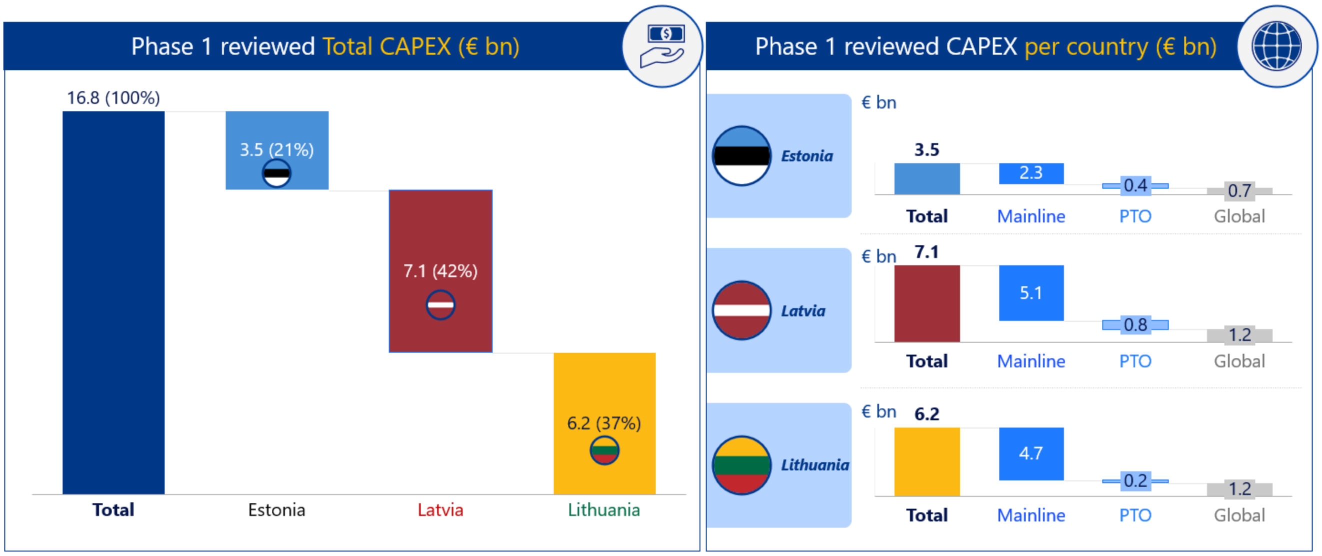


Figure 110: Phase 1 Reviewed CAPEX visualized with country level breakdown (RBR Project Controls Estimation Team input)

10.2.6 CAPEX Phasing

CAPEX phasing refers to the planned distribution of capital expenditures over a project's timeline. In large-scale infrastructure projects like Rail Baltica, CAPEX phasing ensures that financial resources are allocated strategically across different phases of construction, development, and implementation. This phased approach helps manage costs, align investments with project milestones, and accommodate adjustments or scaling over time. For Rail Baltica, CAPEX phasing is critical in ensuring the timely and efficient completion of key infrastructure while balancing the budgetary needs of each participating country.

The next table below presents the **phased CAPEX for Rail Baltica Phase 1 across Estonia, Latvia, and Lithuania,** with the total expenditure spread from 2024 to 2030 in EUR mn.

- **Estonia:** The total CAPEX for Estonia is EUR 3 455 mn, with the highest annual expenditure of EUR 738 mn projected in 2027. Estonia's CAPEX shows steady investment across the years, decreasing toward the later stages of the project with EUR 190 mn planned for 2030.
- **Latvia:** Latvia has the highest CAPEX allocation, totaling EUR 7 116 mn. The peak spending occurs in 2027 at EUR 1 618 mn, reflecting the complexity of the sections within Latvia, such as the Rīga node and Daugava bridge. Investment gradually declines from 2028 onward, with EUR 350 mn allocated for 2030.
- **Lithuania:** The total CAPEX for Lithuania is EUR 6 220 mn. The most intensive period of expenditure is between 2026 and 2028, with a peak of EUR 1 421 mn in 2027. Investment reduces gradually, with EUR 354 mn planned for 2030.

The overall total CAPEX for Phase 1 across all three countries from 2024 to 2030 is EUR 16 791 mn. The most significant expenditures occur between 2025 and 2027, aligning with key construction and development milestones for the Rail Baltica Global Project.

Asset category	Up to end of 2024	2025	2026	2027	2028	2029	2030	TOTAL
Estonia (EUR mn)	338	401	669	738	595	523	190	**3 455**
Latvia (EUR mn)	513	868	1 494	1 618	1 251	1 021	350	**7 116**
Lithuania (EUR mn)	244	722	1 304	1 421	1 157	1 018	354	**6 220**
Total (EUR mn)	**1 096**	**1 991**	**3 467**	**3 777**	**3 003**	**2 562**	**895**	**16 791**

Figure 111: Phasing of Phase 1 CAPEX, end-2023 price level, EUR mn (RBR Project Controls Estimation Team input; Consultant analysis)

The next table shows the cumulative progress of CAPEX expenditure for Rail Baltica Phase 1 across Estonia, Latvia, and Lithuania, expressed as a percentage of total project costs completed by each year from 2024 to 2030.

- Estonia will have 10% of its total CAPEX spent by the end of 2024, rising steadily to full completion in 2030.
- Latvia follows a similar pattern, with 7% spent by 2024 and reaching 100% by 2030.
- Lithuania also tracks closely, with 4% of CAPEX spent by 2024 and 100% projected for 2030.

Asset category	Up to 2024	2025	2026	2027	2028	2029	2030
Estonia	10%	21%	41%	62%	79%	95%	100%
Latvia	7%	19%	40%	63%	81%	95%	100%
Lithuania	4%	16%	36%	59%	78%	94%	100%
Total	**7%**	**18%**	**39%**	**62%**	**79%**	**95%**	**100%**

Figure 112: Cumulative phasing of Phase 1 CAPEX up to project completion (2030), % (RBR Project Controls Estimation Team input; Consultant analysis)

10.2.7 Benefits and Risks of Single-track

In Rail Baltica Phase 1, the scope of the project is focused on carrying out key prioritizations to the mainline. The most notable difference is to adopt a single-track rail route from the North until Panevėžys, along with a lower number of operational Point-Type-Objects. Despite these differences with the full scope, the overarching goal of the Rail Baltica Global Project - to connect the Baltic States with the European TEN-T rail network - remains intact. This critical objective will still be achieved with the completion of Phase 1.

The **single-track solution** in Phase 1 introduces some differences compared to the later stage, full-scope plan with double-track system. While this **first phase might bring risks, it also presents some significant benefits from a project perspective.** In total, **12 key factors** were identified in evaluating the impact of a single-track, with 10 of these being highly relevant to the Rail Baltica project. Below, we delve into these factors, outlining the implications of implementing a single-track for each one.

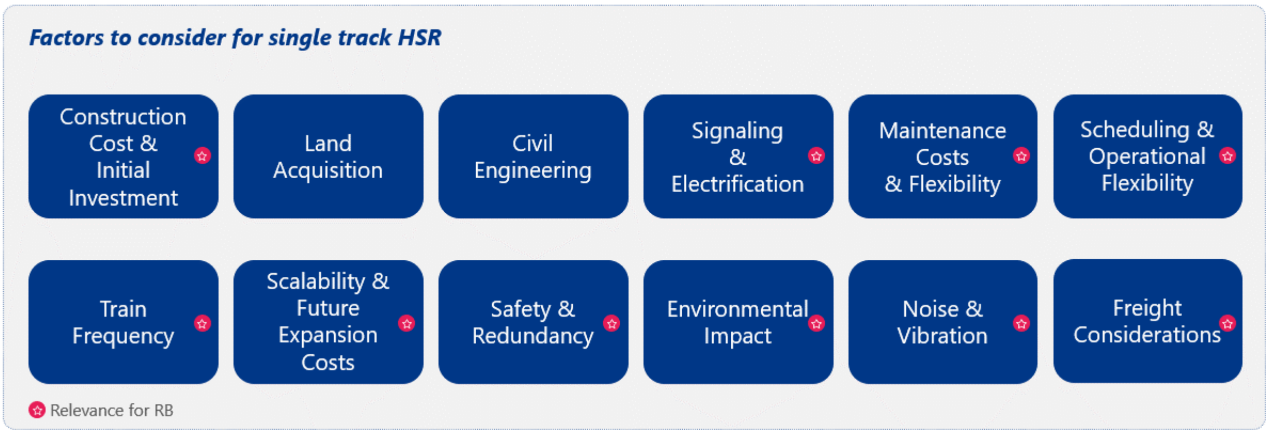


Figure 113: Factors to consider for single-track High Speed Rail (Consultant analysis)

The **ideal use case for a single-track** is best suited for low-traffic regions where demand is lower, and the upfront investment opportunities are limited. In the context of Rail Baltica, this design supports less congested, budget-conscious project execution, making it a viable option for balancing initial costs.

From a **construction cost and initial investment perspective,** single-track lines are up to 30-50% cheaper compared to double-track systems, making them more affordable at the outset. However, this could require costly upgrades as demand grows. For Rail Baltica, the lower initial costs align well with Phase 1 and makes the project affordable, however, future upgrades could lead to to increased expenses and potential complications in later phases. For example, complications may include operating alongside an active line and the additional resource mobilization required.

Regarding **land acquisition**, single-track systems require less land, which reduces acquisition costs and minimizes environmental and social impacts. However, for Rail Baltica Phase 1, the land acquisition will proceed as originally planned for the target Full Scope[73] set-up, ensuring that sufficient land is secured for future upgrades in Phase 2.

From a **civil engineering perspective**, single-tracks are more cost-effective for structures like tunnels and bridges due to their reduced complexity. However, much like land acquisition, civil engineering work in most cases will proceed as planned for the Full Scope, ensuring that the necessary infrastructure is in place to support future upgrades in Phase 2.

Regarding **signaling and electrification**, single-track lines use simpler systems, though advanced signaling may be required in busier areas. For Rail Baltica, this means that signaling systems need careful design to ensure efficiency, particularly in sections that experience higher traffic to avoid bottlenecks. It is worth noting that phasing may carry some risk of differing solutions being implemented across phases, influenced by evolving supplier landscapes or advancements in technology over time. For instance, signaling systems might require adjustments or reinstallation during Phase 2 construction to align with updated solutions available at that stage.

With **maintenance costs and flexibility**, single-track systems offer lower maintenance costs but result in greater disruption during maintenance due to the limited operational flexibility. While Rail Baltica will benefit from lower costs, scheduling maintenance without affecting service could become a challenge, especially as demand grows.

When considering **scheduling and operational flexibility**, single-track lines are less flexible, with more complex scheduling and limited capacity. Recovery from disruptions is slower, potentially leading to cascading delays. For Rail Baltica, this could pose risks to maintaining high operational reliability, especially during peak demand periods.

In terms of **train frequency**, single-track systems typically support lower frequencies, with a higher risk of bottlenecks. For Rail Baltica, this could restrict the potential for frequent services, requiring careful capacity management to prevent congestion. Additionally, the overall operational speed may be impacted by the need to construct the train schedule around the most limiting section's running times, which could affect system efficiency.

Regarding **scalability and future expansion costs**, single-track lines may require costly upgrades to accommodate increased capacity. However, for Rail Baltica, the long-term expansion options are less constrained, as the single-track line is designed with a double embankment, making future upgrades easier and more efficient.

In terms of **safety and redundancy**, single-tracks offer less redundancy during emergencies, making them less safe compared to double-track systems, as there are fewer alternate routes for rerouting trains. For Rail Baltica,

[73] Under Full Scope, the target scope of a double-track fully electrified Rail Baltica track is meant where several additional PTOs are also constructed as described in the *Project Definition Section*.

this could raise safety concerns in case of emergencies. However, with additional sidings planned, this risk will be reduced.

On **environmental impact**, single-tracks have a lower initial environmental footprint due to smaller construction needs. However, they may be less efficient in terms of energy usage over time. For Rail Baltica, this minimizes the disruption caused by construction, but the long-term operational efficiency of the system will need to be assessed as traffic grows.

When it comes to **noise and vibration**, single-track systems produce lower levels of both, since fewer trains operate. For Rail Baltica, this could benefit urban or environmentally sensitive areas by reducing the overall negative environmental and social impacts.

Finally, in terms of **freight considerations**, single-track lines are less flexible for freight operations due to their lower frequency and capacity. For Rail Baltica, this could limit the line's effectiveness for freight transport, requiring careful planning to balance both passenger and freight services.

10.3 Passenger Carrier Financial Analysis

This section conducts a thorough financial analysis of the passenger segment, focusing on high-speed, night, and regional trains. The analysis provides a detailed overview of revenue generation, cost structures, and profit margins within each service line. This examination offers a factual perspective on the financial efficiency and sustainability of these key components of RB. The analysis in this section is significantly influenced by the demand outlined in the *Passenger demand* subsection. Revenues are calculated from the track access charges outlined and the forecasted train and passenger kilometers.

A comprehensive analysis of all passenger service segments reveals a cumulative operating loss. The average yearly operational expenditure (OPEX) during the operational phase from 2031 to 2080 is projected to reach EUR 160.6 mn, while average revenues only account for EUR 39.5 mn during the same period. This financial outlook mirrors the inherent complexities of passenger operations, which often necessitate substantial investments in infrastructure and services to provide a functional and sustainable transportation solution.

The overall narrative highlights a financial deficit, with the sum of the passenger segments exhibiting an average yearly loss of EUR -115.6 mn. The chart below depicts the projected cash flows for both revenues and OPEX of the passenger segments, clearly demonstrating that revenues fall significantly short of OPEX values, consequently generating an operating loss.

Furthermore, the chart reveals a cyclical pattern in OPEX trends. Following the completion of both major investment event (after 2048-2052 and 2068-2072), OPEX experiences a period of seven years with lower values compared to the period before the event. During the years of the major investment events, OPEX also peaks, reaching +78% of the baseline OPEX value due to the significant infrastructure renovation costs that are capitalized in OPEX.

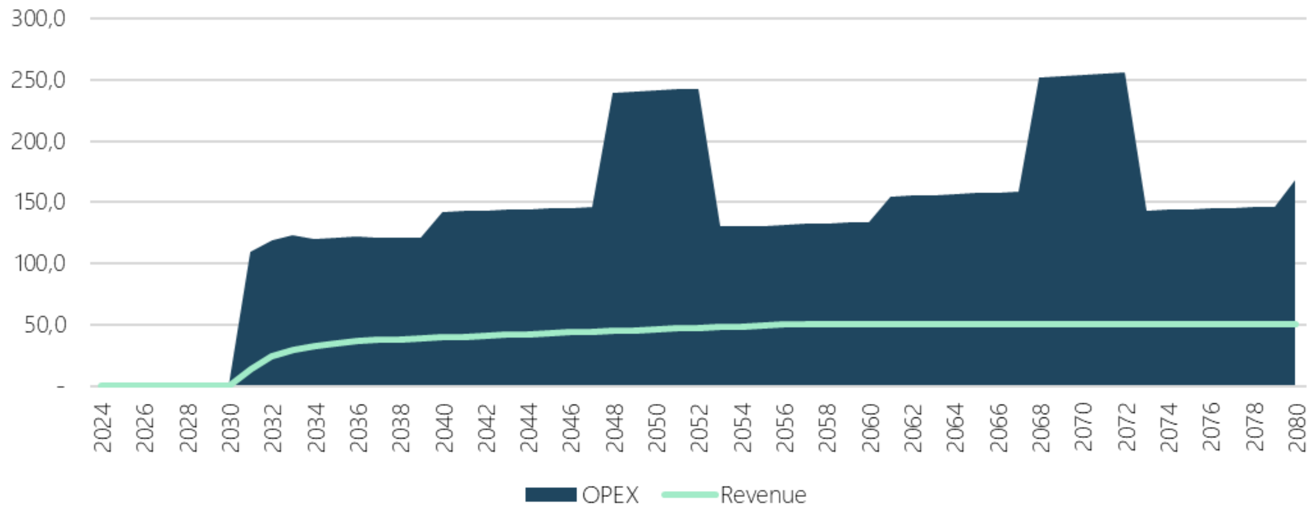


Figure 114: RB passenger segment OPEX and revenues, EUR mn

Revenue growth, on the other hand, is incremental. Over the span of six years, the envisioned passenger train traffic flow accumulates to 100%. Commencing in Year 1 at 40%, it gradually gains momentum, reaching 70% in Year 2, 85% in Year 3, and surging to 90% in Year 4. By Year 5, passenger train traffic operates at 95%, and it culminates at 100% in Year 6. This scenario reflects a future projection, underscoring the anticipated growth and maturation of passenger train services as the railway network evolves from its initial stages to become an integral and fully adopted mode of transportation.

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Passenger	40%	70%	85%	90%	95%	100%

Figure 115: RB passenger train ramp-up after completion (Consultant expert analysis)

10.3.1 High-Speed Carrier

The financial analysis of the first of the passenger segments, the high-speed segment presents a key concern: OPEX consistently surpass the revenues generated annually. The projected average yearly operational expenditure (OPEX) for this segment during the operational phase is anticipated to average EUR 66.6 mn, while the projected average yearly revenues are estimated at EUR 21.8 mn. This financial disparity results in an average yearly operating loss of EUR -44.8 mn for this segment.

Plausible handling of loss generating operations may be multiannual contracts / Public Service Obligations (PSOs) to be applied to sustain the operation of the high-speed segment. While the high-speed service offers tremendous benefits in terms of rapid and efficient transit ac economic impact, the revenue deficit poses a challenge.

The demand for high-speed rail might be poised for increase in the future with many ongoing initiatives on a European level to broaden high-speed infrastructure. These changes, if implemented, could become feeder lines that would increase the demand for the infrastructure while also boosting touristic interest for the region by enabling an eco-friendly and cheap transportation method.

The following figure depicts the annual cash flows of operational expenditures (OPEX) and revenues for the high-speed segment. As evident from the figure, revenues consistently fall below OPEX, leading to an operating loss every year.

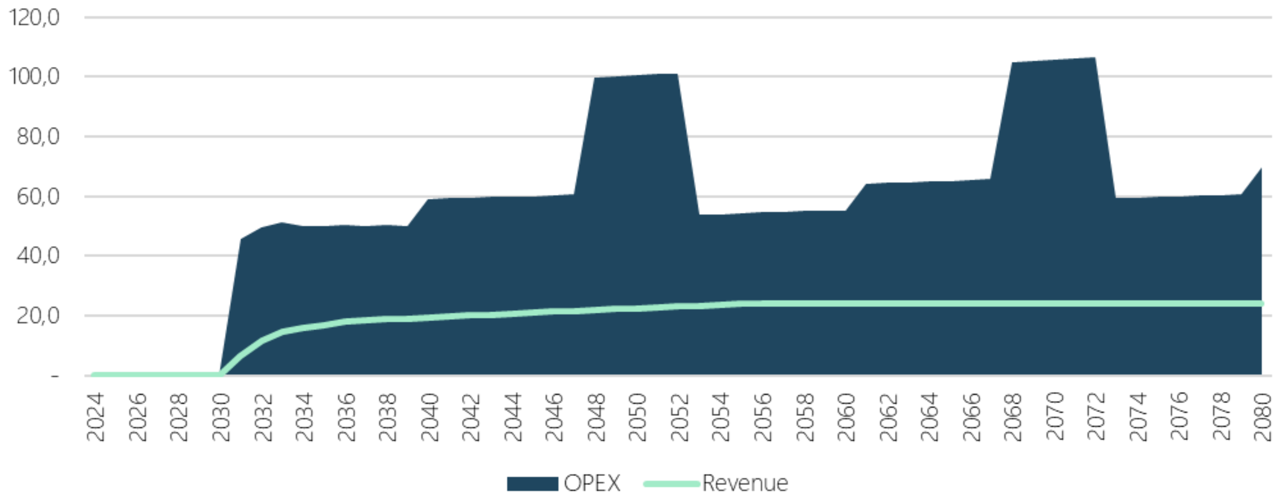


Figure 116: RB high-speed segment OPEX and revenues, EUR mn

10.3.2 Night Carrier

A captivating pattern emerges from the financial analysis of the second passenger segment, RB's night segment, owing to the cyclical nature of OPEX and the incremental revenue growth. The nigh segment's average OPEX stands at EUR 8.7 mn, while average revenues reach EUR 7.0 mn, resulting in an average of EUR -1.7 mn annual loss.

The trend is evident in the accompanying figure, with most of the years exhibiting OPEX values above the revenue line. After the first major investment event the operating loss turns into profit for 8 years, generating a yearly average of EUR 0.6 mn. After the second major investment event the profit margin is lower and the only lasts for

4 years, averaging EUR 0.1 mn annually. With this, the night train service is the only service of the passenger segment that can generate profit during the examined timespan.

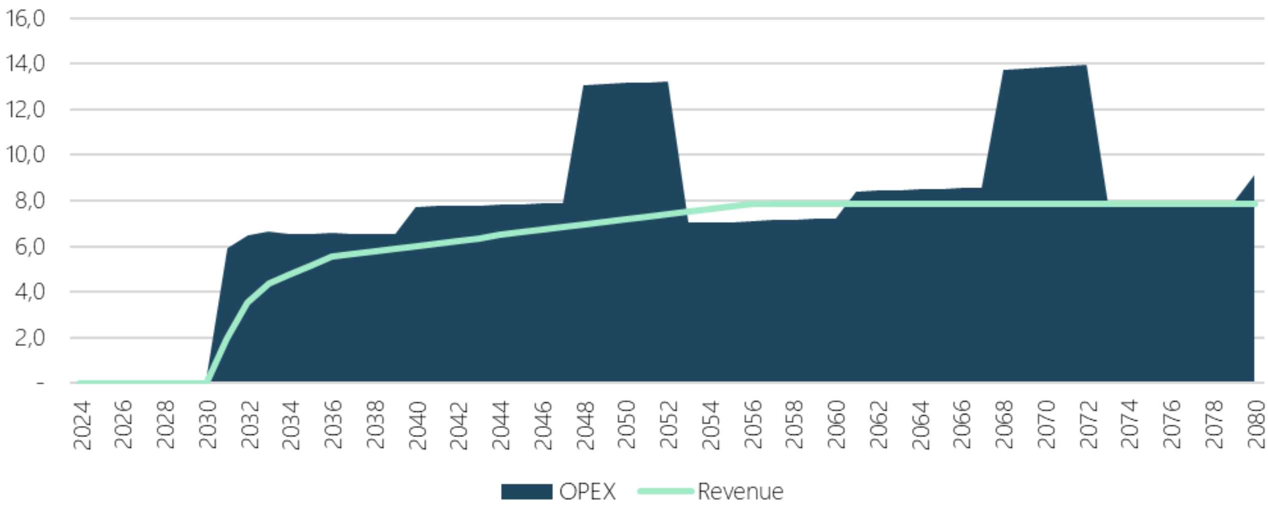


Figure 117: RB night passenger segment OPEX and revenues, EUR mn

10.3.3 Regional Carrier

An examination of the financial performance of the regional train segment within RB reveals a concerning trend: the regional train services exhibit a more significant deficit, with OPEX consistently surpassing generated revenues each year, generating significant loss for the passenger segment.

The average annual OPEX amounts to EUR 85.3 mn, while revenues reach EUR 16.2 mn, resulting in an average yearly operating loss of EUR -69.1 mn. This aligns with the general international profitability patterns of the regional segment, as the TACs are the lowest among all segments and train-km-s (train-kilometers) are the highest. It is crucial to acknowledge, however, that the economic benefits for regional passengers are substantial and, as presented in the *Socio-Economic Analysis*, effectively offset the financial losses.

This financial challenge underscores a similar need for the potential implementation of multiannual contracts / PSOs for the states to provide support to the ongoing operation of the regional train services.

The following chart illustrates the OPEX and revenues of this segment, highlighting the substantial disparity between the two, with revenues consistently falling short of OPEX.

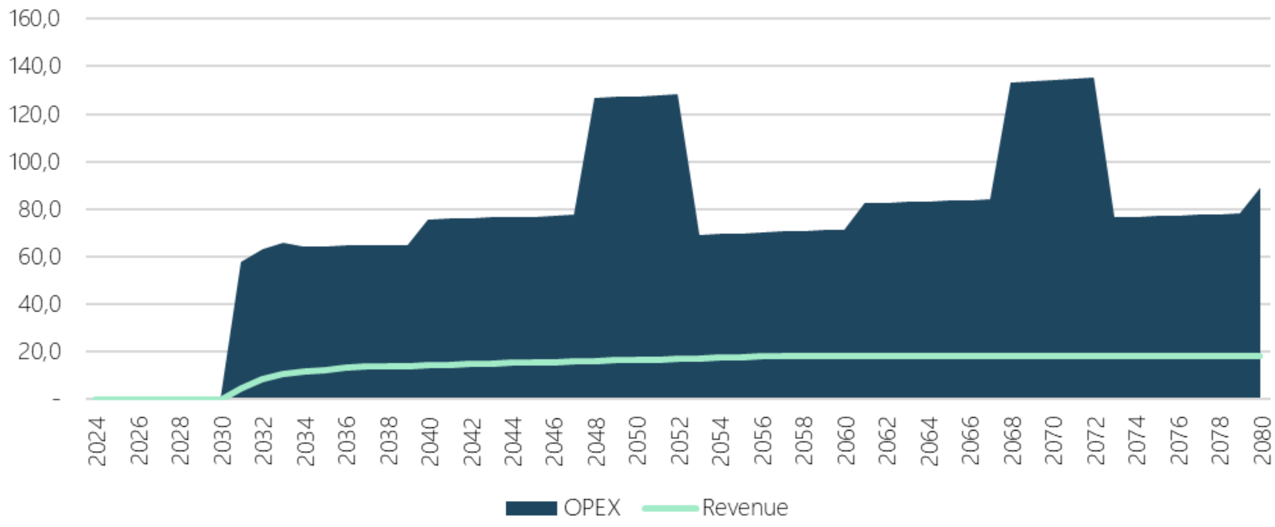


Figure 118: RB regional segment OPEX and revenues, EUR mn

10.4 Freight Carrier Financial Analysis

The analysis in this section is significantly influenced by the demand outlined in the Traffic demand model outputs section. Revenues are calculated from the track access charges outlined and the forecasted train and ton kilometers. This section delves into a comprehensive financial analysis of the freight segment within RB, emphasizing two critical service lines: unitised and non-unitised freight services. This examination provides a factual and data-driven insight into the financial efficiency and sustainability of these pivotal components of the RB project, illuminating their contributions to the overall financial landscape.

In contrast to the passenger service lines, the freight segment is a more attractive opportunity for RB with positive operating profit generation from second year of services and also during major investment events. As opposed to the scenario of the passenger segment during the major investment events between 2048 - 2052 and 2068 - 2072 – when large-scale maintenance work is assumed to take place –, the OPEX can be fully covered by an estimated average operating profit above EUR 15.3 mn for the first event, and of EUR 17.9 mn average profit for the second one, after the stabilization, following the ramp-up period.

With an average annual revenue of EUR 57.4 mn and an average annual OPEX of only EUR 29.1 mn, the total average annual profit stands at EUR 28.3 mn. The following chart demonstrates that revenues consistently exceed OPEX during the regular years.

Utilizing the profits generated from the freight segment to offset the losses incurred by the passenger segment is termed cross-financing. This approach presents a viable option for reducing the overall subsidy requirement during the project's operational phase.

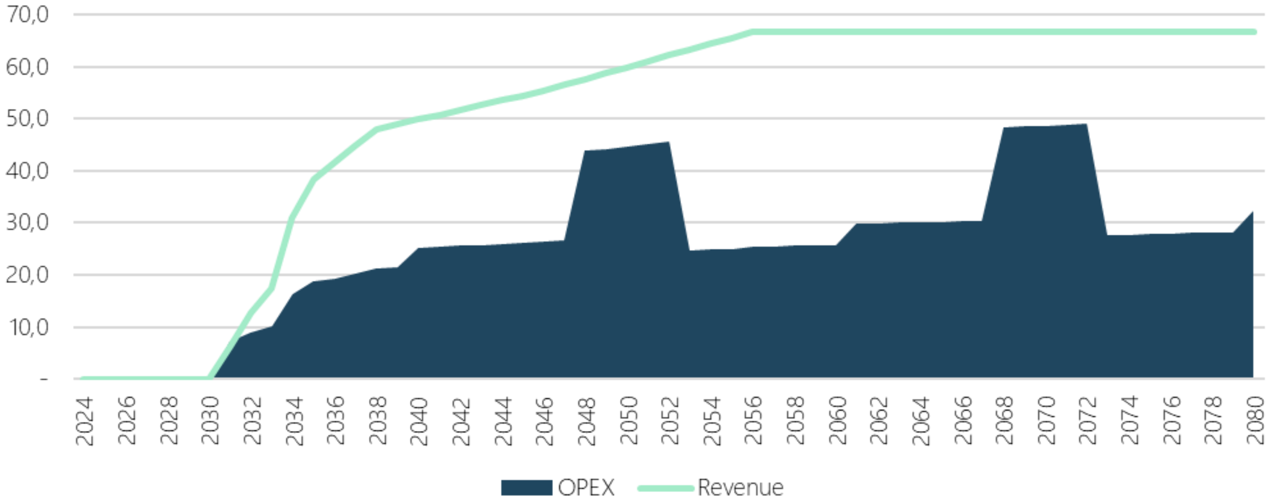


Figure 119: RB freight segments OPEX and revenues, EUR mn

Over an eight-year timeline, the anticipated progression of freight train traffic is expected to show a compelling evolution. Starting at a conservative 15% in year 1, it steadily gains traction, reaching 30% in year 2 and 40% in year 3. The subsequent years are forecast to witness substantial growth, with freight traffic surging to 70% in year 4, further advancing to 85% in year 5, and climbing to 90% by year 6. Year 7 sees an increase to 95%, and, by year 8, freight train traffic is projected to reach full capacity at 100%.

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Passenger	15%	30%	40%	70%	85%	90%	95%	100%

Figure 120: RB freight segment ramp-up after completion (Consultant expert analysis)

10.4.1 Unitised Freight

The unitised segment of RB maintains a consistent record of positive operating profit almost in every year, even during major investment events. The forecasted revenue after the ramp-up period is around EUR 54.3 mn, with OPEX being significantly lower, under EUR 23.1 mn on a yearly average, this consistent profitability highlights the segment's efficiency and its ability to provide intermodal freight services that contribute to financial stability. The unitised segment is a crucial component in efficiently addressing the logistics needs of the region.

Exhibiting an average annual OPEX of EUR 21.1 mn and average annual revenues of EUR 49.3 mn, this segment consistently generates an average annual profit of EUR 28.2 mn, as illustrated in the following figure:

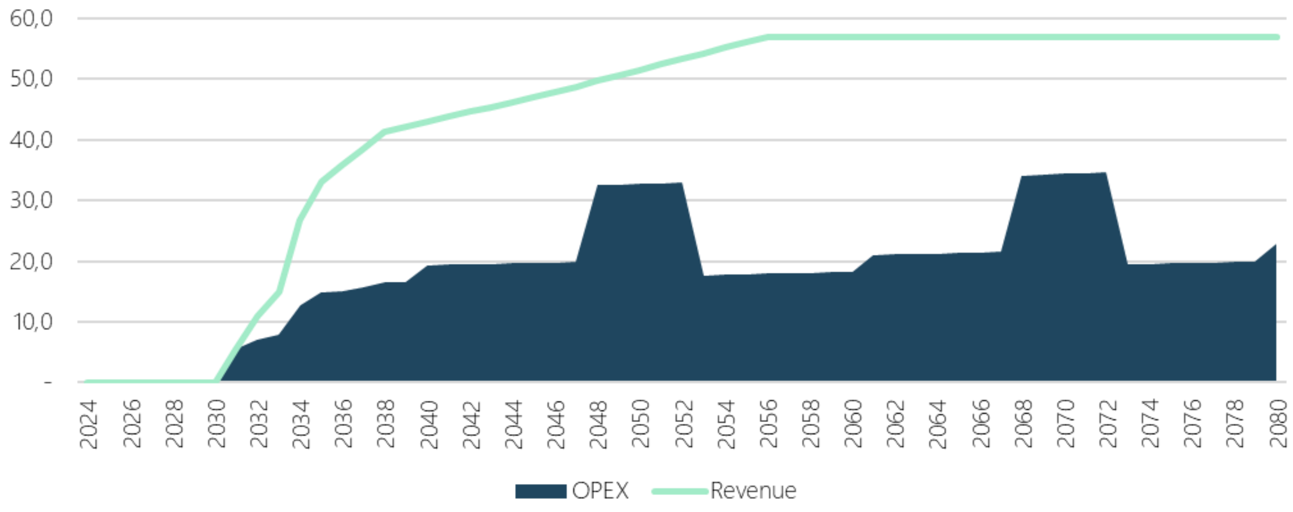


Figure 121: RB unitised segment OPEX and revenues, EUR mn

10.4.2 Non-Unitised Freight

The non-unitised segment of RB, while capable of generating profit under regular circumstances, shows a different operating profit profile compared to the stronger margins seen in the unitised segment. This segment's profitability is more variable, particularly during periods of major CAPEX investments, which can temporarily impact margins. The narrower overall margin likely reflects the specific cost structure and operational demands unique to the non-unitised segment. However, this segment's revenue diversification potential remains valuable, contributing to the overall project's resilience and underscoring the railway system's ability to accommodate a diverse range of cargo transport needs.

With an average annual OPEX of EUR 8.0 million and average annual revenues of EUR 8.1 million, the segment experiences a modest average annual loss of EUR 0.1 million, as shown in the accompanying figure.

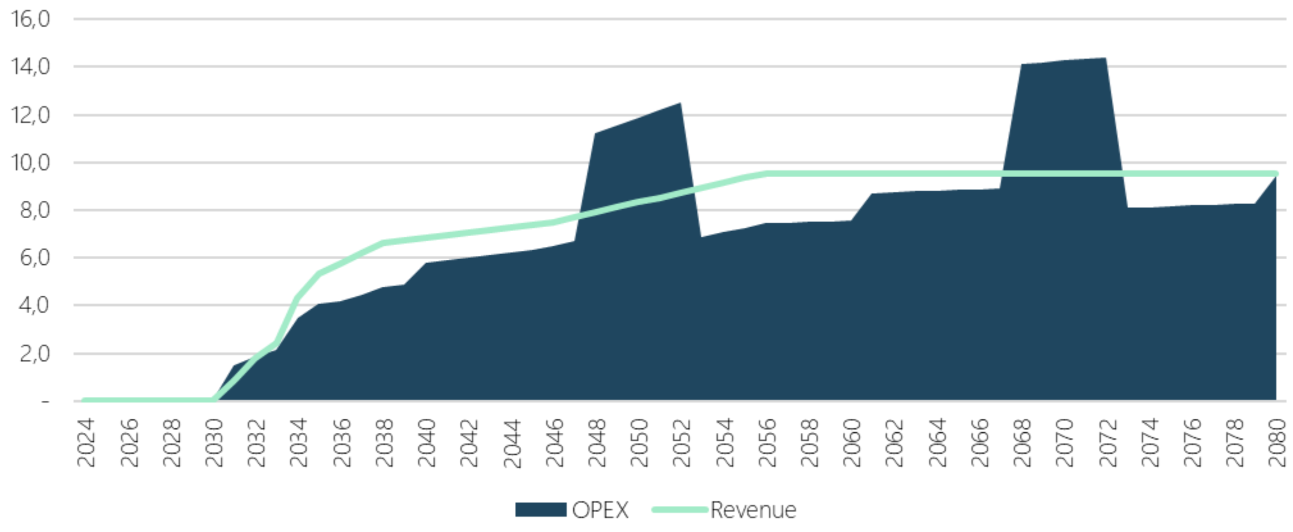


Figure 122: RB non-unitised segment OPEX and revenues, EUR mn

10.5 Electricity Resale Analysis

As part of RB's financial analysis, the RB project includes a forward-thinking approach to energy management, comprised fully of electricity management and resale. This chapter delves into the financial implications of RB's electricity resale initiative.

In its commitment to sustainability, RB opts for electricity from renewable sources. To authenticate this, the project will need to invest in Guarantees of Origin, ensuring transparent verification that the electricity used is renewable. As more renewable electricity generation facilities are emerging throughout Europe, the forecasted price is taken as a percentage of the electricity costs in 2025 and assumed for the rest of the modelled years as a conservative approach.

Category	2022	2023	2024	2025
Guarantees of Origin	7.10	6.27	4.72	3.71

Figure 123: European average Guarantees of Origin price, EUR (Greenfact, 2022)

This not only aligns with the project's environmental goals but also addresses the growing demand for sustainable energy solutions in public transportation. To resell electricity, RB must navigate the regulatory landscapes of Estonia, Latvia, and Lithuania, obtaining an energy trading license in each.

Central to the resale strategy is the purchase of electricity, which would be resold to RUs at an assumed 3% mark-up (RB Financial Model, 2018). This section presents the expected revenue from this mark-up, considering factors such as projected electricity consumption rates and the fluctuating costs of renewable electricity.

On an annual scale, RB's electricity resale is expected to generate EUR 9.0mn of revenue on average with the 3% mark-up, maximizing in 2038 at EUR 10,3 mn. The 3% mark-up would result in an average annual profit of EUR 0.3 mn.

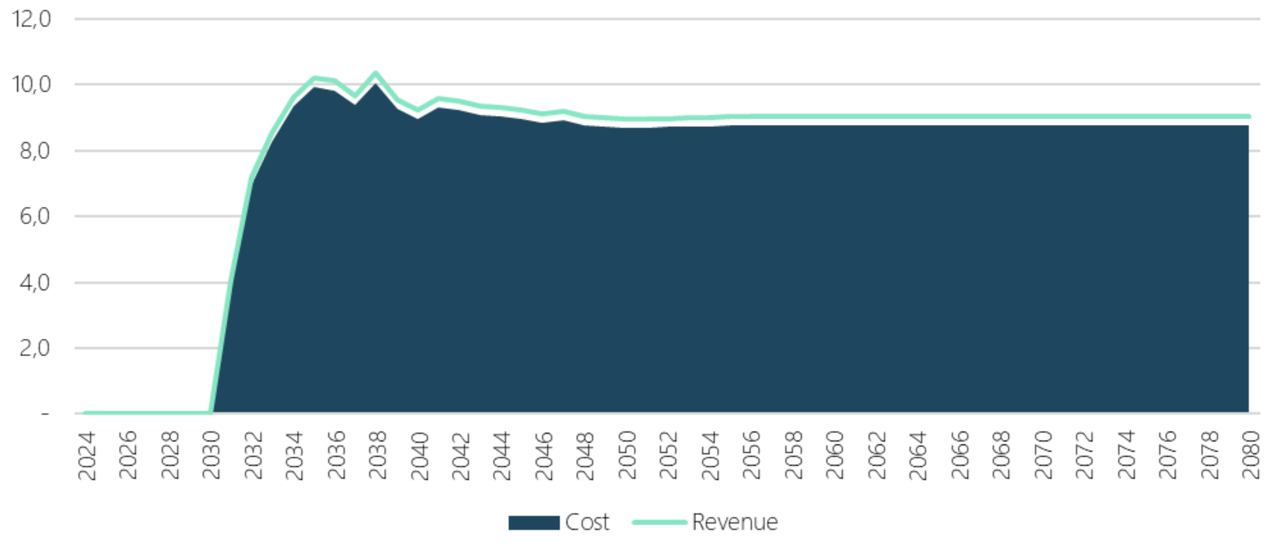


Figure 124: RB electricity resale operating profit, EUR mn

10.6 Facilities Financial Analysis

Facilities financial analysis covers the financial performance of both passenger stations and freight terminals within RB. This analysis aims to provide a comprehensive view of the economic aspects of these critical components. By examining station and freight terminal financial data, their financial viability and efficiency is being evaluated.

The financial analysis of the facilities, encompassing both passenger stations and freight terminals, reflects a positive operating profit trend. Both facilities exhibit consistent profitability, serving as reliable contributors to RB's financial health. The station financial analysis reveals robust financial performance, emphasizing their significance as hubs of passenger activity, generating positive operating profits. Similarly, freight terminal financial analysis underscores the efficient handling of freight, further adding to the project's economic stability.

10.6.1 Passenger Stations Financial Analysis

The passenger stations within RB present a compelling financial performance, consistently generating positive operating profit. Notably, their financial profile experiences a sharp increase, distinct from a gradual ramp-up, signifying their immediate and sustained impact on the project's fiscal health.

In our financial model, station revenues are calculated using a bottom-up approach. The main sources of revenue stem from fees generated by trains stopping at the passenger stations and income from advertising spaces. These core elements constitute the primary income streams, reflecting the pivotal role of passenger stations in connecting passengers and facilitating advertising opportunities. Additionally, the model includes ancillary revenue sources, such as fees from shunting activities and income generated by renting retail spaces within the station premises. The stations generate around EUR 4.0 mn yearly revenue constantly, from 2031 onwards. Noticeably, operating expenses (OPEX) are observed to decrease, representing ~ EUR 2.9 mn per year, with slight variations. This reduction is attributed to a forecasted decline in electricity prices, contributing to improved cost efficiency within the station operations.

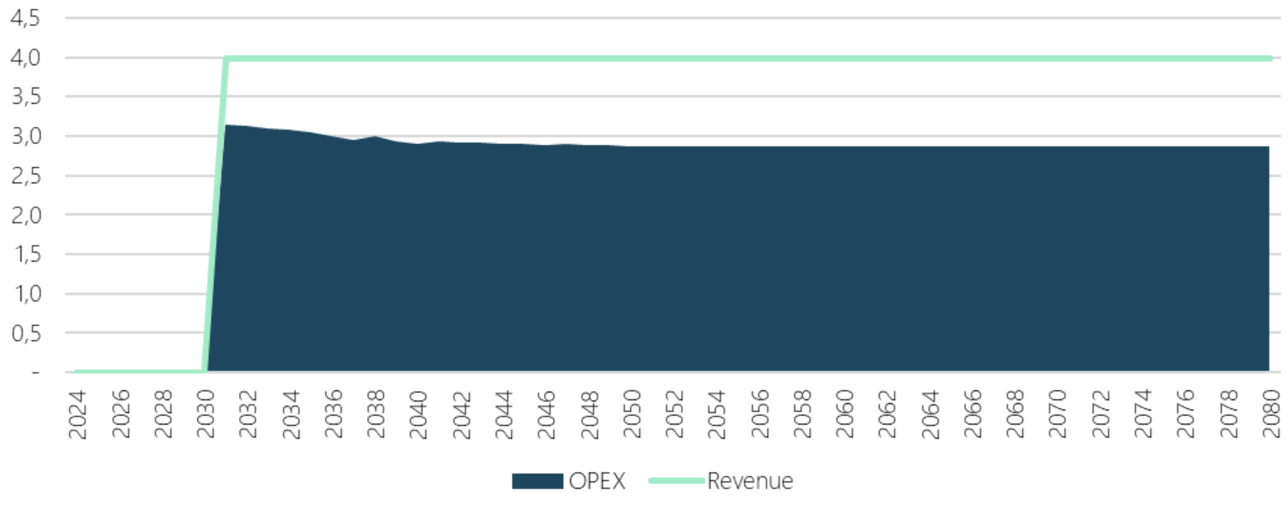


Figure 125: RB passenger stations operating profit[74], EUR mn

[74] List and naming of passenger stations and freight terminals is subject to change during final design stages.

10.6.2 Freight Terminals Financial Analysis

In Phase 1, only the freight terminal in Muuga in Estonia will operate as a revenue source for RB also exhibiting a positive operating profit (with additional terminal operations assumed for Salaspils in Latvia in the *Extended Phase 1 Scenario*). Notably, Muuga's ramp-up aligns closely with the flow of freight traffic reflecting its adaptability and responsiveness to market demands. As key contributor to the project's financial sustainability, the efficient handling of freight underscores the pivotal role of this freight terminal in optimizing revenue streams. Its ability to effectively adjust to evolving freight traffic flows further enhances its importance in the project's overall success.

Freight Terminal Demand Forecast

The demand forecast for the Muuga is an integral component to understand the financial dynamics and the potential return on investment in the development of this facility. Through analyzing the projected throughput of the terminal for 2031, 2046, and 2056, the growth trajectory and demand can be estimated.

Category	Freight terminal[75]	2031	2046	2056
Estonia	Muuga	456	601	707
Latvia	Salaspils	53	72	76
Lithuania	Marijampolė	17	20	24
Lithuania	Kaunas Intermodal Terminal (KIT)	172	222	260
Lithuania	Panevėžys	3	4	4

Figure 126: Freight terminal forecasted TEU handled, thousands (Rail Baltica – internal document, 2023)

In the financial analysis, freight terminal revenues are calculated based on a bottom-up approach, with a substantial portion of the revenues originating from the core activities of loading and unloading freight. This primary source of income reflects the fundamental role freight terminals play in facilitating efficient cargo operations, where fees are generated based on the quantity of goods handled. Furthermore, ancillary revenues associated with freight terminals provide an additional income stream. These ancillary sources include warehousing and storage fees, as well as charges for various value-added services such as cargo-handling

[75] Salaspils, Marijampolė, Kaunas, and Panevėžys terminals are not part of the Phase 1 financial analysis, as the information of service inclusion arrived after data cut-off date. The financial impact of these terminals are the part of the *Phase 1 Extended Scenario*.

equipment rentals, and logistics support. After stabilizing in year 2056, the yearly forecasted revenue is EUR 37.3 mn until 2080, which easily covers the estimated OPEX, valued EUR 21.0 mn in the same period.

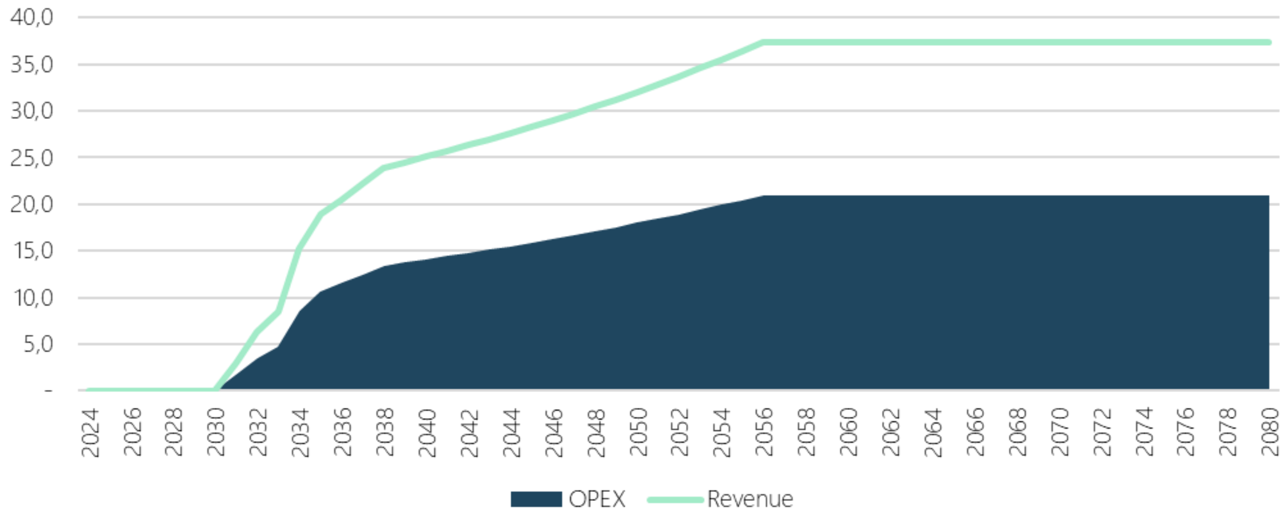


Figure 127: RB freight terminals operating profit, EUR mn

10.7 Country-Level Financial Analysis

This section presents a comprehensive financial analysis for Estonia, Latvia, and Lithuania. The analysis aims to offer a general estimation rather than a detailed country-specific overview, in accordance with CBA guidelines that require focusing on the overall benefits of the entire project. The analysis is split into two main categories: passenger and freight. Both categories assess necessary operational costs and explore revenue generation opportunities. The objective is to evaluate the possibility of profitability at the country level.

10.7.1 Estonia

In Estonia, both the passenger and freight sectors show comparable patterns in the progression of their operational costs, maintaining a generally stable trend with occasional surges, mainly attributed to maintenance expenses. Despite these expenditure trends being alike, the segments have notable differences in profitability. The freight sector proves to be more profitable, generating revenues from the early stages of operation and experiencing a significant growth trajectory thereafter. This indicates a strong possibility for financial success in the Estonian freight transportation segment compared to the passenger segment. Compared to Latvia and Lithuania, Estonia generates ~60% less loss on a yearly average during the forecasted operational years. This is due to significantly lower yearly average OPEX, and similar average revenue compared to the two other countries.

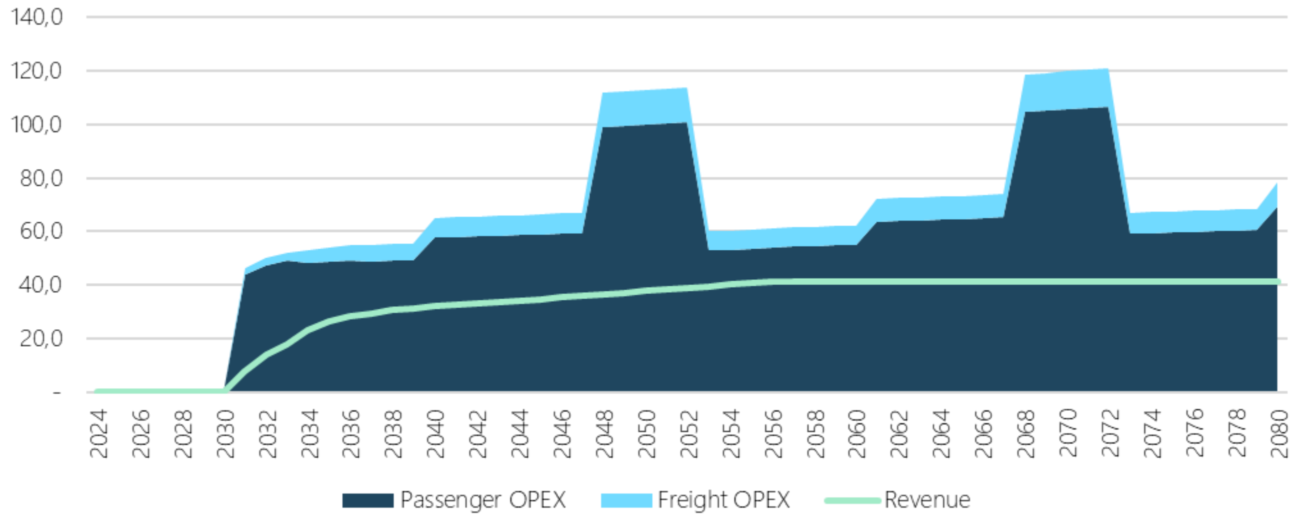


Figure 128: RB Estonia OPEX and revenues, EUR mn

Passenger Segment Financial Analysis

The passenger segments in Estonia consistently operate at a deficit, primarily due to operational expenses exceeding generated revenues. This financial imbalance is particularly evident in specific years, notably around major investment events, due to the asset renewal cycle. The analysis of operational expenditures highlights that the regional segment is the primary cost driver, with an average annual expenditure of EUR 37.2 mn under standard conditions and a significantly higher (EUR 65.3-69.3 mn) during the major CAPEX years. In contrast, high-speed transport services, while still a substantial expense, contribute approximately 50% less to the overall operational costs compared to the regional segment, averaging EUR 20.3 mn annually. This makes them the second-largest cost component, reflecting their operational intensity relative to regional services. The night train segment, however, is a minor cost component, with a notably low average annual operational expenditure of EUR

2.5 mn. This modest figure is due to the segment's limited contribution to total train kilometers, which reduces operational expenditure allocation significantly.

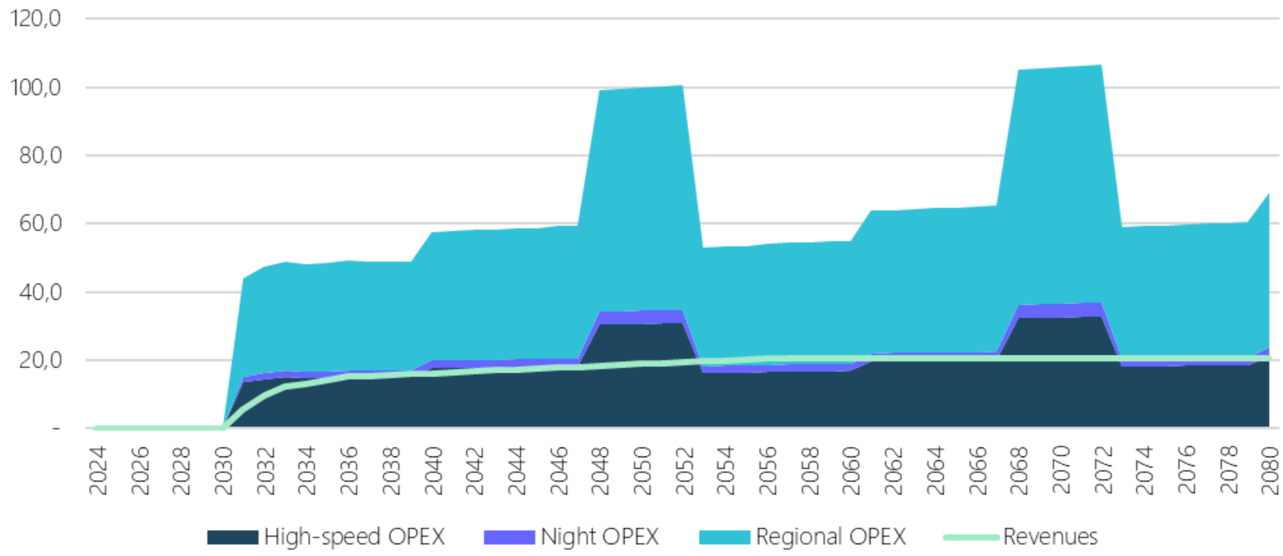


Figure 129: RB Estonia passenger OPEX and revenues, EUR mn

Freight Segment Financial Analysis

In contrast to financial challenges of the passenger segment in Estonia, the freight segment is forecasted to be profitable. Forecasts suggest an increase in revenues as early as in 2031, with expectations of growth leveling out from 2056 onward at ~ EUR 20.9 mn annually. Similarly to the trends observed in the passenger segment, freight OPEX is projected to remain relatively consistent over time, with an anticipated rise in the previously noted years, (2048-2052 and 2068-2072) due to the major investment events. In terms of an operational cost breakdown, the unitised and non-unitised services of the freight segment share similar expenditure patterns and cost structures. The considerable difference in the OPEX volume indicates that the non-unitised segment represents a smaller proportion among services in train kilometers. The segment provides Estonia EUR 9.6 mn annual average profit, strengthening the project's overall financial viability.

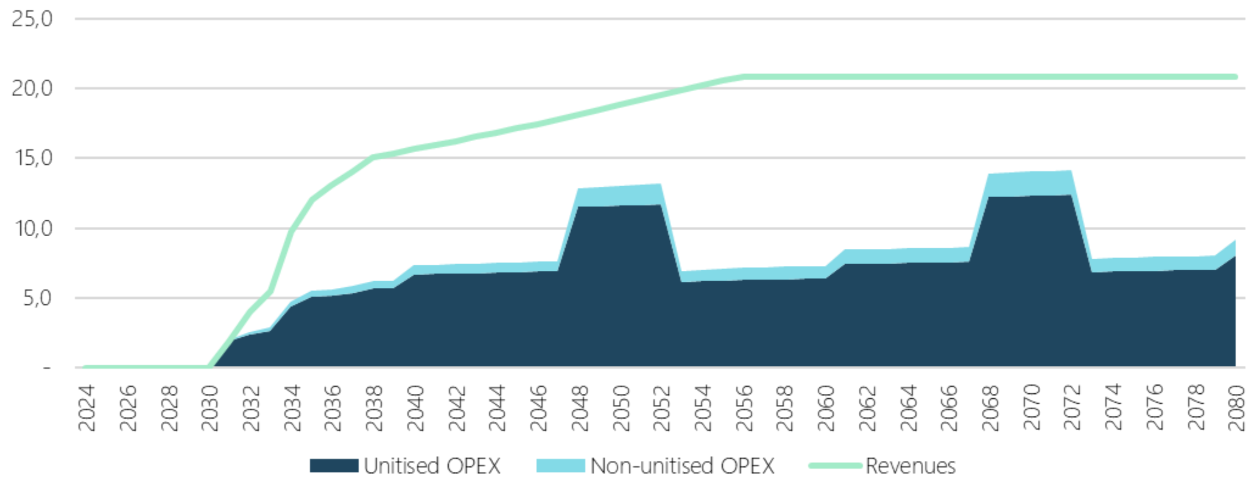


Figure 130: RB Estonia freight OPEX and revenues, EUR mn

10.7.2 Latvia

The freight and passenger sectors in Latvia display similar patterns regarding OPEX**.** Generally, OPEX has a repetitive and incrementally increasing trend which culminates in the two major investment events over time. Although there are similarities in the evolution of expenses, the sectors exhibit a strong contrast in their profitability profiles. The freight segment stands out as being more financially promising due to its ability to generate revenue couple of years after the start of operation. After the completion of ramp-up phase, the freight segment keeps a steady profit margin during standard years, OPEX exceeding revenues only in major investment events. Compared to the other countries, Latvia has the highest average loss nominally throughout the examined operational years, due to higher initial CAPEX invested during the construction years, what turns into asset renewal during operation.

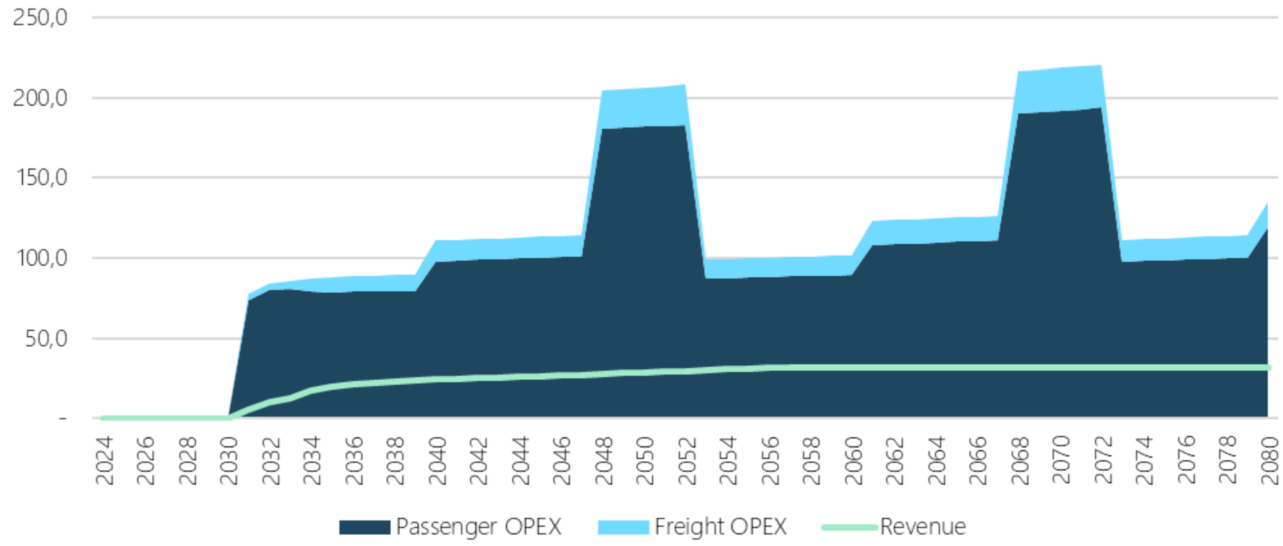


Figure 131: RB Latvia OPEX and revenues, EUR mn

Passenger Segment Financial Analysis

In Latvia, the outlook for the passenger segment looks challenging since projected revenue is anticipated to fall short of OPEX incurred across regional, high-speed, and night segments. The passenger segment in Latvia is generating significantly larger operating loss. When looking at OPEX composition, regional service dominates the cost structure, accounting for the largest share, followed by the high-speed services with marginal ~12% average annual difference. In contrast, expenses associated with the night segments are considerably smaller. Thus, while all services contribute to the overall financial performance, it is the regional and high-speed services that generates the most significant loss.

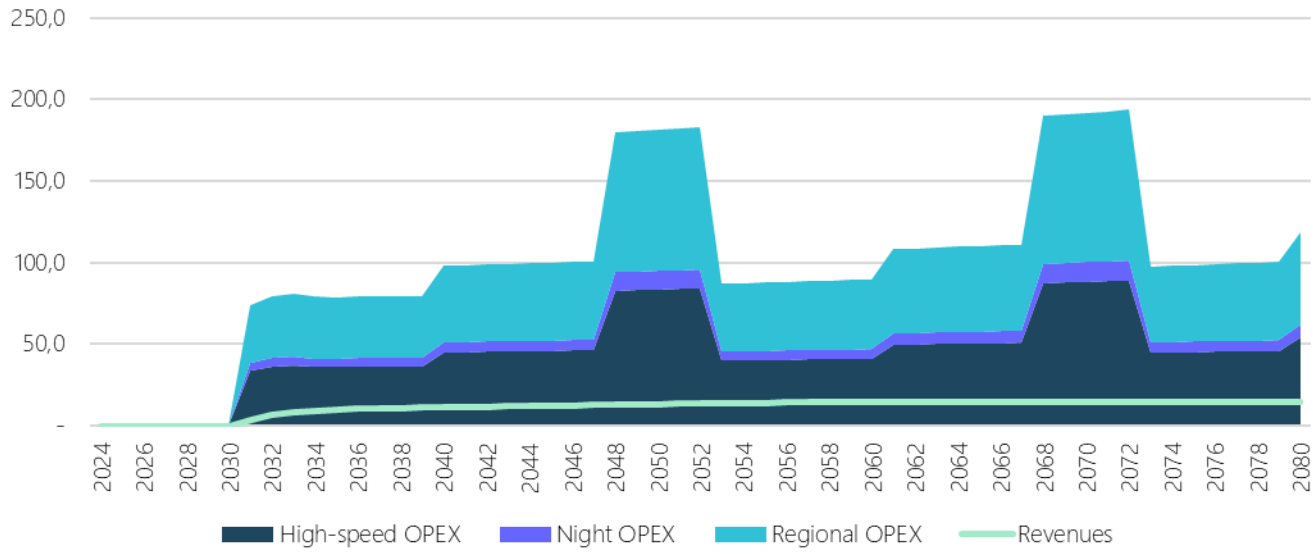


Figure 132: RB Latvia passenger OPEX and revenues, EUR mn

Freight Segment Financial Analysis

The freight segment in Latvia displays a notable upward trend in profitability, with revenues increasing following the ramp-up of train services. After an initial growth period, these revenues stabilize, indicating a solid financial footing. There are similarities in terms of cost structure: the unitised segment of the freight operations consistently demands a slightly higher portion of the operational expenses compared to the non-unitised segment. Comparing the profitability of the two segments, the unitised can generate profit almost in every year with standard conditions.

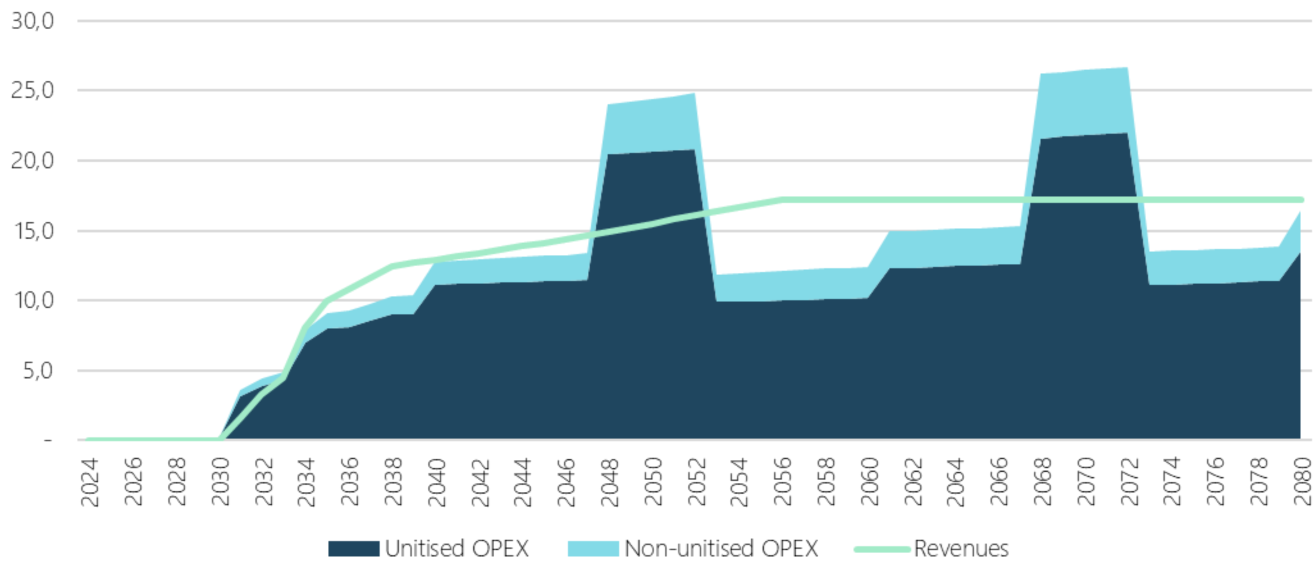


Figure 133: RB Latvia freight OPEX and revenues, EUR mn

10.7.3 Lithuania

The operational costs for both the freight and passenger sectors follow a similar pattern in Lithuania, characterized by general stability with two prominent peaks indicating periodic expenditure increases during major investment events. When it comes to profitability, there is a clear difference, the freight segment, also within the unitised service, generates revenue early after the ramp-up years, making it financially profitable compared to the passenger segment, except during major investment events.

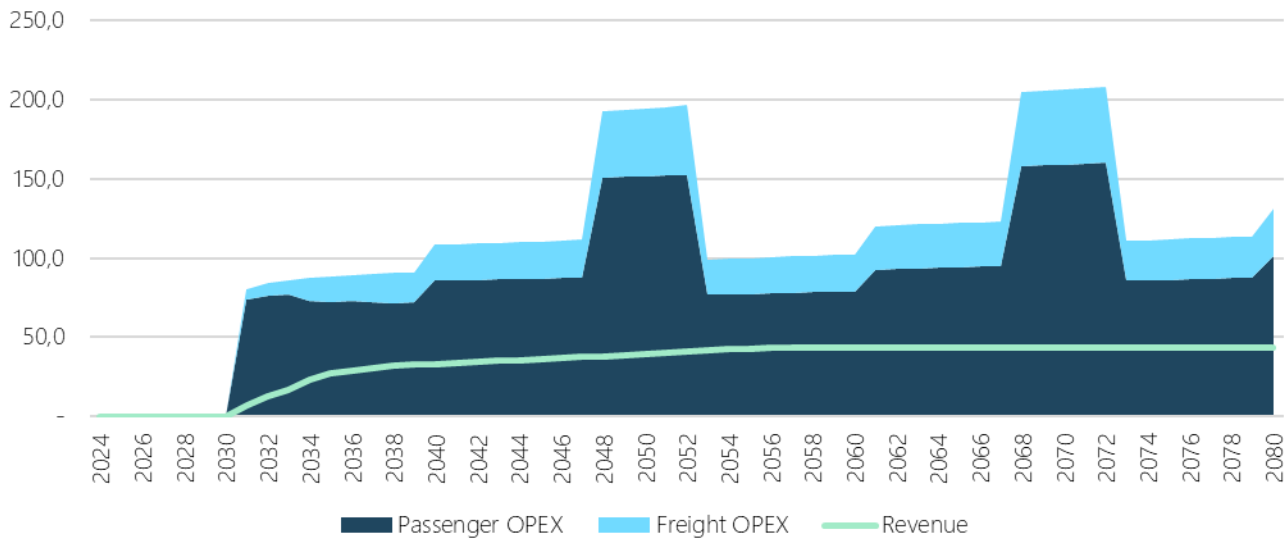


Figure 134: RB Lithuania OPEX and revenues, EUR mn

Passenger Segment Financial Analysis

Lithuania's passenger segment also faces financial challenges related to the operational costs outweighing revenues in the regional, high-speed, and night services. A detailed examination of OPEX confirms that regional and high-speed services are the primary cost contributors. The regional services incur the highest estimated average annual costs at EUR 49.3 million, closely followed by high-speed services at EUR 43.2 million. On the other hand, expenses linked to night trains, are substantially less – in comparison, it only counts for an annual average of EUR 5.3 mn. So, even though all these services add to the total expenses, the regional and high-speed segments are the primary financial challenges for the sector.

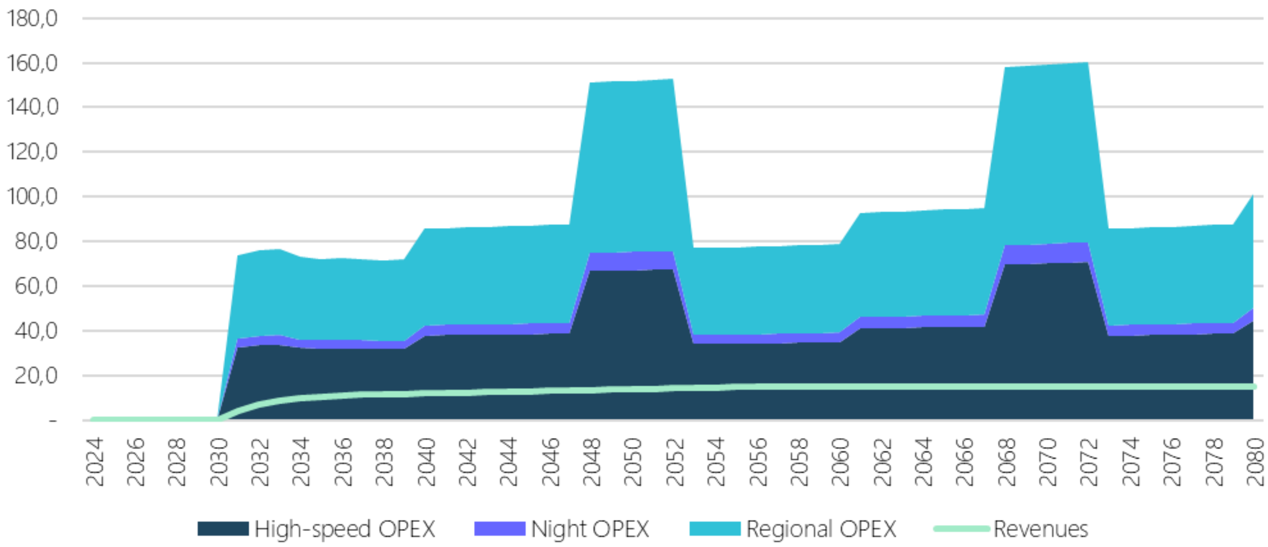


Figure 135: RB Lithuania passenger OPEX and revenues, EUR mn

Freight Segment Financial Analysis

In Lithuania's freight segment, the early years showcase a promising rise in revenue, which eventually levels out at EUR 28.5 mn per year, indicating financial stability. However, closing to and during the major investment events the profit margin disappears and cannot cover operational expenditures until the end of the events. The unitised segment tends to consume a marginally larger slice of the operational budget than the non-unitised one, underscoring the presence of certain universal financial dynamics within the freight industry.

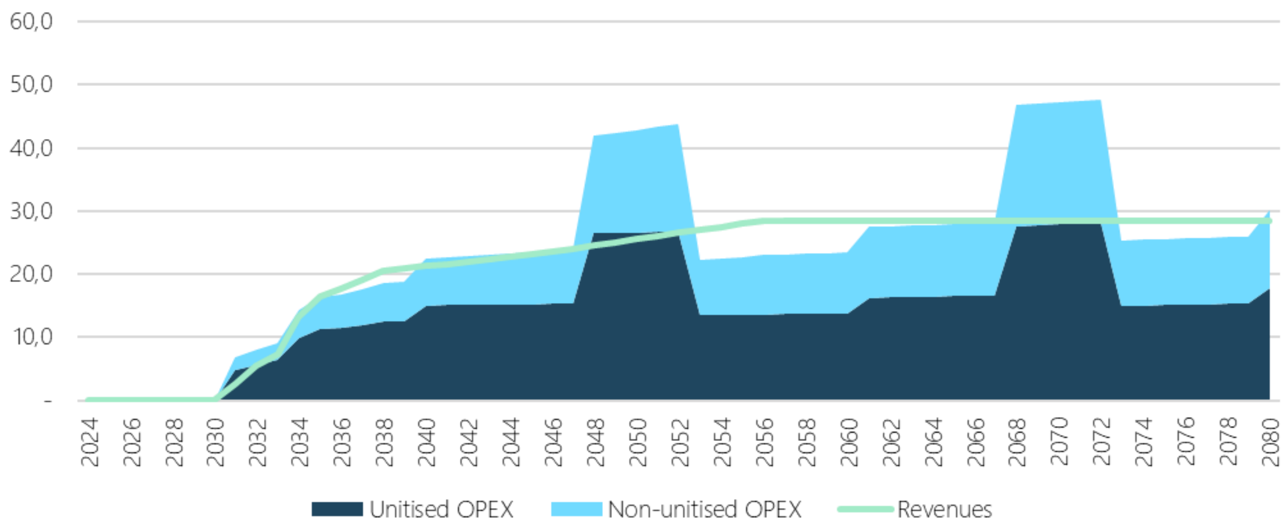


Figure 136: RB Lithuania freight OPEX and revenues, EUR mn

In conclusion, the operational expenditures of both the passenger and freight transportation sectors follow a similar pattern of general stability with occasional spikes due to major financial events related to maintenance and replacements. However, in terms of profitability, freight segment consistently outperforms the passenger segment across all three Baltic countries, with early revenue generation and a rapid growth trajectory indicating a more financially promising outlook for freight transportation in these nations.

10.8 Financial Analysis Results

This section offers a comprehensive analysis of key financial metrics, presenting a detailed overview of the financial net present value (FNPV) across various facets of RB Phase 1. This analysis encompasses the FNPV of CAPEX investments, providing insights into efficiency and returns on capital expenditures. It delves into the FNPV of mainline operations cash flows, shedding light on the financial performance of the core infrastructure. Similarly, the FNPV of facility operations cash flows provide a deep dive into the financial dynamics of passenger stations and freight terminals. Additionally, the section covers the FNPV of residual value, a critical component contributing to the total FNPV, as well as electricity resale. This holistic analysis allows for a thorough understanding of the project's financial viability, sustainability, and overall economic impact.

Notably, the financial net present value on investment (FNPV(C)) is found to be negative, with a value of EUR -13.5 bn, aligning with the general anticipated financial dynamics typical of railway projects. This negative FNPV(C) is indicative of the substantial upfront capital expenditures, the challenges often associated with long-term infrastructure investments, and the overall financial landscape that is inherent to railway developments. High-speed and night train segments are expected to be positive, however with low demand from the region and Western Europe now, it is negative. In contrast, the FNPV(C) for freight services within the Phase 1 scope is positive, signifying a contributing segment to the business case. Moreover, this profitability points to potential for growth, with further investments likely to enhance performance and expand capacity. Such investments could amplify the segment's financials and competitive advantage, potentially positioning freight services as a key revenue generator in the overall portfolio. Despite the negative financial FNPV(C), it is essential to consider the broader socioeconomic benefits and long-term value that such projects contribute to regional development, mobility, and economic growth.

10.8.1 Financial Net Present Value

This results overview provides a detailed financial snapshot of the project, highlighting both the challenges and opportunities within its various segments:

CAPEX:

- The NPV (EUR -12.3 bn) associated with CAPEX is negative, signifying the substantial initial investments required for the project.

Mainline Operations:[76]

- **High-speed:** The NPV (EUR -561 mn) for high-speed train operations is negative, reflecting the costs and investments associated with this service.
- **Night:** Similarly, the NPV (EUR -51 mn) for night train operations is also negative due to costs and capital expenditures.

[76] Effect of increasing passenger TAC can be found in the Passenger TAC subsection of the report.

- **Regional:** The regional train operations NPV (EUR -779 mn) is strongly negative, illustrating the significant financial commitments and challenges faced in maintaining regional services.
- **Unitised:** In contrast, the NPV (EUR 58 mn) for unitised freight services is positive, indicating the revenue generation and financial sustainability of this segment.
- **Non-unitised:** The NPV (EUR -24 mn) for non-unitised freight services is also negative, due to perceived handling capacity issues in existing terminals.

Other Operations:

- **Passenger stations:** The financial analysis reveals a positive NPV (EUR 7 mn) for station operations, emphasizing their role as revenue-generating hubs.
- **Freight terminal:** Freight terminal operations also yield a positive NPV (EUR 67 mn), highlighting their efficiency in handling freight and contributing positively to the project's financial health.
- **Ancillary:** The ancillary revenues also contribute positively to the NPV (EUR 24 mn).
- **Electricity resale:** After the inspection of the resale opportunity, a positive NPV (EUR 67 mn) reveals a modest, but positive potential dependent on further country specific analysis of regulation, cost, and ability of IMs to acquire an electricity license.

Residual Value:

- The residual value is calculated using the depreciation formula and summing all not-modelled weighted average useful lifetime cash flows, resulting in a positive FNPV (EUR 3 mn), reflecting the enduring value of project assets.

Total FNPV(C):

- When all elements are considered, the cumulative FNPV(C) (EUR -13.5 bn) is negative, reflecting the challenges and investments associated with a comprehensive railway project.

The following figure summarized the key elements of FNPV(C).

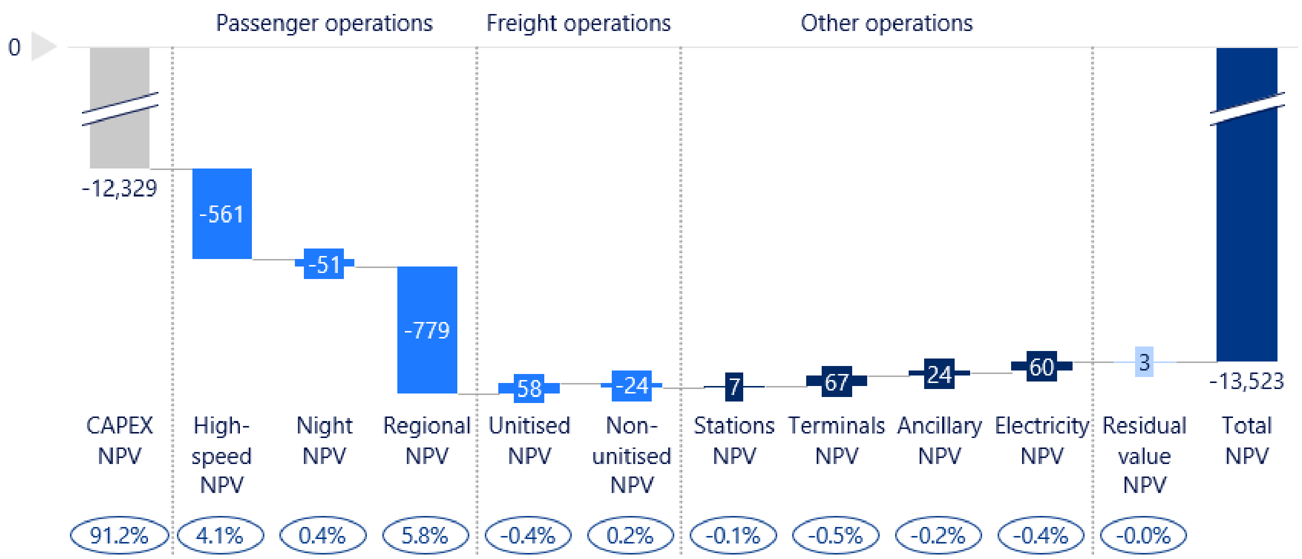


Figure 137: RP PHASE 1 FNPV(C) build-up, EUR mn

The build-up of the FNPV(C) totaling to EUR -13.5 bn is a result of various contributing components that encapsulate the complex financial landscape. In this calculation, revenues account for EUR 220 mn discounted. Conversely, the project's expenses play a pivotal role, amounting to the negative NPV of EUR -13.7 bn discounted.

The following table details each component of the FNPV build-up, also referencing FNPV (K) that reflects the return on national capital.

Key parameters	Value	Unit of Measurement	Type
Revenues	**817**	**EUR mn**	**Discounted**
Passenger track access charges	256	EUR mn	Discounted
Freight track access charges	295	EUR mn	Discounted
Passenger stations	27	EUR mn	Discounted
Freight terminals	154	EUR mn	Discounted
Ancillary revenues	24	EUR mn	Discounted
Electricity resale	60	EUR mn	Discounted
Expenses	**14,343**	**EUR mn**	**Discounted**
CAPEX	12,329	EUR mn	Discounted
OPEX	1,224	EUR mn	Discounted
• *Maintenance*	834	*EUR mn*	*Discounted*
• *Other expenses*[77]	390	*EUR mn*	*Discounted*
Asset renewal	790	EUR mn	Discounted
Residual value	**3**	**EUR mn**	**Discounted**
FNPV (C)	**(13,523)**	**EUR mn**	**Discounted**
FRR (C)	**N/A (negative CF)**	**%**	
FNPV (K)	**(2,842)**	**EUR mn**	**Discounted**
FRR (K)	**N/A (negative CF)**	**%**	

Figure 138: RB Phase 1 FNPV(C) & (K) component build-up

Based on the inputs from the FNPV analysis, a critical financial parameter is the financing gap, quantified at 109.68%. This metric signifies the difference between projected expenses, revenues, and residual value. It provides a pragmatic assessment of the financial challenges the project confronts, revealing the extent to which expenses surpass revenue generation. The financing gap serves as a pivotal indicator to guide practical financial planning and resource allocation, essential for closing the fiscal divide and achieving financial sustainability.

[77] Other expenses: personnel expenses, cost of materials, utilities, and ICT

The following table outlines the calculation of the financing gap:

Key parameters	Discounted value	Unit of Measurement
Total CAPEX	12,329	EUR mn
Residual value	3	EUR mn
Revenues	817	EUR mn
Expenses	2,014	EUR mn
Net profit	(1,194)	EUR mn
Expenses not covered by revenues	13,523	EUR mn
Financing gap rate[78]	109.68	%

Figure 139: RB Phase 1 financing gap calculation

Benchmarking NPV/km

This analysis focuses on comparing the FNPV/km of various high-speed rail lines. The projects under consideration are High Speed 1, Barcelona-Perpignan, Barcelona-Madrid, and Vancouver-Oregon. The FNPV/km metric is pivotal for assessing the economic viability of these projects.

RB Phase 1 has an FNPV of EUR -13.5 bn, positioning it between the FNPV values of High Speed 1 and Vancouver-Oregon. While it has a lower FNPV than Vancouver-Oregon, it is closer to High Speed 1's.

RB Phase 1 exhibits an FNPV/km of EUR -17.7 mn/km. While this is worse than Barcelona-Madrid (EUR -7.0 mn/km), it outperforms High Speed 1 (EUR -61.0 mn/km), Vancouver-Oregon (EUR -45.0 mn/km) and Barcelona-Perpignan (EUR -24.7 mn/km).

High-speed rail line	High Speed 1	Barcelona-Perpignan	Barcelona-Madrid	Vancouver-Oregon	RB Phase 1
Route length (km)	108	175	621	482	**763**
Max speed (km/h)	300	350	350	400	**250**
NPV (EUR bn)	(6.6)	(4.3)	(4.4)	(21.7)	**(13.5)**
NPV/km (EUR mn)	(61.0)	(24.7)	(7.0)	(45.0)	**(17.7)**

Figure 140: High-speed rail project NPV benchmarking (Consultant team analysis)

In the context of FNPV/km, RB Phase 1 demonstrates a performance that falls between Barcelona-Madrid and the less economically viable High Speed 1 and Vancouver-Oregon. The longer track length of RB should be considered when evaluating its overall financial viability in comparison to the other benchmarks.

[78] Financing gap rate = Expenses not covered by revenues NPV / Total CAPEX NPV

10.8.2 Financial Rate of Return

The financial rate of return on investment (FRR(C)) and return on national capital (FRR(K)) in the case of RB cannot be calculated due to negative cash flows during the modelled years of the project.

10.9 Financing Plan

10.9.1 Introduction

The funding for the RB project will be derived from a multifaceted approach encompassing **European Union (EU) resources**, **national co-financing**, and **various alternative financing options**. As per insights provided by the Finance department of RBR, it is envisaged that the principal funding component will originate **from EU Funds**, constituting **60% of the project expenses**. Furthermore, the three Baltic nations are expected to make substantial contributions to the endeavor through their respective **national co-financing, typically accounting for 30-40% of the total project cost**.

The residual **0-10% of the project's financial requirements will be met through a diverse range of private funding sources**. These may encompass state-backed financing, the utilization of Public-Private Partnerships (PPPs), concession agreements, or the engagement of international financial institutions. This comprehensive funding strategy underscores the project's commitment to securing the necessary resources from a variety of avenues.

10.9.2 Key Financing Sources

EU Funds

Connecting Europe Facility (CEF) Transport funds

The Connecting Europe Facility (CEF) is a funding instrument of the European Union that supports investment in transport infrastructure across Europe. It is one of the key pillars of the EU's transport policy, and it aims to create a more interconnected and efficient transport network.

CEF Transport is the main source of funding for the RB project with an 81% co-funding rate from the EU. **The project has already secured over EUR 2.237 bn** in funding from CEF Transport as of October 2023, and it is expected to receive additional funding in the future. Part of the CEF financing sources is **Military Mobility.** The RB project managed to secure an **additional EUR 4.9 mn** in funding.

CEF funding instruments are categorized into specific actions, from which RB has secured the following amounts:

Name of grant agree-ment[79]	Action 2014-LT	Action 2014	Action 2015	Action 2016	Action 2019s	Action 2019w	Action 2020	Action 2021	Action 2021-MM	Action 2022-C	Action 2022-G	Sum
Amount (EUR mn)	72	442	130	110	73	108	16	353	4.9	323	605	**2.237**

Figure 141: Secured CEF funding instruments until 2022, EUR mn

The application process to receive further CEF funding is in progress, and RB expects to receive additional funds in the upcoming years with 60% co-funding rate. However, the **availability of CEF funding in the future is uncertain, which could pose a risk to the financing of the project**.

Cohesion Fund

The Cohesion Fund is designed to reduce the economic and social gap between and within countries where gross national income (GNI) is below 90% of the EU average. **Estonia** will receive **3.5 bn EUR** from the Cohesion Fund from 2021 to 2027 (European Commission, 2023b), **Latvia 4.6 bn EUR** (European Commission, 2023c), and **Lithuania 6.4 bn EUR** (European Commission, 2023d).

European Regional Development Fund (ERDF)

The ERDF aims to strengthen economic, social, and territorial cohesion in the EU by correcting imbalances between its regions. The ERDF can co-finance a percentage of around 50%-85% of eligible costs.

Recovery and Resilience Facility (RRF)

The RRF is a temporary instrument that is the centerpiece of NextGenerationEU, the EU's plan to emerge stronger and more resilient from the COVID-19 crisis. **Estonia** will receive a grant from RRF of **EUR 0.953 bn** (European Commission, 2023e), and **EUR Latvia 1.826 bn** (European Commission, 2023f). **Lithuania** was initially supposed to receive a grant of EUR 2.224 bn, revised to **EUR 2.1 bn**, with a **potential additional EUR 0.194 bn** and a **proposal for EUR 1.7 bn in loans** (European Parliament, 2023b).

National Co-Funding

National co-funding is an essential component of the project's financing. In addition to CEF funding instruments, the **three Baltic states are expected to contribute at between 30-40% in national co-funding**. However, due to the significant increase CAPEX estimates compared to the project's original budget, **state co-funding rates for certain assets could increase significantly** to complete the project on time depending on availability of EU funding.

[79] Names of grant agreements signed between the European Innovation and Networks Executive Agency (INEA) and the RB joint venture

The following table summarizes the national co-funding contributions that the Baltic states have made to the RB project to date.

Action 2014-LT	Action 2014	Action 2015	Action 2016	Action 2019s	Action 2019w	Action 2020	Action 2021	Action 2021-MM	Action 2022-C	Action 2022-G	Sum
12	94	22	19	12	19	2.9	68	4.9	87	108	**454.2**

Figure 142: National co-funding amount per CEF action, EUR mn

Potential Alternative Financing Sources

Three alternative financing avenues are available to address the project's funding shortfall spanning from 2024 to 2030. These options encompass **state financing, Public-Private Partnerships (PPPs) or concessions, and engagement with international financial institutions**. However, achieving private project financing necessitates a structured approach, and RB must navigate **three key steps** to enhance its prospects of securing funding from private sources successfully.

Preparing the RB project for private project financing

Private project financing is a way to finance large-scale infrastructure projects by attracting private investment. Private investors are willing to invest in such projects if they believe that they will generate a sufficient return on their investment.

The RB project is a large-scale infrastructure project that is eligible for private project financing. However, there are several steps that need to be taken to prepare the RB project for private project financing.

Step 1: Establish clear infrastructure management principles and establish multi-annual contracts with them

IMs are responsible for the operation and maintenance of railway infrastructure. To attract private investment, it is important to establish clear infrastructure management principles and sign multi-annual contracts with them. These contracts should define the IMs' responsibilities for construction, operation, and maintenance, as well as the revenue stream that they will receive.

Requirements:

- Create a clear cash flow profit-sharing mechanism between the three Baltic states.
- Set TACs methodology and values for 3 countries, stable over time and countries.
- Make it a legal requirement.
- Prepare business plans for IMs for a period of 7-20 years.

Step 2: Provide state guarantees for the construction period

State guarantees can help to protect private investors from the risk of financial loss. This is important because the construction of large-scale infrastructure projects can be complex and risky.

Requirements:

- A state guarantee that should be provided for the entire financing period to secure the construction phase.
- Getting export credit agency guarantees.

Step 3: Refinance the project without state guarantees, but maintain the multi-annual contracts

Once the RB project is operational and generating a sustainable revenue stream, it may be possible to refinance the project without state guarantees. This would reduce the cost of financing for the project and allow private investors to generate a higher return on their investment.

Requirement:

- Multi-annual contracts must be in place and enforceable.

State Financing Tools

Financing additional funding needs of the RB project from **national budgets will likely be a necessary option to complete the whole project on time**. However, there is a risk that the national credit rating could fall to levels that would significantly negatively impact the state if funding for state needs increases too much.

One option to increase the national budget for the RB project would be to increase carbon taxes for roads. This would also help the Baltic states to reduce their greenhouse gas emissions. As of March 1, 2023, 21 European countries have introduced carbon taxes, and the Baltic states still have room to increase carbon tax rates as current levels are well below EU member averages. Taxes in Europe range from less than EUR 1 per metric ton of carbon emissions in Ukraine to more than EUR 100 in Sweden, Liechtenstein, and Switzerland. The EU average is EUR 44.5 per metric ton of carbon emissions, while Latvia's taxes are set at EUR 15 per metric ton of carbon emissions, and Estonia's rates are set at EUR 2 per metric ton of carbon emissions that are set to increase in 2024 July to EUR 25 per metric ton. Lithuania does participate in the European Union Emissions Trading System (EU ETS), but it does not currently have an explicit carbon tax. The Lithuanian government has proposed to introduce an explicit carbon tax in 2025. The proposed tax would start at EUR 10 per ton of CO2 and rise gradually to EUR 60 per ton of CO2 in 2030.

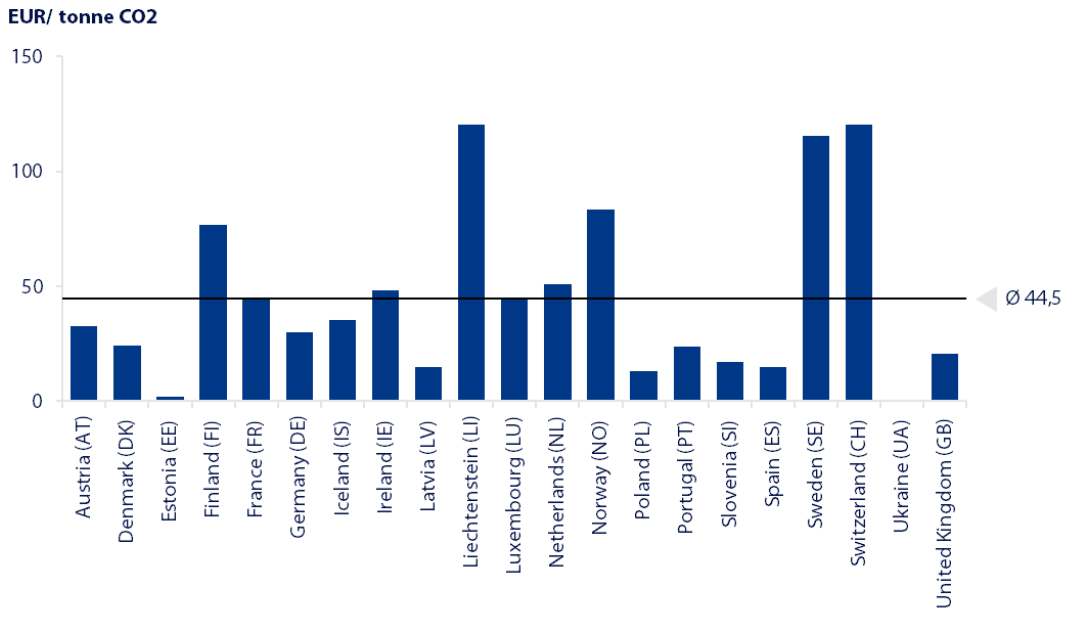


Figure 143: Carbon tax rates in Europe, EUR/ton CO2 (Tax Foundation, 2023)

Another way in which the states could finance the RB project would be **to borrow funds and then lend them to the project companies**. This is often the most cost-effective way of borrowing, but it requires a multi-year contract between the government and companies. It is important to note that the **government may be providing**

state aid to the project company if it borrows money at a lower than market interest rate and then lends it to the project company at the market rate. If this is the case, the government has to consider additional costs (including further risk cost) that may arise, therefore, the government may need to charge the project company an additional margin to cover these costs.

Public-Private Partnerships and Concessions

This option allows the government to tap into the private sector's expertise and resources and reduce the overall project risk. PPPs and concessions are a good solution for the **sections of the project that are most profitable**, yet they also take some part of the profit away from such sections.

International companies **are interested in financing the Rīga loop of the project as a PPP, but in case of insufficient funding for the entire project, the main corridor would be prioritized**. Additional funding could be available from the EU's Multiannual Financial Framework (MFF) in 2035.

Concessions could be a **good option for sections with high service demand if the private sector is willing to take on the risk**. To reduce the private sector's risk, there are three options to consider.

1. To **offer state guarantees**, which is the most straightforward option but also the most expensive one.
2. To **sign multi-annual contracts**, which would require the governments to sign long-term contracts with IMs.
3. To **involve export credit agencies**, as they can provide guarantees for loans made to private companies working on infrastructure projects in developing countries. This is a relatively low-cost financing option but is not suitable for all projects.

If the PPP financing option is pursued to fund a portion of RB-related investments, it would entail engaging in state aid, and consequently adhering to the state aid regulations. This would further mean that the eligibility to apply for the maximum allowable Cohesion Fund support rate would be forfeited.

International financial institutions

International financial institutions provide credit and equity funding as well as guarantees for railway projects. Based on the analysis of the team and the input provided by the RBR team, the following international financial institutions are potential good partners for RB:

- The **Nordic Investment Bank**, for example, provides sustainable, long-term financing for their customers in both the private and public sectors on competitive market terms. Nordic Investment Bank loans usually do not exceed 50% of the project costs. They have allocated a total of EUR 3.8 bn in new funding in the first quarter of 2023.
- The **European Bank for Reconstruction and Development (EBRD)** focuses on projects dealing with infrastructure and climate action, supporting social impact goals. They finance equity stakes of up to 35% and invest between EUR 10 mn and EUR 200 mn per investment. Loans to private sector projects usually start from a minimum of EUR 3 mn up to EUR 250 mn.
- The **European Investment Bank (EIB)** is the lending arm of the European Union and one of the largest providers of climate finance. It provides equity investments of 10% to 20% of the fund size, with a maximum of 25%. Typical investment size is between EUR 25 and EUR 60 mn but can go up to EUR 200 mn for certain conditions. Loans for the public sector can cover up to 50% of a project's total cost, which starts at EUR 25 mn. The EIB approved a total of EUR 65.15 bn of financing in 2022.

10.9.3 Financial Sustainability Analysis

The sustainability analysis indicates that **the project will require external financing throughout its life cycle, both during the construction and operational phases, as it is not expected to generate sufficient revenue and cash flow to cover its costs and meet its financial obligations over the long term**. It is important to note that future externalities could make the business case for the project positive, even if European connectivity is not yet predictable for the infrastructure.

The following figure shows the **additional subsidy requirements during the operational phase, from 2031 to 2080**. It is currently estimated that the additional funding needed for operations will be around **EUR 270 mn annually.**

Year	Revenues	Costs	Cash flow for the year	Opening cash balance	Closing cash balance	Closing after additional funding	Additional funding needed
2024	-	-	-	-	-	-	-
…							
2030	-	-	-	-	-	-	-
2031	34	281	(247)	-	(247)	-	247
2032	58	297	(239)	-	(239)	-	239
2033	72	304	(232)	-	(232)	-	232
2034	96	311	(216)	-	(216)	-	216
2035	110	316	(207)	-	(207)	-	207
2036	117	319	(203)	-	(203)	-	203
2037	122	321	(199)	-	(199)	-	199
2038	128	324	(195)	-	(195)	-	195
2039	130	324	(195)	-	(195)	-	195
2040	131	373	(242)	-	(242)	-	242
2041	134	375	(241)	-	(241)	-	241
2042	136	376	(240)	-	(240)	-	240
2043	138	378	(240)	-	(240)	-	240
2044	140	379	(239)	-	(239)	-	239
2045	143	381	(238)	-	(238)	-	238
2046	145	383	(238)	-	(238)	-	238
2047	147	385	(237)	-	(237)	-	237
2048	150	601	(452)	-	(452)	-	452
2049	152	604	(452)	-	(452)	-	452
2050	155	607	(452)	-	(452)	-	452
2051	157	609	(452)	-	(452)	-	452
2052	160	612	(453)	-	(453)	-	453
2053	162	352	(190)	-	(190)	-	190
2054	165	354	(189)	-	(189)	-	189
2055	168	356	(188)	-	(188)	-	188
2056	170	358	(188)	-	(188)	-	188
2057	170	359	(189)	-	(189)	-	189

Year	Revenues	Costs	Cash flow for the year	Opening cash balance	Closing cash balance	Closing after additional funding	Additional funding needed
2058	170	360	(190)	-	(190)	-	190
2059	170	361	(191)	-	(191)	-	191
2060	170	362	(192)	-	(192)	-	192
2061	170	411	(241)	-	(241)	-	241
2062	170	413	(242)	-	(242)	-	242
2063	170	414	(244)	-	(244)	-	244
2064	170	415	(245)	-	(245)	-	245
2065	170	417	(246)	-	(246)	-	246
2066	170	418	(248)	-	(248)	-	248
2067	170	419	(249)	-	(249)	-	249
2068	170	636	(465)	-	(465)	-	465
2069	170	638	(468)	-	(468)	-	468
2070	170	640	(470)	-	(470)	-	470
2071	170	643	(473)	-	(473)	-	473
2072	170	645	(475)	-	(475)	-	475
2073	170	385	(215)	-	(215)	-	215
2074	170	386	(216)	-	(216)	-	216
2075	170	387	(217)	-	(217)	-	217
2076	170	389	(218)	-	(218)	-	218
2077	170	390	(219)	-	(219)	-	219
2078	170	391	(221)	-	(221)	-	221
2079	170	392	(222)	-	(222)	-	222
2080	170	441	(271)	-	(271)	-	271

Figure 144: RB Phase 1 sustainability analysis, EUR mn

When observing the subsidies allocated to the high-speed segment, Lativa leads with a subsidy of EUR 45.0 mn, followed closely by Lithuania with EUR 36.0 mn, and Estonia with a lower allocation of EUR 12.6 mn. The night segment receives the lowest allocation in Estonia (EUR 0.2 mn), while Latvia and Lithuania have higher subsidies with EUR 4.9 mn and EUR 3.1 mn respectively. A significant portion of the subsidies in Latvia and Lithuania are directed towards the regional segment, with Latvia needing to allocate EUR 50.4 mn and Lithuania at EUR 45.2 mn. Estonia, on the other hand, needs to allocate a lower amount of EUR 34.9 mn. As mentioned throughout the *Financial Analysis* chapter, passenger segments are forecasted to be loss generating, thus large subsidies are needed to sustain them.

While the unitised segment is generally profitable, during asset renewal years, it generates a loss but these losses are averaged out throughout the years resulting an unsubsidized segment in all countries. Lastly, the non-unitised segment sees allocations with Lithuania providing a subsidy of EUR 4.6 mn and Latvia allocating EUR 1.4 mn, while in Estonia the average annual need is EUR 0.0 mn.

Country	High-speed	Night	Regional	Unitised	Non-unitised
Estonia	12.6	0.2	34.9	0.0	0.0
Latvia	45.0	4.9	50.4	0.0	1.4
Lithuania	36.0	3.1	45.2	0.0	4.6

Figure 145: RB average annual subsidy need per segment per country, EUR mn

10.9.4 Financing of the Construction and Operational Phases

The RB project is financed through a combination of construction financing and operational financing. Details for the two phases are described below.

Construction Financing

The construction phase is expected to be finished by 2030 but is subject to change. **During this period, out of the total CAPEX requirements**, **60%** of financing comes from **EU financing sources**, **30-40%** from **state co-funding** and **0-10%** from private sources.

There is major risk associated with the assumed financing structure of the project. Decrease in the percentage of grants can significantly increase the interest expenses. Furthermore, not securing funds in a timely manner can cause delays in construction. Associated risks with financing can be found in detail in the *Appendix* in the *Risk Mapping* section.

The total financing need of the constructions phase adds up to a total value of EUR 16.8 bn not accounting for inflation from 2023 on, of which **EUR 10.1 bn comes from EU funds**, **EUR 5.7 bn from national co-funding** and **EUR 1.0 bn from alternative financing sources**. The following table summarizes the already identified and expected sources of construction financing by year and by country. In case of unavailability of the expected amount in EU funds, state co-funding and alternative financing sources need to increase.

Up to 2024	2025	2026	2027	2028	2029	2030	Sum
EU funds (60% of total CAPEX)							
EE	203	241	402	443	357	314	114	**2,073**
LV	308	521	897	971	751	613	210	**4,270**
LT	147	433	782	853	694	611	213	**3,732**
Total	**657**	**1,195**	**2,080**	**2,266**	**1,802**	**1,537**	**537**	**10 075**
State co-funding (30%-40% of total CAPEX)								
EE	135	160	268	295	238	209	76	**1,382**
LV	154	260	448	485	375	306	105	**2,135**
LT	85	253	456	497	405	356	124	**2,177**
Total	**375**	**674**	**1,172**	**1,278**	**1,018**	**872**	**305**	**5,694**
Alternative financing (0%-10% of total CAPEX)								
EE	-	-	-	-	-	-	-	**-**
LV	51	87	149	162	125	102	35	**712**
LT	12	36	65	71	58	51	18	**311**
Total	**64**	**123**	**215**	**233**	**183**	**153**	**53**	**1,023**

Figure 146: Sources of construction financing by country, EUR mn

Operational Financing

Operational financing of the RB project is assumed to **start in 2031 and continue until 2080**. Operating costs will need to be subsidized by each state, with **a higher subsidy required every 20 years during major investment events.** Subsidies can be given to either passenger or freight operations. If either category generates a surplus, it is possible to allocate that surplus to the other category, which is referred to as cross-financing. In the base case, **passenger operations** are loss generating so they **could be cross financed from freight** operations making a surplus.

Analysis shows that there is a **5% difference in subsidy needs between scenarios with and without cross-financing**. **Without cross-financing**, the total need is **EUR 322 mn** while with **cross-financing**, the total subsidy need is estimated to be **an annual EUR 306 mn for the three Baltic countries**. The following two tables summarize the yearly estimates for both scenarios by year and by country.

Annual average subsidy need	Estonia	Latvia	Lithuania	Total
With cross-financing	25	159	122	306
Without cross-financing	35	161	125	322

Figure 147: Subsidy need across countries with and without cross financing, EUR mn

The **need for subsidies during the operational phase could be mitigated by introducing the Defense Capacity Fee** part of military mobility sources of funding for RB. **Ministries of defense and NATO do not invest in railway infrastructure themselves, but they do pay for usage**. It is difficult to predict how much money actors would be willing to pay as a capacity fee for RB. However, **this could be a possible source of funding**, and it could be put into law. The capacity fee could be a fixed amount, or it could be based on future cash flow. The Defense Capacity Fee would be a way for the military to contribute more to RB as the latter provides benefits not only for passengers and cargo but also for defense.

The following charts showcase annual subsidy needs estimated for passenger operations across countries without and with cross-financing from freight operations.

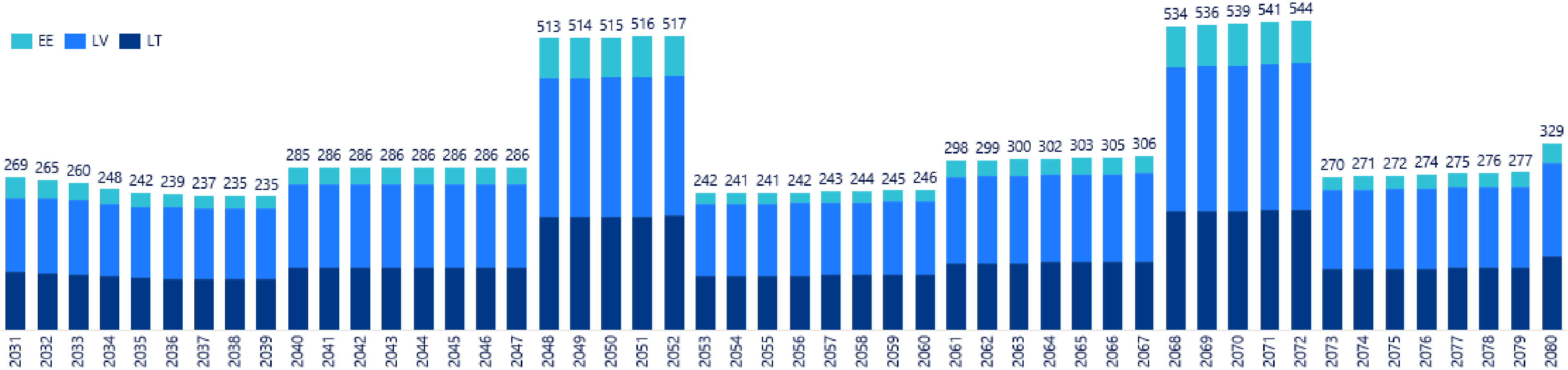


Figure 148: Subsidy need across countries with cross financing, total EUR mn

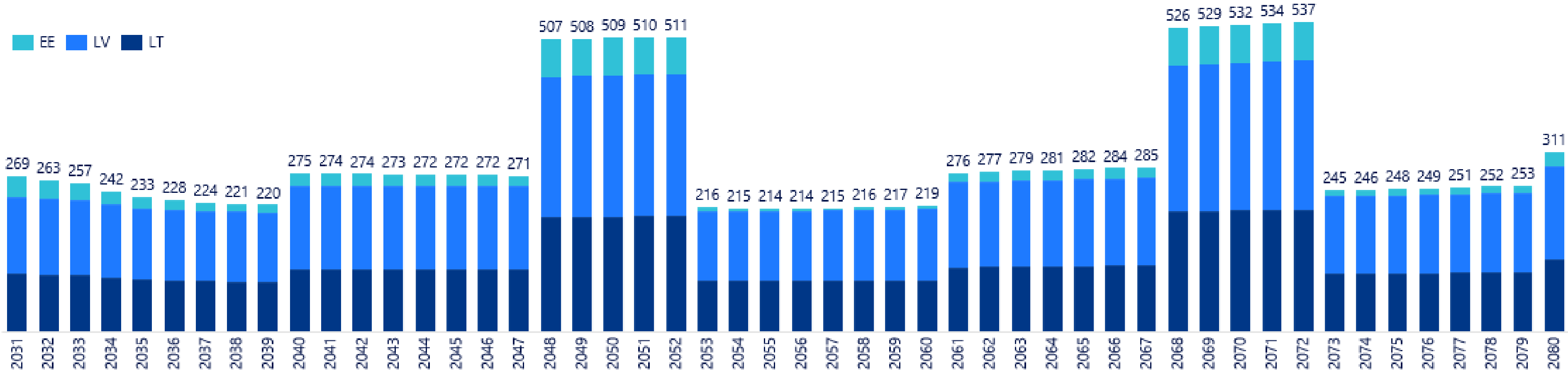


Figure 149: Subsidy need across countries without cross financing, total EUR mn

10.9.5 Financing Sensitivity Analysis

As summarized in the previous sections, the RB project is expected to be financed from three major sources: EU financing, state financing from the three Baltic states, and other sources of financing. In this subsection three analyses are outlined to provide a view on the potential financing plans and their impacts:

- **A sensitivity analysis on FNPV(C)** (Financial Net Present Value on Investment) to demonstrate how varying the shares of different financing sources impacts the overall FNPV value of the RB project.
- **Financing plan scenarios** to offer an overview of the financing needs for each country involved in RB, depending on the distribution of financing sources.
- A **risk-return matrix with different EU financing and interest rates on loan service** for the project to illustrate the maximum feasible combination of leverage and interest rates for the RB project.

Sensitivity Analysis on FNPV(C)

The total financial **net present value of the RB project is highly dependent on CAPEX** due to the nature of the project. During construction period, financing is primarily aimed at covering capital expenditures, making **the cost of financing a crucial factor.**

		EU contribution										
	(13,5)	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
National contribution	0%	(15,0)	(14,9)	(14,7)	(14,5)	(14,4)	(14,2)	(14,0)	(13,9)	(13,7)	(13,6)	(13,5)
	10%	(14,9)	(14,7)	(14,5)	(14,4)	(14,2)	(14,0)	(13,9)	(13,7)	(13,6)	(13,5)	(13,3)
	20%	(14,7)	(14,5)	(14,4)	(14,2)	(14,0)	(13,9)	(13,7)	(13,6)	(13,5)	(13,3)	(13,2)
	30%	(14,5)	(14,4)	(14,2)	(14,0)	(13,9)	(13,7)	(13,6)	(13,5)	(13,3)	(13,2)	(13,0)
	40%	(14,4)	(14,2)	(14,0)	(13,9)	(13,7)	(13,6)	(13,5)	(13,3)	(13,2)	(13,0)	(12,9)
	50%	(14,2)	(14,0)	(13,9)	(13,7)	(13,6)	(13,5)	(13,3)	(13,2)	(13,0)	(12,9)	(12,8)
	60%	(14,0)	(13,9)	(13,7)	(13,6)	(13,5)	(13,3)	(13,2)	(13,0)	(12,9)	(12,8)	(12,7)
	70%	(13,9)	(13,7)	(13,6)	(13,5)	(13,3)	(13,2)	(13,0)	(12,9)	(12,8)	(12,7)	(12,6)
	80%	(13,7)	(13,6)	(13,5)	(13,3)	(13,2)	(13,0)	(12,9)	(12,8)	(12,7)	(12,6)	(12,4)
	90%	(13,6)	(13,5)	(13,3)	(13,2)	(13,0)	(12,9)	(12,8)	(12,7)	(12,6)	(12,4)	(12,3)
	100%	(13,5)	(13,3)	(13,2)	(13,0)	(12,9)	(12,8)	(12,7)	(12,6)	(12,4)	(12,3)	(12,2)

Figure 150 - Sensitivity of FNPV(C) from financing sources, EUR bn

The sensitivity analysis above explores the impact of changes in these proportions, summing up the **sensitivity of FNPV(C) in relation to the various shares of financing**. FNPV(C) excludes interest expenses and interest capitalization. The columns in the table represent the percentage of EU financing, while the rows show the state financing percentages. The proportion of financing from other sources is calculated by subtracting the total of EU and state financing percentages from 100%.

The most favorable options from FNPV(C) perspective are the ones, where other non-EU and non-state **financing sources are low**; please see with green coloring on the figure above. As other financing sources incur costs in terms of debt, this makes this financing source less preferred, and it impacts FNPV(C) negatively. Until the absolute value of FNPV(C) is lower than the absolute value of economic benefits monetized, inclusion of other financing sources with the assumption of having a 5.9% interest rate. The calculated value for economic benefits is EUR 22.1 bn (to be detailed in the next chapter), resulting in a **favorable position regarding FNPV(C), as its absolute value remains always below the absolute value of economic benefits.**

Financing Plan Scenarios

The **EU co-financing rate highly influences the need for other financing sources**; therefore, scenarios are analyzed with different financing plans during the construction period on country level breakdown. Below, there are five financing plan scenarios analyzed with the assumption that 10% of the total financing sources come from other sources. As the value for other sources of financing is fixed, cost of debt is affecting the financing plan scenarios to the same extent, leaving **FNPV(C) value at a negative EUR 13.6 bn level, as seen in the last rows in each table.**

	Share of financing			Share of financing			Share of financing			Share of financing			Share of financing			Share of financing		
	5%	85%	10%	10%	80%	10%	15%	75%	10%	20%	70%	10%	30%	60%	10%	40%	50%	10%
	State funding	EU financing	Other financing	State funding	EU financing	Other financing	State funding	EU financing	Other financing	State funding	EU financing	Other financing	State funding	EU financing	Other financing	State funding	EU financing	Other financing
Estonia	0.2	2.9	0.3	0.3	2.8	0.3	0.5	2.6	0.3	0.7	2.4	0.3	1.0	2.1	0.3	1.4	1.7	0.3
Latvia	0.4	6.0	0.7	0.7	5.7	0.7	1.1	5.3	0.7	1.4	5.0	0.7	2.1	4.3	0.7	2.8	3.6	0.7
Lithuania	0.3	5.3	0.6	0.6	5.0	0.6	0.9	4.7	0.6	1.2	4.4	0.6	1.9	3.7	0.6	2.5	3.1	0.6
Total	**0.8**	**14.3**	**1.7**	**1.7**	**13.4**	**1.7**	**2.5**	**12.6**	**1.7**	**3.4**	**11.8**	**1.7**	**5.0**	**10.1**	**1.7**	**6.7**	**8.4**	**1.7**
FNPV(C)			**(13.6)**			**(13.6)**			**(13.6)**			**(13.6)**			**(13.6)**			**(13.6)**

Figure 151: Financing plan scenarios with 10% of other sources of financing, EUR bn

The table below presents varying assumptions regarding the contribution of other sources to the project's financing, ranging from 0% to 30%. The variations lead to different values for total project FNPV(C). A higher rate of financing from other sources correlates with a lower FNPV(C) value. For instance, a **30 percentage-point increase in the rate of other financing sources (resulting in a 30% contribution) corresponds to a 3 percentage-point decrease in the FNPV(C).**

	Share of financing			Share of financing			Share of financing			Share of financing			Share of financing			Share of financing		
	15%	85%	0%	20%	80%	0%	20%	75%	5%	20%	70%	10%	20%	60%	20%	20%	50%	30%
	National	EU	Other	National	EU	Other	National	EU	Other	National	EU	Other	National	EU	Other	National	EU	Other
Estonia	0.5	2.9	-	0.7	2.8	-	0.7	2.6	0.2	0.7	2.4	0.3	0.7	2.1	0.7	0.7	1.7	1.0
Latvia	1.1	6.0	-	1.4	5.7	-	1.4	5.3	0.4	1.4	5.0	0.7	1.4	4.3	1.4	1.4	3.6	2.1
Lithuania	0.9	5.3	-	1.2	5.0	-	1.2	4.7	0.3	1.2	4.4	0.6	1.2	3.7	1.2	1.2	3.1	1.9
Total	**2.5**	**14.3**	**-**	**3.4**	**13.4**	**-**	**3.4**	**12.6**	**0.8**	**3.4**	**11.8**	**1.7**	**3.4**	**10.1**	**3.4**	**3.4**	**8.4**	**5.0**
FNPV(C)			**(13.5)**			**(13.5)**			**(13.5)**			**(13.6)**			**(13.7)**			**(13.9)**

Figure 152: Financing plan scenarios with varying rates for other sources of financing, EUR bn

Risk-Return Analysis

The risk-return analysis of the RB project examines **the interrelation between the percentage of capital expenditures (CAPEX) financed through grants (EU and national contribution) and the interest rate on loans**. Considering that interest rates can vary significantly over time, evaluating different interest rate scenarios is crucial for understanding their impact on the project's financial health.

The primary **outcome of this analysis is the FNPV(C)** of the project. The following table summarizes the results, based on the assumption that the portion of CAPEX not covered by grants is financed through loans. As shown, **changes in the interest rate have a more pronounced impact on the FNPV(C) than the proportion of the project financed by grants**. This is primarily because **the interest rate also acts as the cost of debt in the WACC calculation**. The most favorable scenario, highlighted in the top right-hand corner of the table, showcases the relationship between WACC and FNPV(C). The improvement in this scenario is largely due to the residual value discounting: as the discount rate decreases, the future value of the asset increases when viewed from the present perspective.

In summary, the interest rate exerts a more significant influence on RB's ability to generate cash flow than the proportion of grants received. The matrix focuses on the FNPV(C), where interest-related expenses are not included. Therefore, the analysis would yield a different outcome if the overall FNPV is used instead.

	Risk-return matrix	Interest rate										
Grant	(13,5)	10,0%	9,0%	8,0%	7,0%	6,0%	5,0%	4,0%	3,0%	2,0%	1,0%	0,0%
25%	-70%	(14,7)	(15,2)	(15,7)	(16,3)	(16,9)	(17,5)	(18,0)	(18,5)	(18,8)	(18,6)	(17,5)
35%	-60%	(14,5)	(14,9)	(15,3)	(15,8)	(16,3)	(16,8)	(17,3)	(17,9)	(18,3)	(18,7)	(18,8)
45%	-50%	(14,3)	(14,6)	(15,0)	(15,4)	(15,8)	(16,2)	(16,6)	(17,1)	(17,5)	(17,9)	(18,3)
55%	-40%	(14,1)	(14,4)	(14,6)	(14,9)	(15,2)	(15,6)	(15,9)	(16,3)	(16,6)	(17,0)	(17,4)
65%	-30%	(13,9)	(14,1)	(14,3)	(14,5)	(14,8)	(15,0)	(15,3)	(15,5)	(15,8)	(16,0)	(16,3)
75%	-20%	(13,7)	(13,9)	(14,0)	(14,2)	(14,3)	(14,5)	(14,6)	(14,8)	(15,0)	(15,2)	(15,3)
85%	-10%	(13,6)	(13,6)	(13,7)	(13,8)	(13,9)	(14,0)	(14,1)	(14,2)	(14,3)	(14,4)	(14,5)
95%	0%	(13,4)	(13,4)	(13,5)	(13,5)	(13,5)	(13,6)	(13,6)	(13,6)	(13,6)	(13,7)	(13,7)
100%	5%	(13,3)	(13,3)	(13,3)	(13,3)	(13,3)	(13,3)	(13,3)	(13,4)	(13,4)	(13,4)	(13,4)

Figure 153: Risk-return matrix, EUR bn

10.9.6 Conclusions

Financing is essential to the success of the RB project. The **total funding requirement for the construction phase is EUR 16.8 bn**, not considering inflation from 2023 on. Of this amount, EUR 10.1 bn will come from EU funds, EUR 5.7 bn from national co-funding, and EUR 1.0 bn from alternative financing sources. During the operational phase, total **subsidy requirements** could range from **EUR 15.3 bn with cross-financing** to **EUR 16.1 bn without cross-financing**.

The sensitivity analysis shows that the amount of **grant funding received for the project has the greatest impact on its profitability**. This suggests that RB should focus on securing as much grant funding as possible.

RB is committed to securing the necessary financing for the project, exploring a variety of financing options, including:

- EU funds
- National co-funding
- Alternative financing sources, such as loans, guarantees, and equity investments
- Cross-financing, which involves allocating surplus revenue from one category of operation (e.g., freight) to subsidize another category of operation (e.g., passenger)

The RB team is confident that it will be able to secure the necessary financing for the project. The project is a strategic priority for the Baltic states and the EU, and it is expected to generate significant economic benefits.

10.10 Sensitivity Analysis

10.10.1 Sensitivity of Drivers

The sensitivity analysis assesses the impact of six different variables on the FNPV(C) of the RB project: discount rate, TAC, traffic demand, CAPEX overrun, OPEX overrun, and 1-TAC incidents on RU revenues. It can be observed that:

- A 1%p reduction in the discount rate decreases FNPV(C) by approximately EUR 0.7 bn. This is because a lower discount rate gives more weight to negative cash flows early in the modeled period. Important, that the sensitivity is progressive on decreasing discount rate changes and degressive on increasing discount rate changes.
- A 10%p reduction in TAC decreases FNPV(C) by EUR 200 mn. This is because TAC is a close to ~50% of the revenue source for the RB project, and a lower TAC revenue would reduce the overall revenue of the project.
- A 10%p increase in OPEX (operating expenses) overrun decreases FNPV(C) by EUR 0.5 bn. This is because OPEX overruns are unexpected increases in operating costs, which can significantly reduce the profitability of a project. The analysis is not symmetrical in results, as the operating profit in aggregate is negative for RB.
- A 20%p decrease in traffic demand decreases FNPV(C) by approximately EUR 50 mn. This is because lower traffic demand would lead to lower revenues for the RB project.
- A 5%p change in CAPEX overrun decreases FNPV(C) by approximately EUR 0.7 bn. This is because CAPEX overruns are unexpected increases in construction costs, which materializing early in the modeled period, can significantly decrease the overall value of the project.
- A 5%p decrease in TAC % of RU revenues decreases FNPV(C) by approximately EUR 50 mn. This is because TAC disruptions can lead to lost revenue for RUs, which can reduce the overall profitability of the RB.

Key findings show that the most significant factors influencing the FNPV(C) are the discount rate, and the CAPEX overrun. Notably, no individual parameter, even under a worst-case scenario, leads to a decrease in FNPV(C) greater than EUR 3.3 bn. In this context, the analysis concludes with a high degree of confidence that the FNPV(C) likely falls within a **range of EUR -16.8 bn to EUR -10.8 bn**.

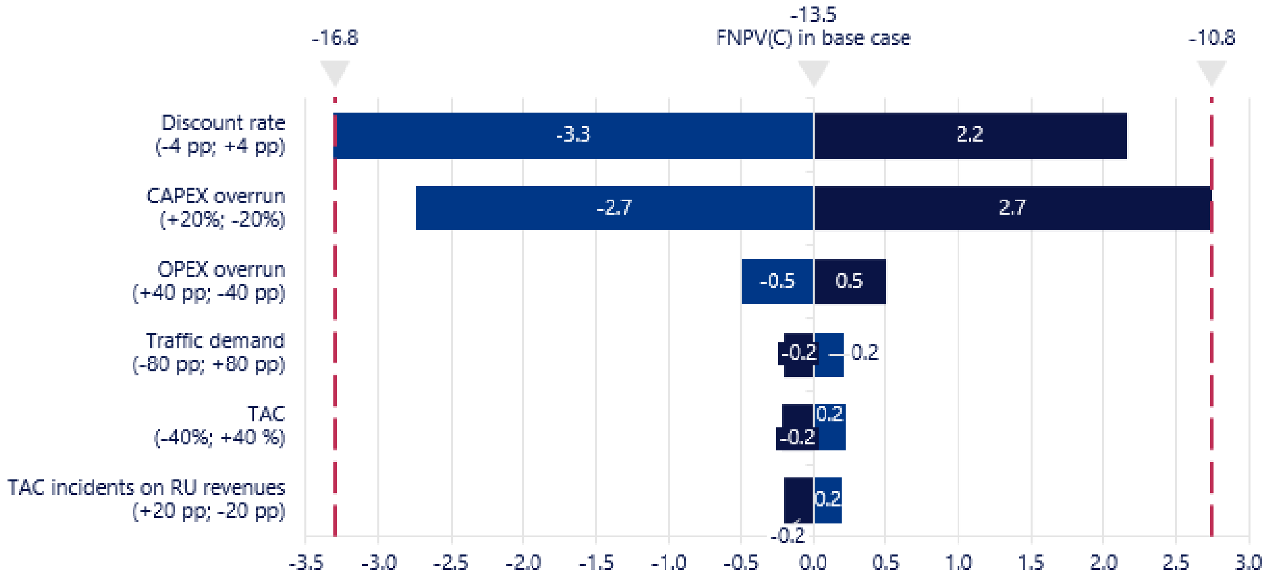


Figure 154: Financial sensitivity analysis overview (Consultant team analysis)

The next page provides a detailed overview of the sensitivity of various variables, presenting an incremental analysis of each one.

Value	Change (%p)	Discount rate chg.	FNPV(C) (13.5)
4.2%	-4%	-4%	(16.8)
5.2%	-3%	-3%	(15.9)
6.2%	-2%	-2%	(15.0)
7.2%	-1%	-1%	(14.2)
8.2%	0%	0%	(13.5)
9.2%	1%	1%	(12.9)
10.2%	2%	2%	(12.3)
11.2%	3%	3%	(11.8)
12.2%	4%	4%	(11.4)

Change (%p)	TAC	FNPV(C) (13.5)
-40%	60%	(13.7)
-30%	70%	(13.7)
-20%	80%	(13.6)
-10%	90%	(13.6)
0%	100%	(13.5)
10%	110%	(13.5)
20%	120%	(13.4)
30%	130%	(13.4)
40%	140%	(13.3)

Change (%p)	OPEX overrun	FNPV(C) (13.5)
40%	140%	(14.0)
30%	130%	(13.9)
20%	120%	(13.8)
10%	110%	(13.6)
0%	100%	(13.5)
-10%	90%	(13.4)
-20%	80%	(13.3)
-30%	70%	(13.1)
-40%	60%	(13.0)

Change (%p)	Traffic demand	FNPV(C) (13.5)
-80%	20%	(13.7)
-60%	40%	(13.7)
-40%	60%	(13.6)
-20%	80%	(13.6)
0%	100%	(13.5)
20%	120%	(13.5)
40%	140%	(13.4)
60%	160%	(13.4)
80%	180%	(13.3)

Change (%p)	CAPEX overrun	FNPV(C) (13.5)
20%	120%	(16.3)
15%	115%	(15.6)
10%	110%	(14.9)
5%	105%	(14.2)
0%	100%	(13.5)
-5%	95%	(12.8)
-10%	90%	(12.1)
-15%	85%	(11.5)
-20%	80%	(10.8)

Change (%p)	1-TAC incidents on RU revenues	FNPV(C) (13.5)
20%	94%	(13.7)
15%	89%	(13.7)
10%	84%	(13.6)
5%	79%	(13.6)
0%	74%	(13.5)
-5%	69%	(13.5)
-10%	64%	(13.4)
-15%	59%	(13.4)
-20%	54%	(13.3)

Figure 155: Financial analysis sensitivity analysis, EUR bn

10.10.2 Passenger TAC

The objective to analyze the sensitivity of RB's passenger TACs is relevant to evaluate the current and future market conditions. The current charges might be poised to change from the present-day market analyses, considering factors such as passenger demand, operational costs, and existing competition. A crucial aspect to consider is that the final ticket prices for passengers influence the forecasted TAC.

There are two potential avenues for increasing the TAC. The first is the completion of high-speed infrastructure developments in surrounding countries. This expansion is expected to enhance RB's connectivity to the broader European high-speed rail network. As a result, RB may find an opportunity to increase the TAC, given that better connections might enhance the rail line's attractiveness to passengers.

Additionally, RB might leverage its anticipated superior service quality compared to other 1520mm gauge local infrastructures to justify a higher TAC. This assumption is based on the expectation that Rail Baltica will provide faster, more comfortable, and safer services, with additional amenities compared to other local rail lines operating on the 1520mm gauge.

A 100%p increase in TAC (doubling) can result in an increase in FNPV(C) of EUR 257 mn.

High-speed and night final consumer price	Average regional final consumer price	Change (%p)	Passenger TAC	FNPV(C) (13.5)
EUR 0.10	EUR 0.06	0%	100%	(13.5)
EUR 0.12	EUR 0.07	20%	120%	(13.5)
EUR 0.14	EUR 0.08	40%	140%	(13.4)
EUR 0.16	EUR 0.09	60%	160%	(13.4)
EUR 0.18	EUR 0.10	80%	180%	(13.3)
EUR 0.20	EUR 0.12	100%	200%	(13.3)
EUR 0.22	EUR 0.13	120%	220%	(13.2)
EUR 0.24	EUR 0.14	140%	240%	(13.2)
EUR 0.26	EUR 0.15	160%	260%	(13.1)

Figure 156: RB passenger TAC sensitivity analysis, EUR bn

The sensitivity analysis findings demonstrate that, even in the worst-case scenario, the financial outcomes provide a baseline that the project's potential economic benefits can consistently exceed. This reinforces the project's viability across a range of financial conditions. The next chapter will offer a comprehensive evaluation of the project's overall economic performance, identifying key indicators and assessing its socio-economic impact.

11 Socio-Economic Analysis

11.1 Methodology Overview

Within the CBA framework, this chapter presents the **socio-economic impact analysis** of Rail Baltica Phase 1. In line with EU guidelines, the net economic benefits of RB are identified, a key step prior to the combination of these benefits with the financial impact to calculate the ultimate performance indicators: the economic net present value (ENPV) and economic rate of return (ERR). These indicators will ultimately demonstrate the value of RB for the economy and society. The analysis focuses on the project's direct microeconomic impact on market participants, emphasizing that RB's financial gains represent only a part of its broader societal and economic benefits.

Direct benefits are realized by industry players across the passenger and freight value chains, passengers, freight shippers, the environment, and labor[80] (see following figure). The impact components are defined to provide a mutually exclusive and completely exhaustive set of elements, covering all relevant aspects of the RB project's socio-economic influence. While the induced and indirect impacts of the project are also crucial to understand the true extent of societal benefits, they are assessed in the *Wider Economic Impact Analysis* chapter to avoid potential overlaps and to comply with EU CBA guidelines.

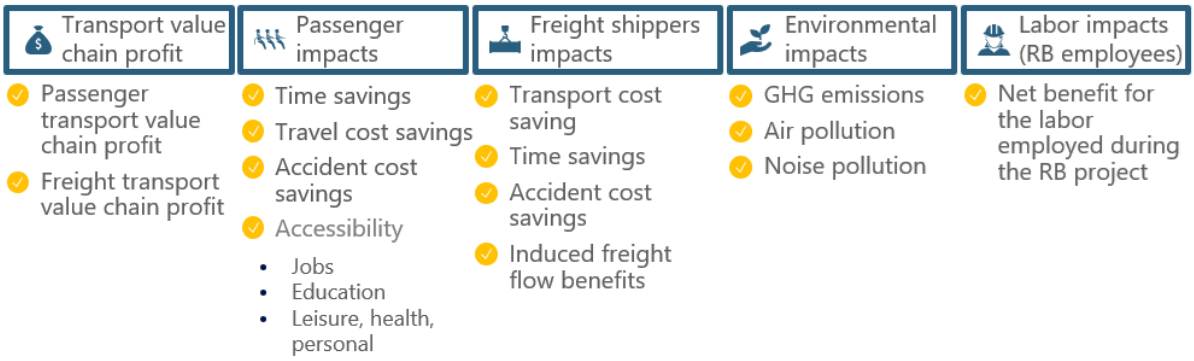


Figure 157: Socio-economic impacts measured within the CBA framework

To determine direct socio-economic impacts, **the analysis focuses primarily on modal shift and induced demand, comparing scenarios both with and without RB Phase 1** (detailed in the *Traffic Demand Forecasting* chapter). Specific impact components (detailed in the *Assumptions* chapter) are considered to understand the incremental benefits of both scenarios.

This socio-economic impact analysis is conducted without assuming any additional investments beyond the project itself as these are considered independent developments requiring a separate CBA. This is to ensure a consistent attribution of benefits to their respective costs. Nevertheless, this approach might be conservative in capturing the synergistic impact of dependent developments, such as the interplay between rail development and urban housing schemes.

The **evaluation framework is defined by crucial project characteristics**, including RB's useful economic life and the social discount rate. These parameters are vital for evaluating the project's long-term socio-economic benefits

[80] The calculation excludes potential benefits realized by construction workers as construction is considered as the cost of the project which enables the realization of benefits during the operational phase.

and costs. All results are presented within this framework, ensuring a comprehensive assessment that accurately represents RB's entire lifespan and its socio-economic context.

First, a summary of the socio-economic impact analysis results is presented, followed by detailed assessment methodologies, and assumptions of each impact component. A sensitivity analysis concludes the chapter, exploring how variation in different assumptions might affect socio-economic impacts.

11.2 Socio-Economic Impact Summary (NPV)

RB Phase 1 is projected to deliver substantial net economic benefits, **estimated at EUR 22.1 billion NPV** over the project's lifetime. Passenger benefits represent the largest share, contributing 84.0% of the total economic impact, followed by environmental benefits at 12.2%, freight shipper impacts at 3.1%, and labor and transport value chain impacts at less than 1%. The table below provides a comprehensive breakdown of the net economic benefits for each component analyzed in the socio-economic impact assessment.

Impact component	Impact driver	EUR mn	% Total
Transport value chain profit		**52.8**	**0.2%**
Passenger transport profit	Passenger	-18.2	-0.1%
Freight transport profit	Freight	71.0	0.3%
Passenger benefits		**18,535.9**	**84.0%**
Passenger time savings	Modal shift	9,393.6	42.6%
Travel cost savings	Modal shift	3,914.8	17.7%
Accident cost savings	Modal shift	3,069.0	13.9%
Leisure, health, personal accessibility	Induced demand	1,865.2	8.5%
Education accessibility	Induced demand	150.8	0.7%
Job accessibility	Induced demand	142.5	0.6%
Freight shipper impacts		**679.9**	**3.1%**
Transport cost savings	Modal shift	426.3	1.9%
Time savings	Modal shift	167.9	0.8%
Accident cost savings	Modal shift	51.3	0.2%
Induced freight flow benefits	Induced demand	34.4	0.2%
Environmental impact		**2,687.5**	**12.2%**
GHG emissions (passenger)	Operation - Passenger	1,588.2	7.2%
Air pollution (passenger)	Operation - Passenger	440.1	2.0%
Noise pollution (passenger)	Operation - Passenger	334.6	1.5%
GHG emissions (freight)	Operation - Freight	419.2	1.9%
Air pollution (freight)	Operation - Freight	66.2	0.3%
Noise pollution (freight)	Operation - Freight	139.9	0.6%
GHG (const)	Construction	-0.1	0.0%
Air (const)	Construction	-271.9	-1.2%
Noise (const)	Construction	-29.0	-0.1%
Labor impact		**110.4**	**0.5%**
Net benefit for labor employed	RB employees	110.4	0.5%
Total benefits (discounted)		**22,066.5**	**100.0%**

Figure 158: Summary of socio-economic impact components (NPV) of RB Phase 1[81]

[81] Regarding the provided figures, the sum of parts might not add up to the subtotals and totals due to rounding.

The following chapter provides a clear and detailed explanation of the calculation methodologies and assumptions applied to each impact component.

11.3 Socio-Economic Impact Components

To understand underlying rationale and assumptions behind results above, this section shifts focus to **specific socio-economic impact components** assessed within the CBA framework. Each component is thoroughly analyzed to understand its contribution to the project's overall socio-economic impact, considering calculation methodologies and assumptions.

Total **discounted benefits of Rail Baltica are estimated at EUR 22.1 bn**, with significant contributions from various components. Operational benefits within the transportation value chain amount to EUR 0.1 bn, reflecting enhanced performance and efficiencies. Passenger impacts, being the largest contributor, are valued at EUR 18.5 bn, underscoring the project's transformative role in passenger transportation. Freight shippers are expected to see benefits of EUR 0.7 bn, highlighting improvements in freight transport. Environmental benefits, another major contributor, are estimated at EUR 2.7 bn, demonstrating Rail Baltica's commitment to sustainable development. Labor market (RB employees) stand to gain EUR 0.1 bn, indicative of the positive outcomes from job creation.

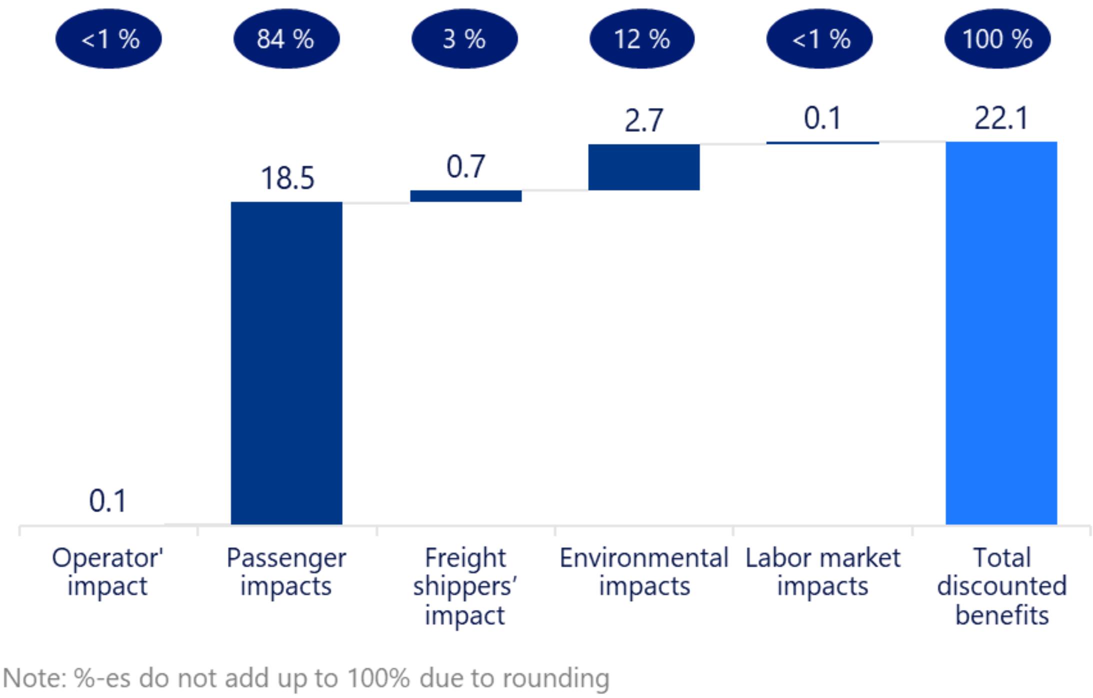


Figure 159: Overview of Socio-Economic Components of RB Phase 1, EUR bn

In the next subsections, each of these components is further examined, providing insights into their particular significance and contribution to RB's socio-economic impact.

11.3.1 Transport Value Chain Impact

This subsection assesses the impact of Rail Baltica on industry players involved in both passenger and freight transportation. Total **net benefits from these impacts are expected to reach EUR 0.05 bn**. As seen on the figure below, while the passenger transport value chain expects a small loss, this is greatly offset by the gains along the freight transport value chain, resulting in an overall positive impact on the transport value chain.

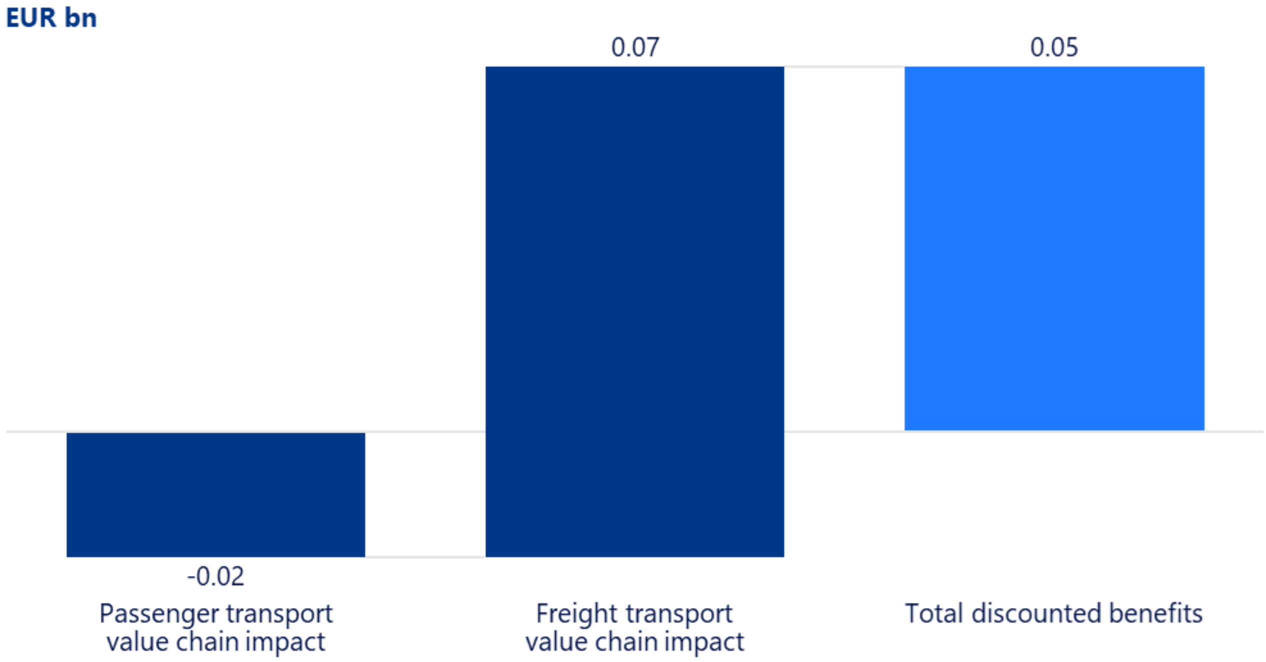


Figure 160: Transport value chain profit impact overview in RB Phase 1

Passenger Transport Value Chain Impact

The illustrated methodology aims to determine the extent of economic benefits and costs of RB within the passenger transport ecosystem. The **analysis assesses modal shift and induced demand** between scenarios with and without RB (expressed in pkm), with **subsequent steps** quantifying average revenues, expressed in EUR/pkm, for various modes of transportation, considering factors such as fuel cost, insurance, and maintenance (Rail Baltica TDM, 2024).

Further in the analysis, industry benchmarks are employed to determine the profit margins for each transport mode. Assumptions for these margins such as the average EBT margin, are derived from expert analyses and other industry benchmarks. An essential component in this analysis is the consideration of road damage, quantified in EUR/pkm, which encompasses factors including wear and tear on road infrastructure due to transportation.

Consequently, this methodology estimates the net present value (NPV) of the total expenses in the passenger value chain at **EUR -0.018 billion**.

Calculation steps

Modal shift + induced demand (pkm)

×

Revenues (EUR/pkm)

×

Profit margin based on industry benchmarks

=

Transport value chain profit

+

Modal shift + induced RB demand (pkm)

×

Road damage (EUR/pkm)

=

Passenger value chain impact NPV
(EUR 0.018 bn)

Analysis and assumptions

Modal shift and induced demand for RB analyze the variation in modal shares between scenarios with and without the project.

Air (pkm)	Car (pkm)	Bus (pkm)	Train (pkm)
(779,605,586)	(2,081,913,723)	646,495,441	3,521,608,590

Modal shift + induced demand per mode in 2046, *Source: Rail Baltica Traffic Demand Model*

Average price assumptions from the demand model segmented by transport mode encompass the overall revenue of operating each mode*. This includes but is not limited to fuel cost, insurance cost and maintenance cost.

Air (EUR/pkm)	Car (EUR/pkm)	Bus (EUR/pkm)	Train (EUR/pkm)
0.20	0.14	0.06	0.08

Source: Rail Baltica Traffic Demand Model

Average EBT margin assumptions are derived from industry benchmarks**.

Air short haul	Air long haul	Car**	Local Bus	Coach	Train regional	Train high speed
0.0%	1.0%	5.5%	0.0%	5.0%	0.0%	4.0%

Source: Expert Analysis and industry benchmarks

Average road damage factor for passenger cars: 0.004 EUR/pkm.

Source: Nilsson et al. (2015), prices adjusted to 2023 Euros

*Segmentation shown on aggregate level. For more details, refer to *Assumptions* chapter
**Benchmarks derived from average profitability along the car value chain, including car manufacturing and fuel suppliers

Figure 161: Passenger value chain profit calculation in RB Phase 1

Freight Transport Value Chain Impact

In this chapter, impacts on players in the freight transport value chain are outlined. The **analysis starts with modal shift and induced demand** (in tkm), showing expected changes in freight volumes for each transport mode with Rail Baltica's introduction.

Next, average transport prices for various cargo types and modes are considered, along with profit margins based on industry benchmarks. The analysis also covers road damage costs caused by truck transport, which is EUR 0.004/tkm.

Consequently, this methodology estimates the NPV of the **total benefits in the freight value chain at EUR 0.071 billion.**

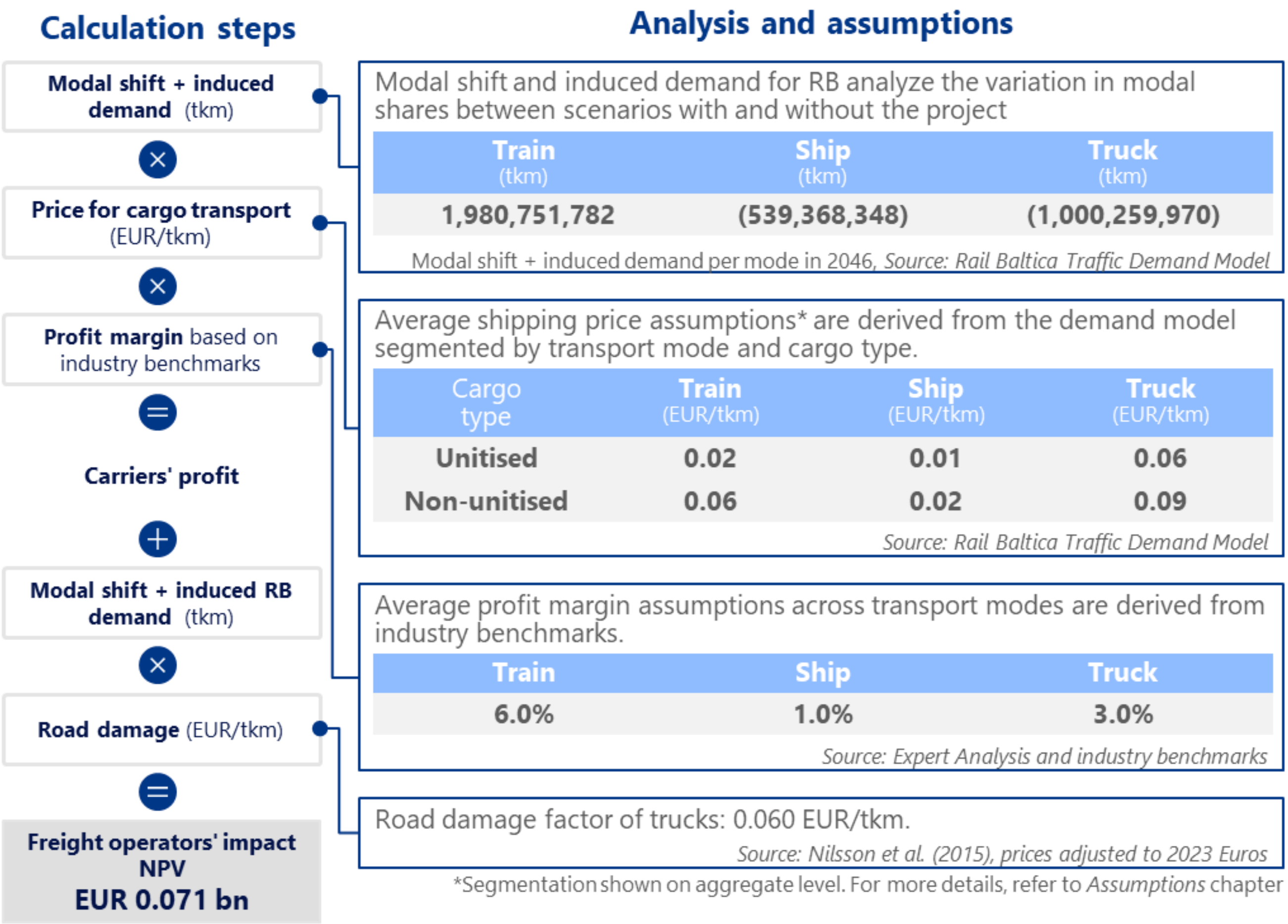


Figure 162: Freight transport value chain profit calculation in RB Phase 1

11.3.2 Passenger Impacts

Passengers represent a key beneficiary of the RB project and constitute the category with the **highest net discounted benefits, amounting to EUR 18.54 bn, representing 84% of total net benefits**. The following chapter examines the direct impact on passengers through the analysis of six categories and their related specific benefits. The first three categories, namely **travel cost savings, time savings, and accident cost savings**, are outlined in the EU guidelines as mandatory parts of the Cost-Benefit Analysis, and assess effects related to modal shift of existing passengers.

The remaining three benefit categories – **job, personal, and education accessibility benefits** – though not directly outlined in the EU guidelines, are crucial in analyzing the passenger impact by assessing induced passenger demand. While the guidelines provide a methodology for estimating induced demand benefits, specifying the trip purpose adds depth to the analysis. Such an assessment is particularly valuable for large transport infrastructure projects like RB, as it highlights the enhanced access to opportunities in education, employment, and leisure, among others. This aspect is especially relevant for the Baltic region, where rail connectivity is currently limited.

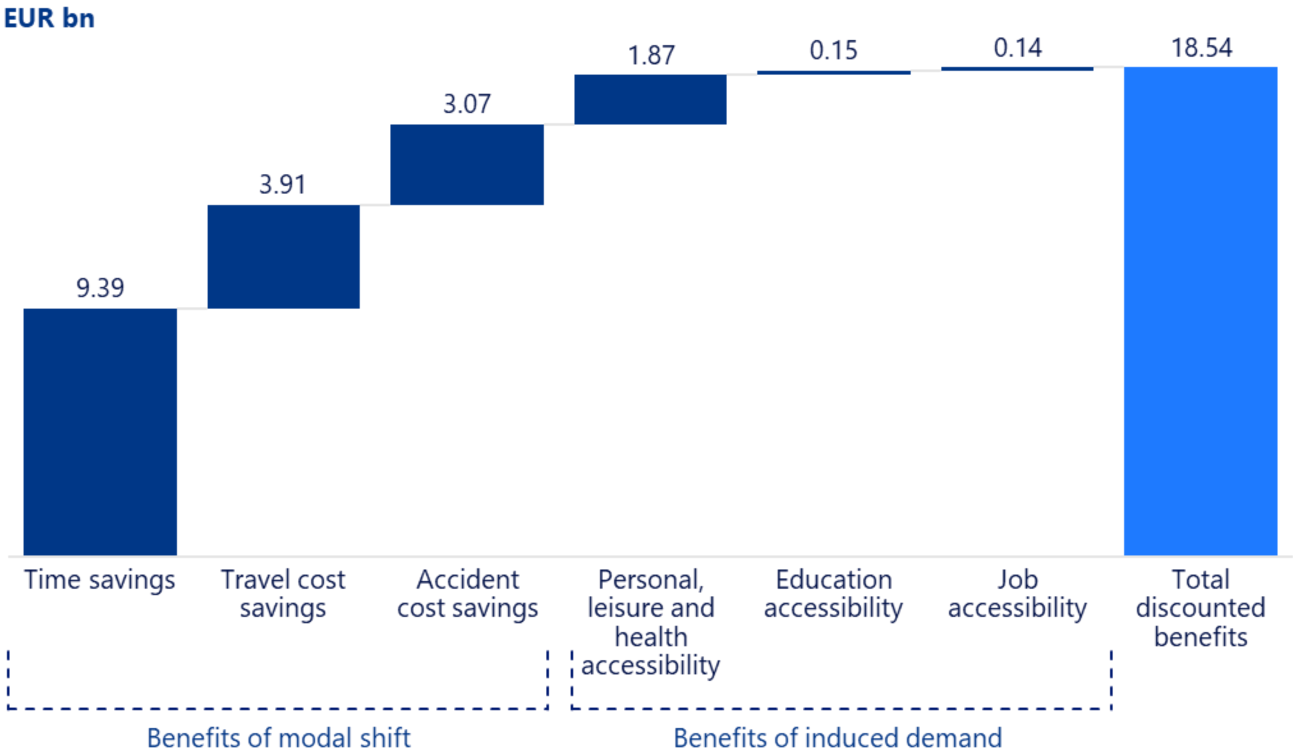


Figure 163: Passenger impacts overview in RB Phase 1

Time Savings

This chapter focuses on passenger time savings associated with Rail Baltica. The **methodology starts by analyzing the modal shift between transport modes** (in pkm) to understand expected changes in passenger volumes due to the introduction of RB.

The **analysis then moves to the speed difference between scenarios** with and without RB, determining potential time savings. It is important to note the variations in travel speeds across different modes, such as air, car, and train, highlighting the time efficiency RB brings.

Furthermore, productive time ratios associated with different transport modes are defined, expressed as the average share of non-productive time during travel with each mode, providing insights into how effectively time passengers can utilize their time.

Lastly, these time savings are monetized using the Value of Time (VoT) metrics, based on passenger surveys and literature from the RBM model.

Consequently, **NPV is estimated at EUR 9.394 bn**, emphasizing the significant economic value RB introduces in terms of time savings for passengers.

Calculation steps

Modal shift between transport modes (pkm)

÷

Speed difference between without- and with RB scenario (km/h)

×

Share of productive time across different modes (%)

=

Total time saving (h)

×

Value of time (EUR/h)

=

Monetized time savings NPV
EUR 9.394 bn

Analysis and assumptions

Modal shift measures the traffic diverted from other modes to RB (and potentially adjacent public transport modes) when comparing scenarios with and without the project.

Air (pkm)	Car (pkm)	Bus (pkm)	Train (pkm)
(919,233,534)	(2,081,913,723)	495,517,380	2,505,629,878

Modal shift per mode in 2046, *Source: Rail Baltica Traffic Demand Model*

Volume weighted headway-based travel time across all modes, incl. waiting times, segmented per trip length and purpose, also considering congestion*.

Segment and trip type	Speed without RB (km/h)	Speed with RB (km/h)	Difference (%)
Air	274.2	279.2	1.8%
Car	52.6	53.4	1.52%
Bus	54.5	54.3	-0.3%
Day train	57.4	83.6	45.6%
Night train	49.4	85.2	72.5%

Source: Rail Baltica Traffic Demand Model – average taken across all O/Ds

The share of productive time is calculated on the basis of the non-productive time per each travel mode, detailed below:

Air	Car	Bus	Day train	Night train
86%	88%	90%	62%	54%

Source : Wardman (2015) -The digital revolution and worthwhile use of travel time...

Value of time (VoT) is based on passenger survey and literature elaboration of RBM model. The table below outlines the VoT in EUR/h according to length of trip and purpose*:

Commuting (EUR/h)	Local business (EUR/h)	Local personal (EUR/h)	Medium long - business (EUR/h)	Medium long – personal (EUR/h)	Very long – business (EUR/h)	Very long – personal (EUR/h)
5	12	7	18	8	22	8

For the evolution of VoT evolution over time, a 70% elasticity to GDP per capita is assumed**.

**Segmentation shown on aggregate level. For more specific assumptions, please see chapter 7.*

*** Source : EU – Economic Appraisal Vademecum (2017)*

Figure 164: Passenger time savings calculation in RB Phase 1

Travel Cost Savings

Passenger cost savings are indicative of the monetary benefits passengers may experience, encompassing reduced ticket prices, ancillary expenses, and potential indirect savings (such as car ownership costs).

The calculation **methodology** first measures modal shift (pkm). This shift is then multiplied by the difference in travel costs (EUR/pkm), considering average travel costs across different transport modes, such as air, car, buses, regional trains, and high-speed or night trains.

Consequently, **total passenger cost savings are estimated at EUR 3.915 bn NPV**, emphasizing the substantial economic benefits RB is set to deliver to travelers.

Calculation steps

Analysis and assumptions

Modal shift between transport modes (pkm)

Modal shift measures the traffic diverted from other modes to RB (and potentially adjacent public transport modes) when comparing scenarios with and without the project.

Air (pkm)	Car (pkm)	Bus (pkm)	Train (pkm)
(919,233,534)	(2,081,913,723)	495,517,380	2,505,629,878

Modal shift per mode in 2046, *Source: Rail Baltica Traffic Demand Model*

×

Travel cost difference (EUR/pkm)

Average travel costs across transport modes* are compared to estimate the marginal impact of passengers shifting between modes.

Air (EUR/pkm)	Car (EUR/pkm)	Bus/coach (EUR/pkm)	Regional train (EUR/pkm)**	Regional train (EUR/pkm)***	HSR/Night train (EUR/pkm)
0.20	0.14	0.06	0.02	0.0	0.10

**Segmentation shown on aggregate level. For more specific assumptions, please see chapter 7.*
***Avg price across countries in the commuting segment *** Avg price across countries in Business/Non-business segments*
Sources: Rail Baltica Traffic Demand Model , Skyscanner.com and Maibach, M.; Peter, M.; Sutter, D. (2006)

=

Travel cost savings NPV
EUR 3.915 bn

Figure 165: Travel cost savings calculation in RB Phase 1

Passenger Accident Cost Savings

This chapter focuses on savings related to a reduction in accident costs because of the modal shift due to Rail Baltica. The **methodology starts by analyzing the modal shift between transport modes**, highlighting anticipated changes in passenger volumes once RB is in operation.

Next, average externality costs of accidents per transport mode are assessed and expressed in EUR/pkm. This step encompasses a thorough examination of the number of casualties and related costs across different vehicle categories, including both human and material impacts.

Based on this detailed assessment, total accident cost savings are estimated at **EUR 3.069 bn NPV**, emphasizing the potential of RB to reduce transport-related accidents and their associated economic burdens.

Calculation steps | **Analysis and assumptions**

Modal shift between transport modes (pkm)

Modal shift measures the traffic diverted from other modes to RB (and potentially adjacent public transport modes) when comparing scenarios with and without the project.

Air (pkm)	Car (pkm)	Bus (pkm)	Train (pkm)
(919,233,534)	(2,081,913,723)	495,517,380	2,505,629,878

Modal shift per mode in 2046, *Source: Rail Baltica Traffic Demand Model*

×

Average externality costs of accidents per transport mode (EUR/pkm)

In assessing accident costs for each transport mode, the analysis accounts for the number of casualties and related costs in each vehicle category, encompassing both human and material expenses*.

Air (EUR/pkm)	Car (EUR/pkm)	Bus (EUR/pkm)	Day train train (EUR/pkm)	Night train (EUR/pkm)
0.000	0.064	0.019	0.003	0.001

For the evolution of externality costs, 80% elasticity to GDP per capita has been assumed**.

**Segmentation shown on aggregate level. For more specific assumptions, please see chapter 7.*

*** Source : EU – Economic Appraisal Vademecum (2017)*

=

Accident cost savings NPV
EUR 3.069 bn

Figure 166: Accidents calculation in RB Phase 1

Leisure, Health and Personal Accessibility

Leisure, health and personal accessibility refers to the **convenience of individuals in reaching desired destinations, whether it is for personal purposes, leisure activities, or healthcare services** – a significant component in assessing the societal advantages of railway infrastructure investment. The assessment method examines the induced non-business trips demand, gauging the difference in passenger volumes between scenarios with and without the RB project.

The **subsequent part quantifies the implicit cost and time savings for individuals** traveling for these purposes, expressed in EUR/pkm. These savings account for factors like reduced travel time, diminished personal vehicle expenses, and increased convenience.

In accordance with the **rule of half**, for all induced trips related to personal, leisure, and healthcare purposes, only half of the generalized cost savings are considered. This rule is used to account for the fact that not all benefits from induced demand translate to full savings, ensuring a more conservative and realistic estimation in line with standardized EU CBA methodologies.

Combining all these benefits, the RB project's total value for better access to personal, leisure, and healthcare is estimated at **EUR 1.865 bn**.

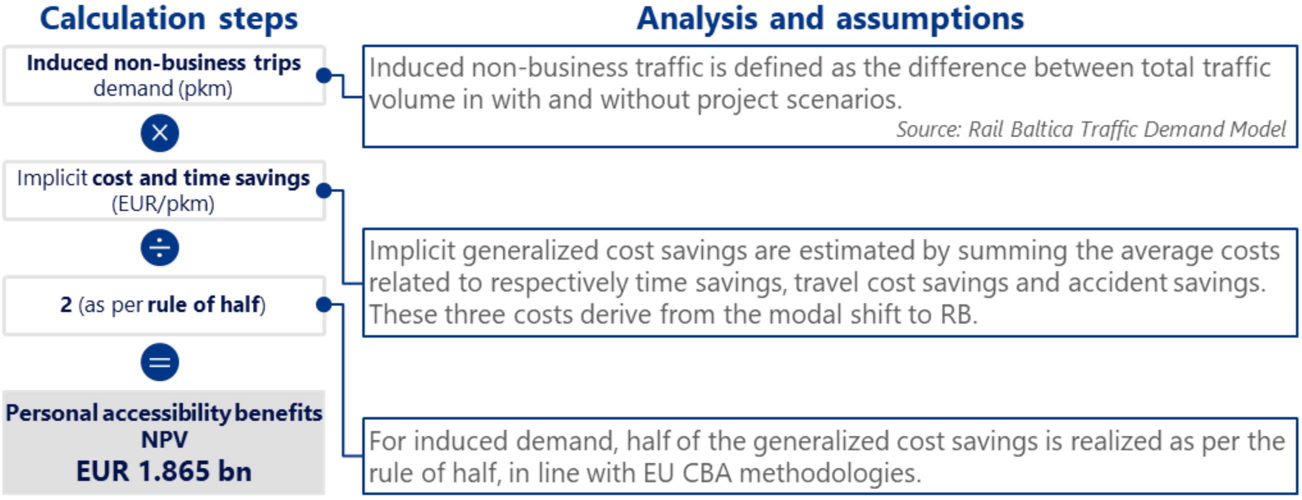


Figure 167: Leisure, health and personal accessibility benefits calculation in RB Phase 1

Education Accessibility

Education accessibility, in the context of this analysis, specifically refers to the ease with which individuals, influenced by the presence of RB, decide to pursue university education across different regions. The presented **methodology measures how RB facilitates this increased accessibility for potential university students**. The assessment starts by determining the total number of induced commuters, shedding light on the anticipated rise in passenger trips due to the project.

The analysis then **estimates the percentage of the commutes that are university-related**, leading to the projection of the number of new university students (who would have not pursued higher education if it was not for RB). This data highlights RB's role in enhancing university student mobility across regions.

An essential element of the analysis is the **assessment of wage disparities between highly educated and less educated labor cohorts**. This comparison highlights the wider economic advantages of university education and the role that enhanced accessibility can play in these benefits.

Considering these factors, the **NPV of education accessibility benefits is projected at EUR 0.151 bn**. This figure highlights RB's potential to positively impact university enrollment and the subsequent economic benefits of a more educated workforce.

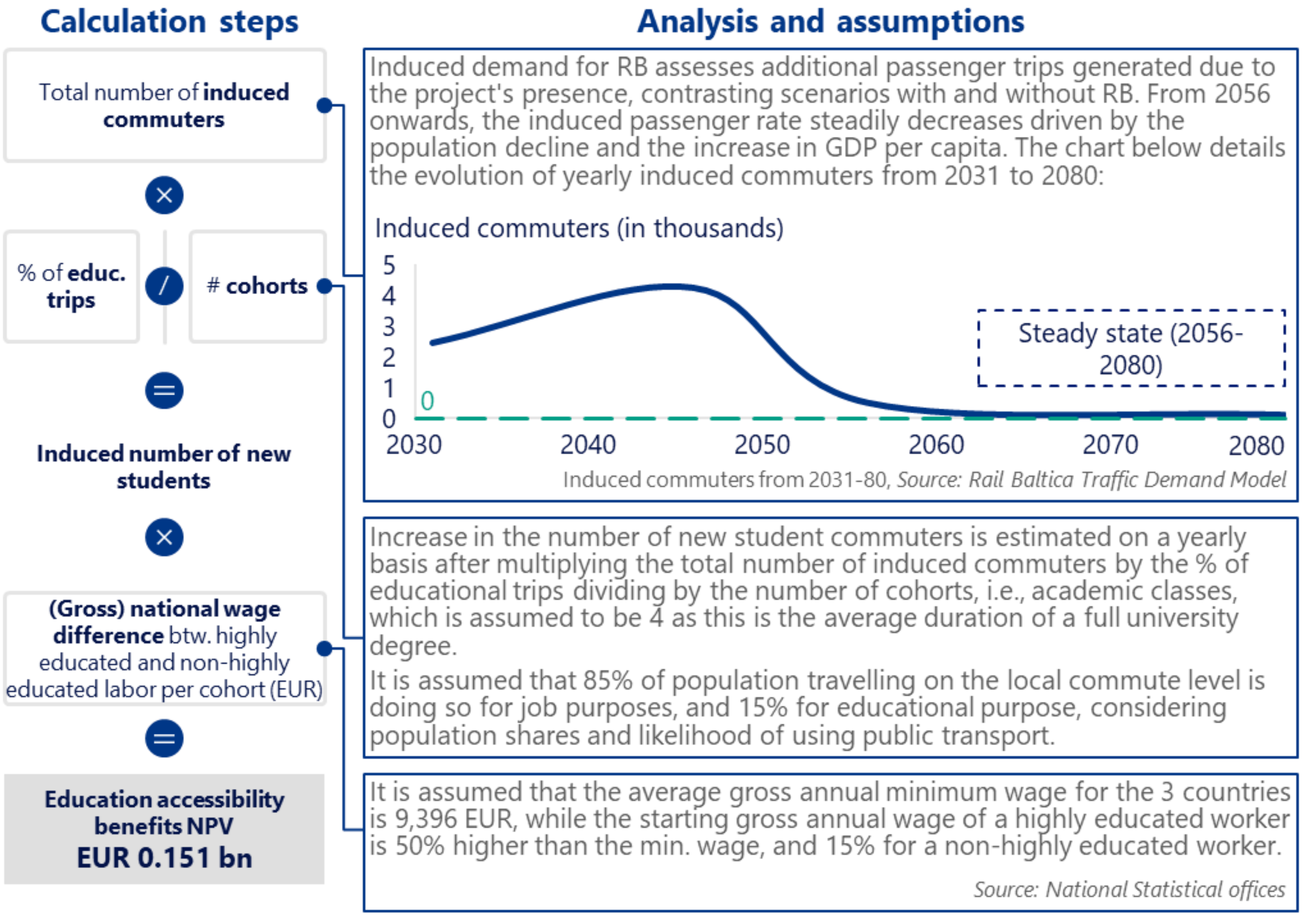


Figure 168: Education accessibility calculation in RB Phase 1

Job Accessibility

Improving job accessibility is an important objective of Rail Baltica, emphasizing its potential to enable individuals to pursue more productive job opportunities. By improving connectivity and reducing travel times, RB can play a role in bridging the gap between job seekers and employment hubs.

The **assessment of job accessibility benefits begins by determining the total number of induced commuters**, reflecting the additional passenger trips generated by the project on a yearly basis. From this, the analysis identifies the proportion of the commutes that are job-related, then evaluates the discounted average wage level difference between the capital city and other regions connected by RB.

Incorporating these factors, the net job accessibility benefits, quantified by the Net Present Value (NPV), are estimated at **EUR 0.142 bn**. This figure underscores Rail Baltica's role in enhancing employment prospects and fostering economic development in the region.

Calculation steps

Total number of **induced commuters**

×

% of **job-purpose commute trips**

=

New job-purpose trips

×

Discounted average (gross) wage level change in the capital city vs. other regions through which RB passes

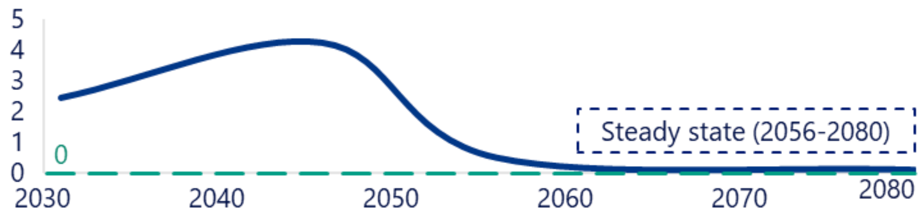
=

Job accessibility benefits NPV
EUR 0.142 bn

Analysis and assumptions

Induced demand for RB assesses additional passenger trips generated due to the project's presence, contrasting scenarios with and without RB. From 2056 onwards, the induced passenger rate steadily decreases driven by the population decline and the increase in GDP per capita. The chart below details the evolution of yearly induced commuters from 2031 to 2080:

Induced commuters (in thousands)



Induced commuters from 2031-80, *Source: Rail Baltica Traffic Demand Model*

It is assumed that 85% of population travelling on the local commute level is doing so for job purposes, and 15% for educational purpose, considering population shares and likelihood of using public transport.

Gross wage data is calculated based on average wage level in different regions in the RB catchment area, using national statistical offices data. A discount factor of 70% is applied based on expert analysis to account for potential counter effects due to job losses from existing employees, additional travel time and ticket spending, etc.

The resulting discounted annual average (gross) wage changes are summarized below:

Estonia (EUR)	Latvia (EUR)	Lithuania (EUR)
3,788	3,032	4,168

Source: National Statistical Offices

Figure 169: Jobs accessibility benefits calculation in RB Phase 1

11.3.3 Freight Shipper Impact

Freight shippers are one of the main stakeholders in the RB project. This chapter analyzes the related benefits by evaluating four separate sub-divisions: shipping cost savings, cargo time savings, trade volume expansion, and accident cost saving. The following figure summarizes the net present value of the impact of RB.

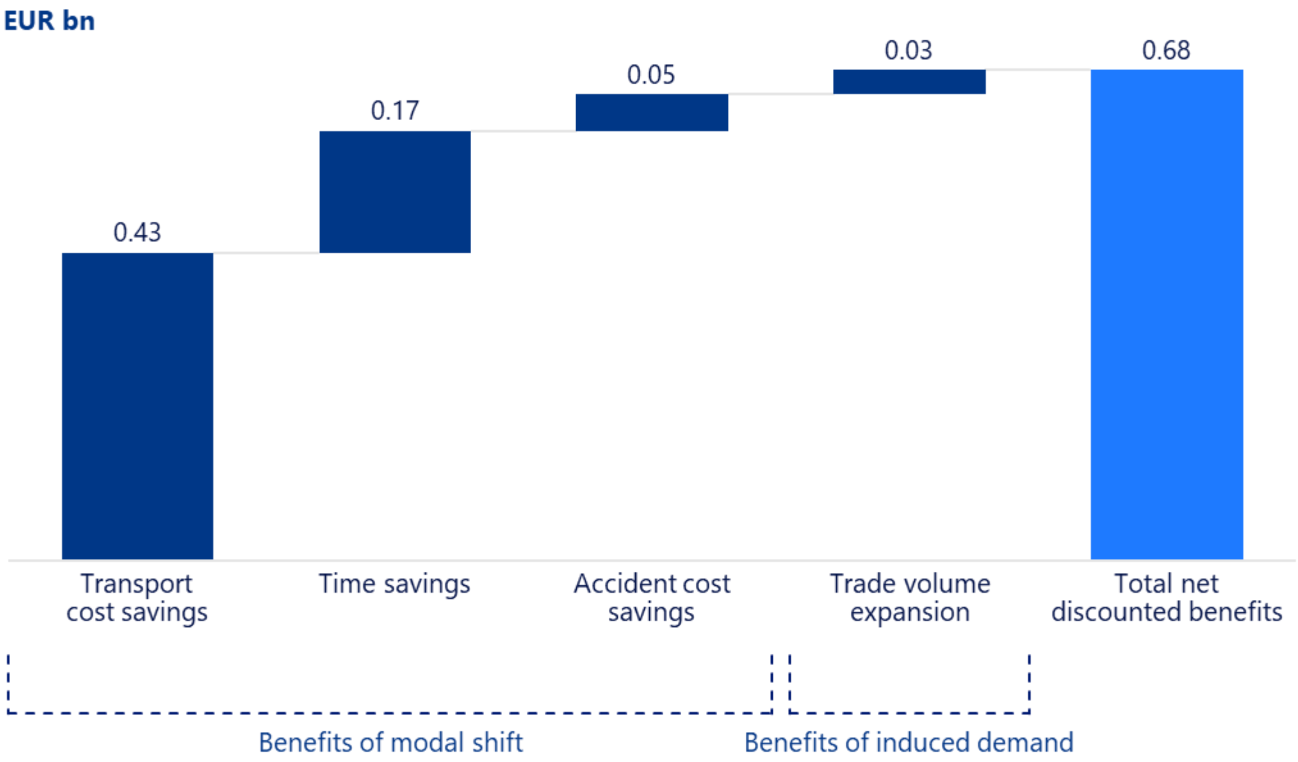


Figure 170: Freight shippers' impact overview in RB Phase 1

Transport Cost Savings

Transport cost savings refer to the reduction in expenses associated with moving goods from one place to another, achieved through optimized routes, efficient modes of transportation, and streamlined operations. In the context of the RB project, these savings underscore the economic advantages of transitioning freight traffic to more efficient and sustainable rail-based solutions.

The process begins with identifying the modal shift to rail, (in tkm) representing the volume of traffic that transitions from other transport modes, such as ship and truck, to RB.

Following this, the focus shifts to the **calculation of incremental shipping cost differences** between transport modes, expressed in EUR/tkm. This difference is a cumulative result of several factors:

- base shipping costs associated with transporting goods,
- insurance costs related to safeguarding shipments,
- stockholding costs associated with holding stock or inventory,
- environmental costs attributed to environmental considerations, such as emissions.

After considering the modal shift and associated cost reductions, the net present value of these savings for the RB project stands at **EUR 0.426 bn.**

Analysis and assumptions

Modal shift measures the traffic diverted from other modes to RB when comparing scenarios with and without the project.

Train (tkm)	Ship (tkm)	Truck (tkm)
1,539,628,319	(539,368,348)	(1,000,259,970)

Modal shift per mode in 2046, *Source: Rail Baltica Traffic Demand Model*

Transport cost assumptions per transport mode and cargo type*, considering the singular components such as shipping, insurance, and stockholding.

Cargo type	Train (EUR/tkm)	Ship (EUR/tkm)	Truck (EUR/tkm)
Unitised	0.02	0.01	0.06
Non-unitised	0.06	0.02	0.09

*Segmentation shown on aggregate level. For more details, see chapter *Assumptions*.
Source: Rail Baltica Traffic Demand Model

Figure 171: Transport cost savings calculation in RB Phase 1

Time Savings

In the context of the RB project, **time savings refer to the reduction in transit durations achieved by redirecting freight** from slower transport methods to the more efficient RB system. To estimate net benefits of this impact, the modal shift to RB is identified (in tkm). This indicates how much freight is redirected from other methods to the more rapid RB system.

Subsequently, the **speed difference between RB and alternative transport modes** is determined. This distinction suggests that while trucking remains more favorable in terms of speed due to flexibility and first and last mile convenience, rail is highly competitive against maritime shipping in this aspect.

From this data, the **total hours saved are calculated**. A monetary value, known as the value of time, is then attributed to these saved hours. It is noted that the value varies, with unitised cargo typically being assigned a higher value due to its time-sensitive nature.

By integrating the modal shift data, speed differences, and the value of time, the **net present value of time savings for the RB project is projected at EUR 0.168 bn.**

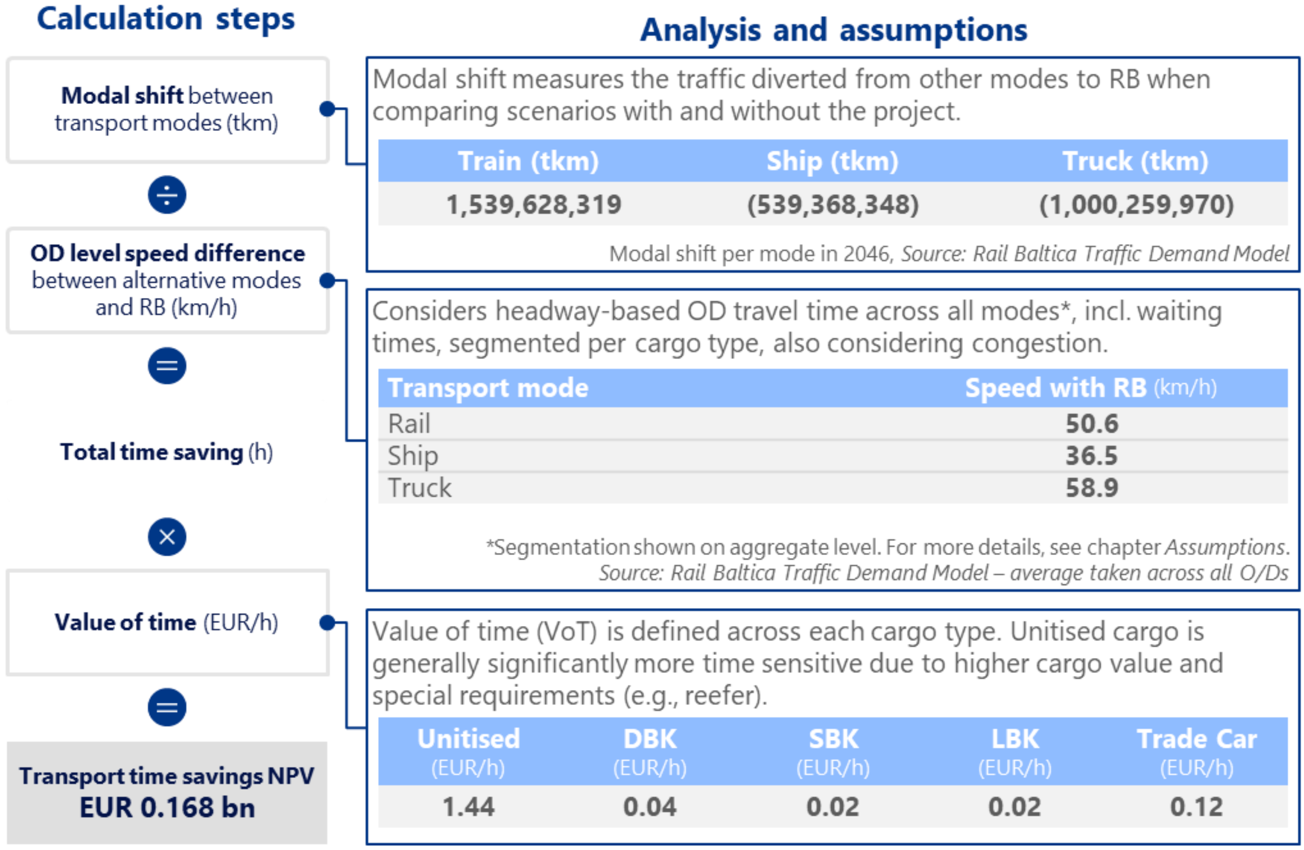


Figure 172: Cargo time savings calculation in RB Phase 1

Freight Accident Cost Savings

In the context of the RB project, **accident savings refer to the reduced costs associated with freight-related accidents**, achieved by shifting cargo from more accident-prone transport methods to the safer RB system. The first step in understanding these savings is to **identify the extent of modal shift to RB** (in tkm). This shows the volume of freight that is moved from other modes to RB.

Following this, **the costs associated with accidents per transport mode are determined**, expressed in EUR/tkm. These costs encompass the number of casualties per vehicle category and the corresponding financial implications, factoring in both human and material losses.

Based on the above data, the net present value of the savings from reduced accidents due to the RB project is calculated. Integrating the modal shift data and externality costs of accidents reveals that the **NPV of accident savings for the RB project amount to EUR 0.051 bn.**

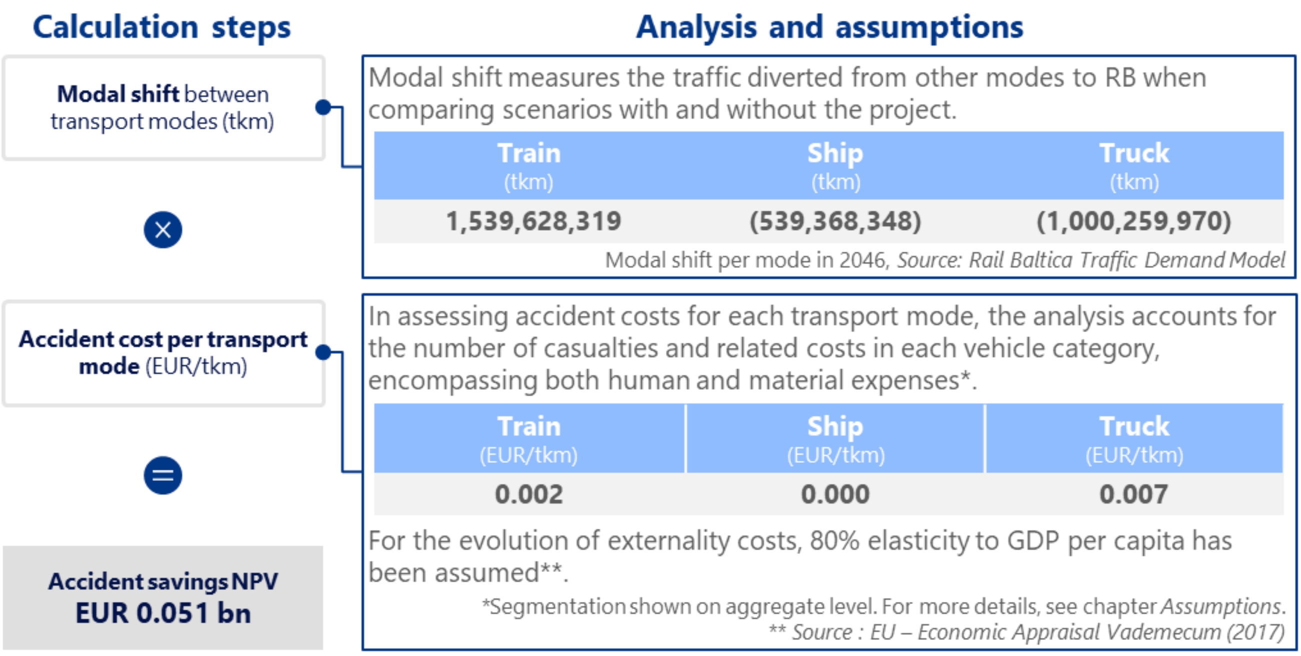


Figure 173: Accident cost savings overview in RB Phase 1

Induced freight flow benefits

In the context of the RB project, **induced freight flow benefits** (trade volume expansion) **denote the increase in freight traffic**, resulting in economic growth, due to the efficiencies and advantages introduced by the project. The analysis begins with identifying freight demand induced by RB (in tkm). This measures the additional freight traffic generated because of the project's presence, distinguishing between scenarios with and without RB infrastructure in place.

The next step involves **calculating the marginal implicit decrease in generalized transport costs,** expressed in EUR/tkm. This represents the savings in transportation costs per unit of freight due to the shift to RB.

In accordance with the **rule of half method** outlined in the EU CBA guidelines, only half of the generalized transportation savings, encompassing both time and cost savings, is accounted for in calculating induced demand. This approach provides a conservative estimate, aligning with established methodologies.

By integrating the induced demand data and the cost savings, the NPV of **benefits arising from expanded trade volumes due to the RB project is estimated at EUR 0.034 bn**.

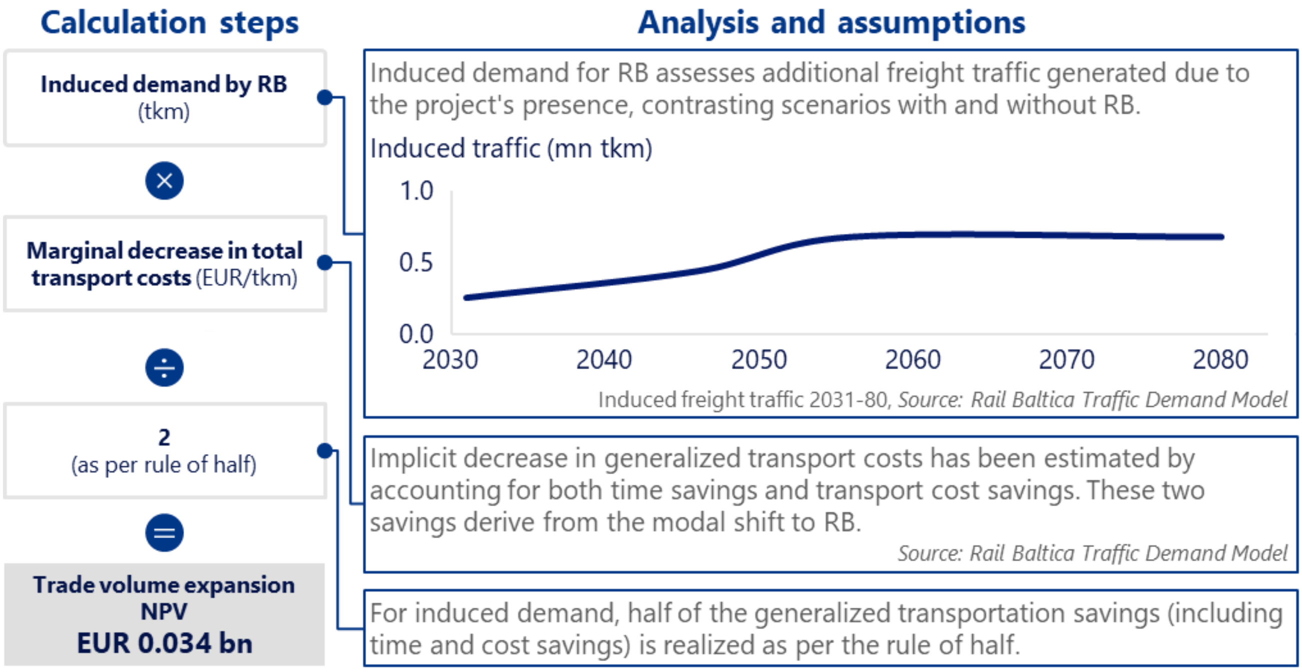


Figure 174: Induced freight flow benefits (trade volume expansion) calculation in RB Phase 1

11.3.4 Environmental Impacts

The **environmental impact generated by RB is one of the cornerstones of the project** as public rail transport is viewed as a greener alternative to existing transportation options in the Baltic regions. This subsection analyzes the direct environmental implications of RB by assessing the project’s impact on **both operational and construction phases.**

EU guidelines do not explicitly require the inclusion of construction-phase environmental impacts in the CBA framework. However, they have been included in this report to provide a more comprehensive analysis of the environmental effects, especially that they are expected to be included in future CBA guidelines.

The environmental impact of RB is further **broken down into three categories**: climate change impact of GHG emissions, air pollution, and noise pollution. Furthermore, a qualitative analysis of the biodiversity impact of RB is carried out alongside the potential mitigation measures in this regard.

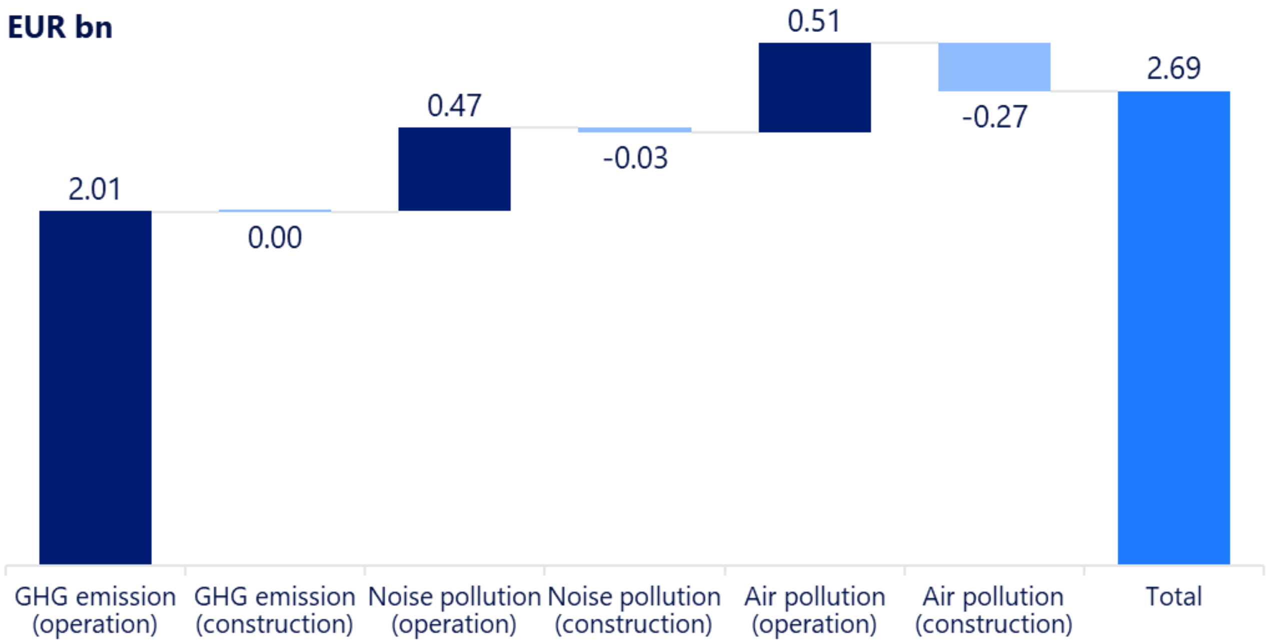


Figure 175: Environmental impacts overview

GHG emission – Operation Phase

Climate change impact of GHG emissions impact refers to the **effect of greenhouse gases on the environment**, a crucial factor in assessing the sustainability and ecological footprint of railway infrastructure investment. The assessment begins with considering modal shift and induced demand, evaluating the difference in traffic volumes and modal shares between scenarios with and without the RB project (in pkm and tkm).

The next step quantifies the **average GHG emissions for various modes of transportation** in grams of CO2 equivalent (g CO2e/pkm or g CO2/tkm). Combustion engine emissions are assumed to decrease over time, reflecting the evolution and modernization of vehicle fleets.

Subsequently, **external costs associated with GHG emissions are calculated**, expressed in EUR per ton (EUR/t) of CO2 equivalent. The shadow costs of GHG emissions have been determined based on guidance from the EU, with data sourced from the European Investment Bank (EIB).

Based on this methodology, the net **NPV of the cost savings associated with reduced GHG emissions due to the RB project is projected at EUR 2.007 bn**.

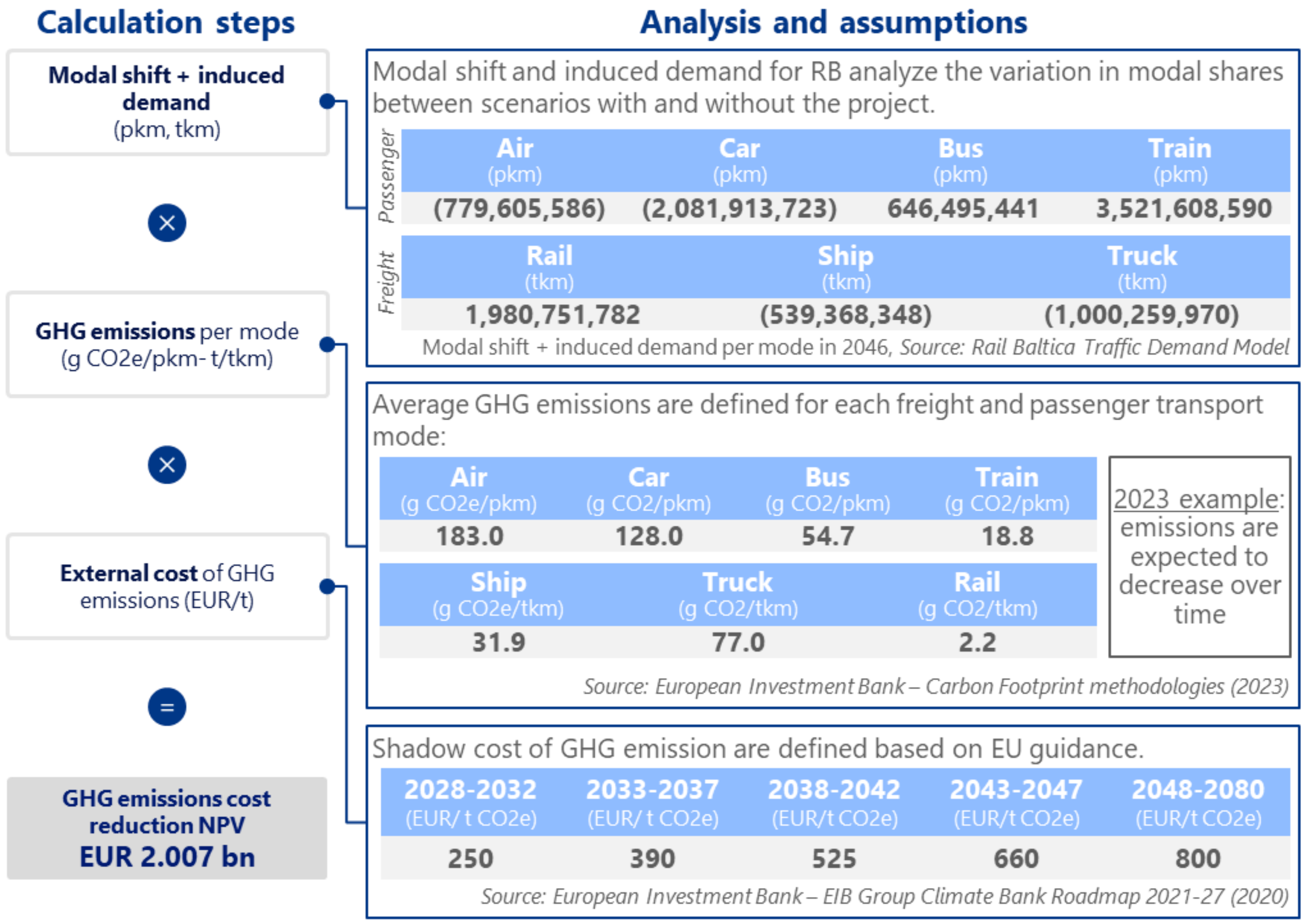


Figure 176: Climate change – operation phase calculation

GHG emission – Construction Phase

The methodology presented quantifies the GHG emission impact due to the construction activities of the RB project. The process commences with the **determination of the total line length of the RB project** based on the RB design documentation and input from the RBR project team.

Subsequently, **GHG emissions resulting from the construction works are calculated.** Emissions are denoted in tons per constructed kilometer (t/km) and are informed by several Environmental Impact Assessments (EIAs) conducted by RB.

Following this, **external costs associated with the GHG emissions** are calculated, expressed in EUR per ton (EUR/t) of CO_2 equivalent. Shadow costs of GHG emissions are derived from specific breakdowns provided for different periods up to the year 2080 by the European Investment Bank (2023b).

After assessing all the parameters, the net present value of the GHG emissions due to the RB project's construction activities is defined at **EUR -0.0001 bn**. This negative value suggests a minimal adverse economic impact from GHG emissions associated with the project's construction.

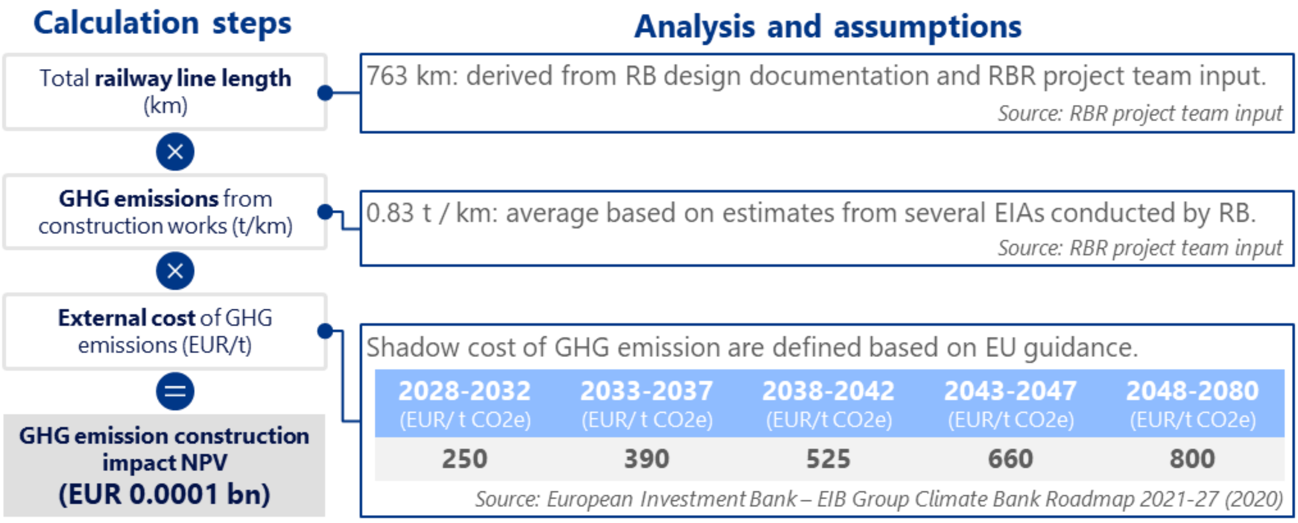


Figure 177: Climate change – construction phase calculation

Air Pollution – Operation Phase

Transportation modes relying heavily on the combustion of fossil fuels emit harmful pollutants such as nitrous oxides, particulate matter, and volatile organic compounds into the air, degrading air quality and posing a serious health risk to both urban and rural populations. RB aims to provide a less harmful alternative and, therefore, to **reduce air pollution externalities of the transport ecosystem**.

The following methodology evaluates the i**mpact of the modal shift to RB and the associated induced demand on air pollution**.

The analysis begins by assessing **modal shift and induced demand**, by comparing modal shares in scenarios with and without the RB project (in pkm and tkm).

Next, **external costs associated with air pollution are determined** (in EUR/pkm and EUR/tkm) based on the "Handbook of external costs of transport (European Commission, 2019a). Combustion engine emissions are expected to decrease over time due to an anticipated evolution and modernization of vehicle fleets. Externality costs are projected to increase over time in line with GDP/capita growth.

Consequently, **air pollution benefits of the RB project during the operational phase are projected at EUR 0.507 bn NPV**, representing the socio-economic implications of the noise pollution generated or mitigated by the project over its lifecycle.

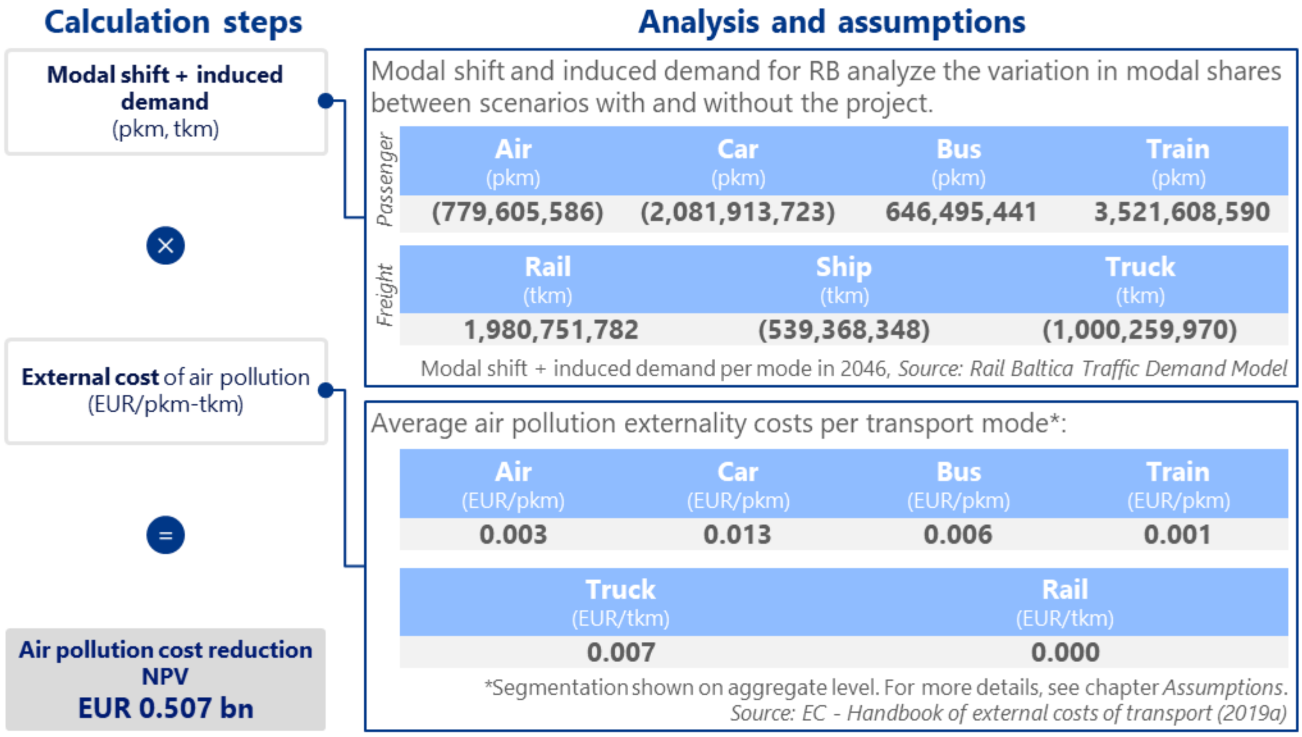


Figure 178: Air pollution – operation phase calculation

Air Pollution – Construction Phase

Air pollution resulting from the construction phase of RB is another pivotal environmental concern due to its potential implications on public health and the environment. The methodology extrapolates data from specific rail sections to quantify the air pollution impact, with the assumption that these sections are representative of the entire infrastructure in terms of air pollution.

The process begins by determining the **total duration of the construction**, which is based on the project's operational concept and is assumed to span seven years. It has to be noted that this is a conservative assumption, as the construction of specific sections is expected to be completed in less than seven years.

Subsequently, **air pollution resulting from construction activities is quantified** in terms of emissions per year per kilometer (t/year/km). Specific pollutants like PM10, PM2.5, and NOx have been considered, and their respective emissions have been sourced from the RB Environmental Impact Assessment, extrapolated to estimate emissions for the construction of the total rail length for the project.

Finally, the **external cost of air pollution**, expressed in EUR per ton (EUR/t), is derived. The costs for individual pollutants, like PM10, PM2.5, and NOx, are based on the EU Handbook for external cost of transport.

Consequently, the **externality cost of air pollution during construction is projected at EUR -0.272 bn NPV**, representing the socio-economic implications of the air pollution generated during the construction phase.

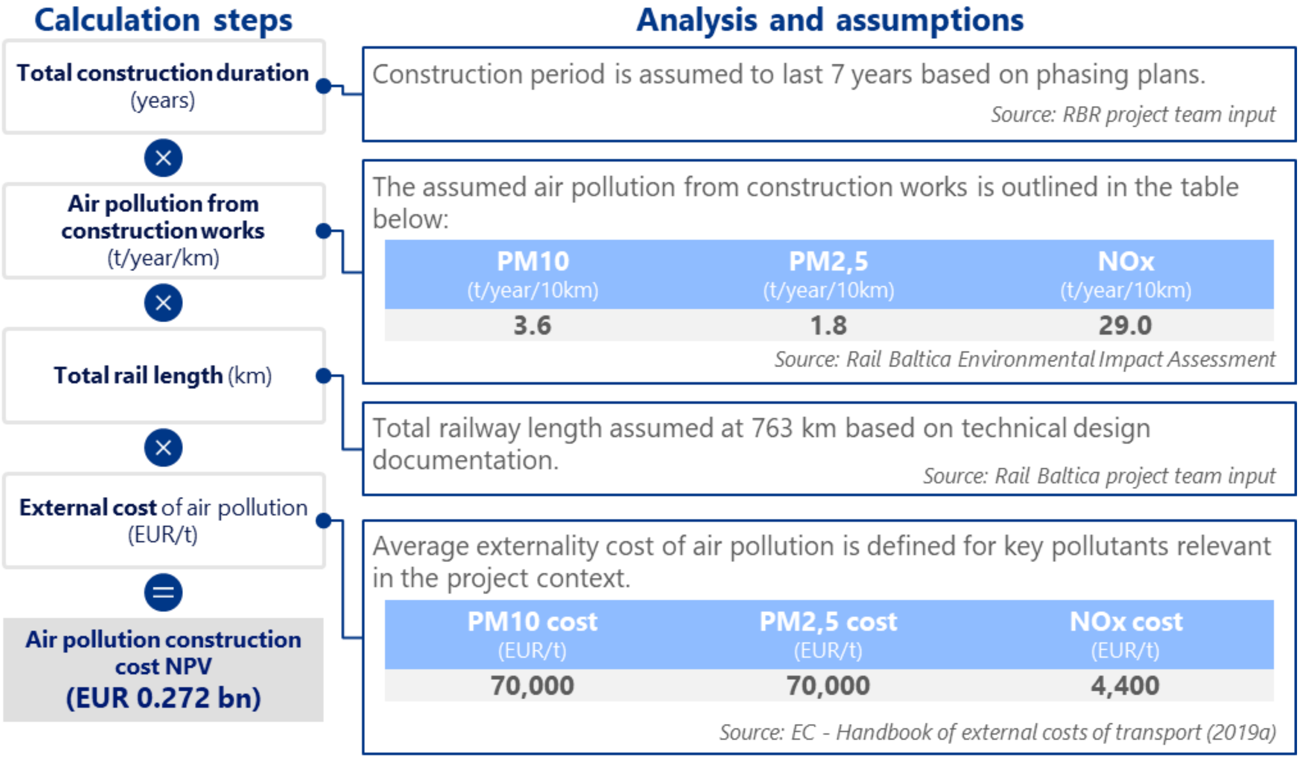


Figure 179: Air pollution – construction phase calculation

Noise Pollution – Operation Phase

Combustion engine vehicles and public transportation systems contribute **to increasing noise pollution in cities impacting residents' well-being**. RB tracks are planned to be mostly located at a considerable distance from densely populated areas. Additionally, the use of noise barriers along railways will help mitigate the impact of vibrations and noise, offering an improvement over traditional transport modes. This is particularly relevant in Estonia and Latvia, where the absence of a motorway system results in increased traffic near residential areas.

The following methodology evaluating the impact on noise pollution encompasses **both modal shift and induced demand.** The analysis begins by assessing the modal shift to RB, including induced demand, by comparing modal shares in scenarios with and without the RB project (in pkm and tkm).

Following this, the **cost associated with noise pollution for each transport mode is quantified** (in EUR/pkm or EUR/tkm). The averages for each mode, such as cars, buses, and trains, are sourced from the "Handbook of external costs of transport (European Commission, 2019a). Combustion engine emissions are expected to decrease over time due to an anticipated evolution and modernization of vehicle fleets. Externality costs are projected to increase over time in line with GDP/capita growth.

As a result, **noise pollution savings due to the RB project are projected at EUR 0.474 bn NPV.** This figure represents the socio-economic implications of the noise pollution generated or mitigated by the project throughout its lifecycle.

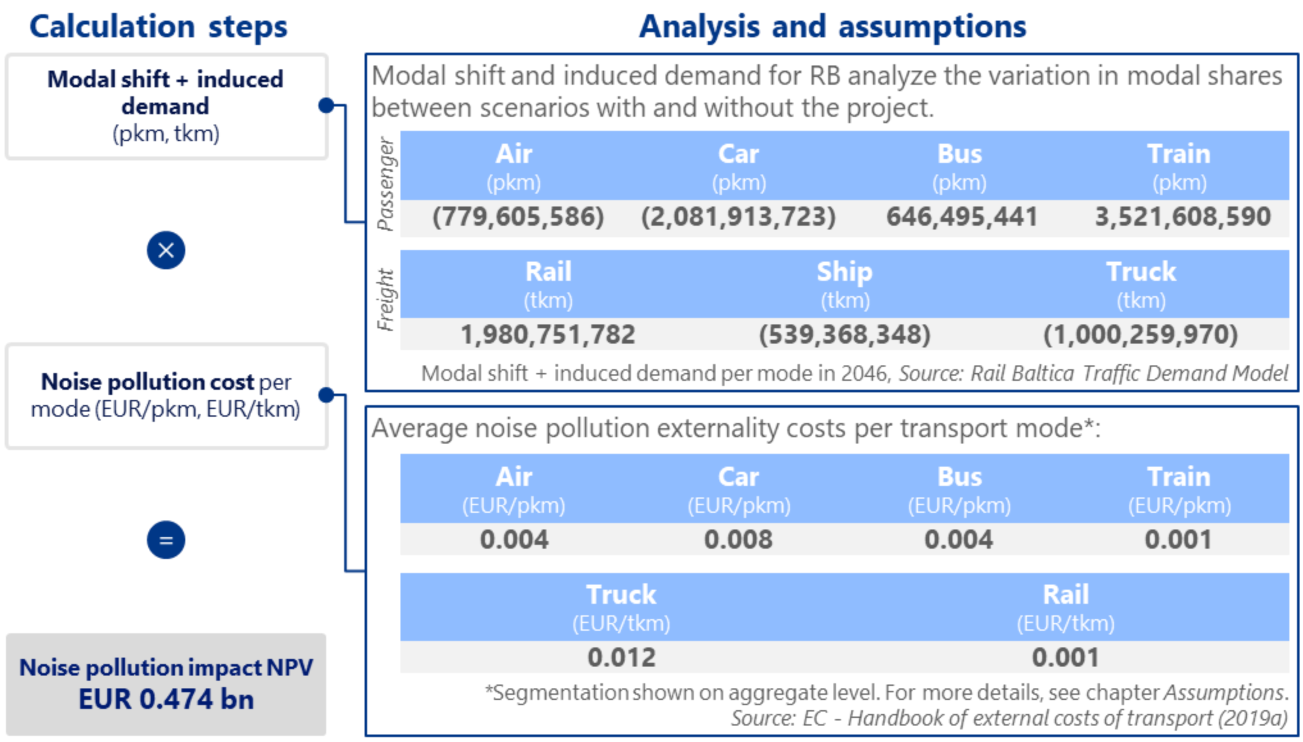


Figure 180: Noise pollution – operation phase calculation

Noise Pollution – Construction Phase

While RB brings significant benefits in terms of reduced noise pollution in the operational phase, it is essential to recognize that there are also **negative impacts in the construction phase**. The methodology for quantifying the impact of noise pollution during the construction phase of the RB project is based on detailed estimations from specific rail sections. These estimations are then extrapolated to represent the noise pollution impact for the entire infrastructure.

The first step in the analysis identifies the **number of people exposed to various noise levels**. This figure assumes that 5,564 residents would be exposed to a noise level higher than 58 dB (the threshold chosen to identify impacted residents), as outlined in RB's environmental impact assessments.

Subsequently, **annual exposure in decibels per year (db/year) is calculated**. This is based on several factors: the duration of the construction, the proportion of exposed residents, and the average noise pollution level. Construction duration is presumed to span seven years as per the RB operational concept, with an average noise pollution level of 58 db. Some 20% of the impacted residents are forecast to be simultaneously exposed.

External cost of noise emissions, expressed in EUR per decibel per year (EUR/db/year), is then determined based on the EU Handbook for external cost of transport (European Commission, 2019a).

In total, **NPV of noise pollution externality costs during the construction phase is estimated at EUR -0.029 bn**. This figure represents the socio-economic implications related to noise pollution arising from the project's construction.

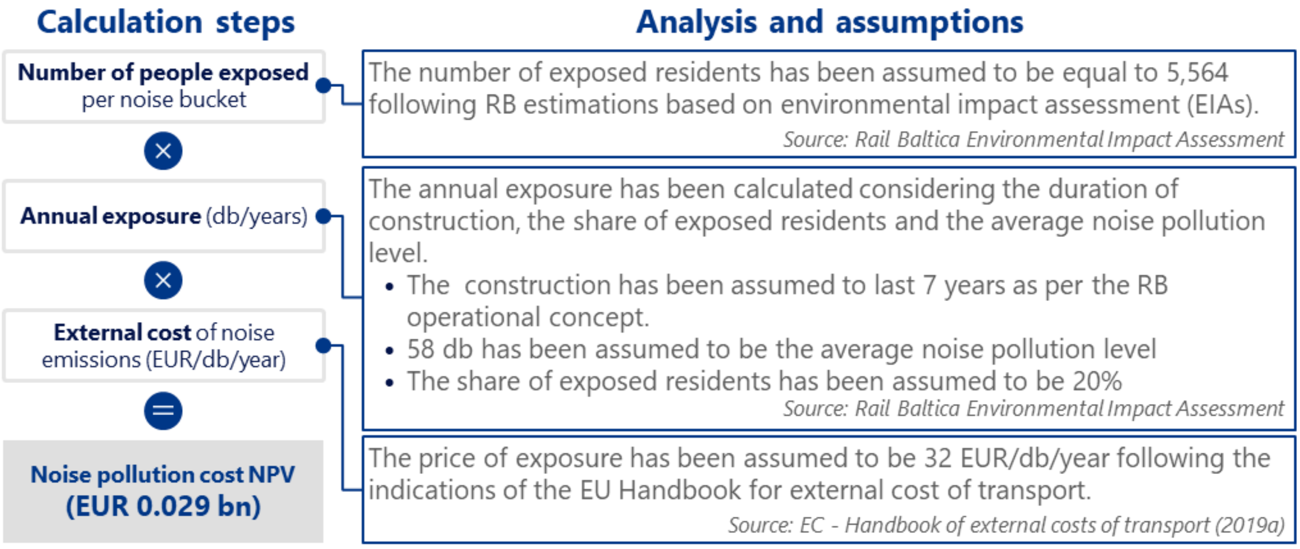


Figure 181: Noise pollution – construction phase calculation

Biodiversity

The preservation of biodiversity is essential in infrastructure projects to **prevent the disruption of ecosystems and thus preserve the health of the environment**. RB has carried out extensive site investigations and research in this regard including biodiversity monitoring. The latter refers to the studies of mammals and birds, vegetation, their habitats, species and landscape specifics such as migration patterns.

The main mitigation solutions identified for the project encompass both **operational and construction phase implications**. The latter encompasses special planning for the inclusion of **technical solutions for animal migration** such as animal passages in the RB corridor. These can take the form of green bridges, river crossings with special clearance for animal passage, multiuse overpasses, green tunnels, and multiuse underpasses.

Throughout the construction phase of the project, it is crucial to **preserve the local fauna and flora.** This involves implementing time restrictions and carefully planning construction sites to avoid establishing bases and roads in protected habitats. From an operational perspective, it will be necessary to verify that the solutions implemented for habitat protection are effective, and that regular maintenance of the animal crossings is carried out.

While biodiversity is not measured in the ENPV calculation in line with CBA guidelines (European Commission, 2014), the mitigation measures of such impacts are important to understand the overall environmental footprint and ensure sustainable development throughout the project's lifecycle.

11.3.5 Labor Market Impacts

Within the RB project, the **benefit of wage increases for RB employees** signifies not only the enhanced compensation but also the improved livelihoods for those working in the initiative. The process to quantify these benefits is structured as follows:

Firstly, the **number of workers employed by RB is identified**. The number of RB employees are expected to grow from 122 in 2024 and peaking at 845 from 2055 onwards. The calculation excludes potential benefits realized by construction workers as construction is considered as the cost of the project which enables the realization of benefits during the operational phase.

Subsequently, the **marginal salary increase of these employees is determined in EUR**. This represents the additional earnings that RB employees receive compared to what they might have earned in alternative employment scenarios without the RB project. The opportunity cost of RB employees (essentially their potential earnings in other jobs) is based on several assumptions:

- A 4.3% unemployment rate, which is proportional to the weighted average of unemployment.
- 45.7% of these individuals might have earned 70% of the RB salary in alternative roles.
- The remaining 50% are assumed to potentially earn 100% of the RB salary in other employment scenarios.

Integrating the employee count and their associated wage benefits, **the NPV of additional compensation for RB employees is calculated to be EUR 0.110 bn**.

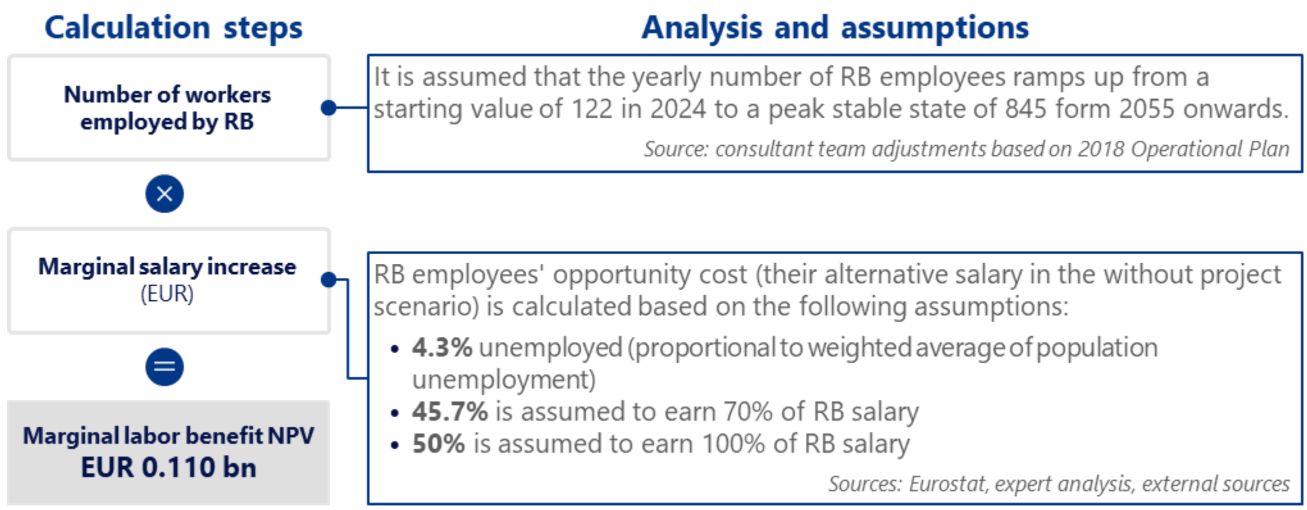


Figure 182: Labor market impacts calculation

In addition to benefits realized by RB employees, the project is expected to **mitigate labor shortages** in the Baltic states through modal shift from more labor-intensive transport modes (i.e. trucking). This transition from labor-intensive trucking to more efficient transport modes will add flexibility to the job market and could decrease the reliance on recruiting workers from abroad. Furthermore, this strategic shift not only addresses immediate labor concerns but also fosters a more adaptable and sustainable workforce structure, crucial in the context of demographic changes in the region. Ultimately, this effect is expected be realized as transport shipping cost savings for freight shippers and considered accordingly in subsection *Freight Market Impacts*.

11.4 Socio-Economic Impact Analysis Results and Sensitivity Analysis

Building on the economic impact assessment outlined in the previous chapter, revealing EUR 22.1 bn in net economic benefits for the RB Phase 1, this chapter turns to **evaluate the robustness of the socio-economic impact of the project**. In this context, a sensitivity analysis is carried out, assessing the ceteris paribus impact of variations in several key parameters on the project's socio-economic impact.

Global parameters

1. **Social discount rate** adjusts the chosen rate to reflect the present value of future benefits and costs.
2. **Construction delay** refers to the extent of delays experienced in the construction process and the timeline for the opening.
3. **Residual lifetime**: sets the assumption for the last year of the useful economic life of the infrastructure after the modeling period (2080).
4. **Value of time – GDP/capita elasticity** changes the elasticity of the value of time and real wage growth to GDP/capita growth.
5. **Vehicle fleet pollution evolution** determines the rate of decrease in pollution (GHG, air and noise) by all transport modes with setting the assumption for 2080 as the percentage of today's emissions.
6. **Vehicle fleet safety evolution** determines the rate of safety increase across all transport modes. It assumes that by 2080, the costs associated with accidents will be a certain percentage of today's accident costs.

Passenger impact parameters

1. **Passenger modal shift** determines the percentage of the forecasted modal shift that is expected to be realized.
2. **Passenger induced demand** determines the percentage of forecasted induced demand that is expected to be realized.

Freight impact parameters

1. **Freight modal shift** determines the percentage of forecasted modal shift that is expected to be realized.
2. **Freight induced demand** determines the percentage of forecasted induced demand that is expected to be realized.

To evaluate potential positive and negative impacts of the parameters outlined, a specific **adjustment range is defined** based on realistic fluctuations, considering the unique characteristics of each parameter.

Key findings show that the most significant factors influencing the NPV of the socio-economic impact are the social discount rate, construction delays, and residual lifetime. Notably, no individual parameter, even under a worst-case scenario, leads to a decrease in NPV greater than EUR 4.1 bn. In this context, the analysis concludes with a high degree of confidence that the NPV likely falls within a **range of EUR 18.0 bn to EUR 25.5 bn**.

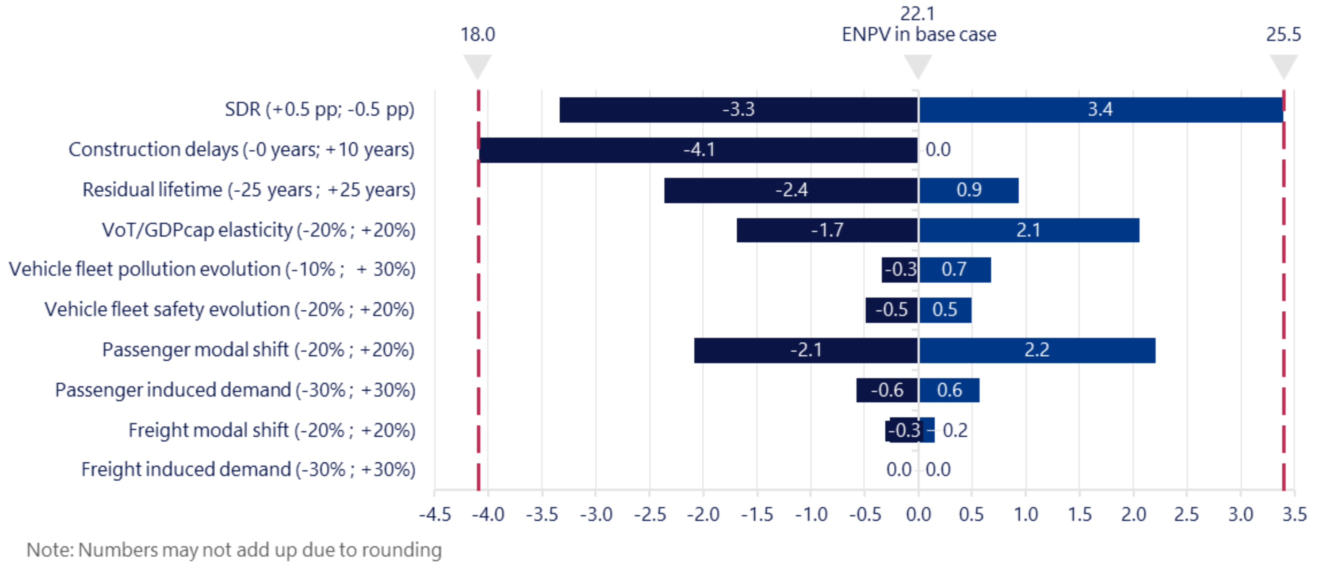


Figure 183: Sensitivity analysis overview (Consultant team analysis)

Findings of the sensitivity analysis clearly show that the **socio-economic impact range consistently exceeds the negative financial outlook presented** in the base case scenario, reinforcing the project's economic viability across a spectrum of socio-economic conditions. Moving forward, the next chapter provides a more comprehensive evaluation of the project's total economic performance by identifying key economic performance indicators, considering both financial and economic factors.

12 Conclusion of Economic Viability and Key Performance Indicators

Considering both financial and socio-economic impact assessments within the CBA framework, the project is expected to generate **EUR 8.5 billion in ENPV** by offsetting the negative EUR -13.5 bn FNPV with positive EUR 22.1 bn in net present economic benefits. This corresponds to **a benefit-cost ratio (BCR) of 1.6** and an **economic rate of return (ERR) equal to 6.2%[82],** well above the SDR[83] employed. Consequently, the project's economic viability is firmly established, with expectations for generating more economic benefits for the region than the financial costs incurred.

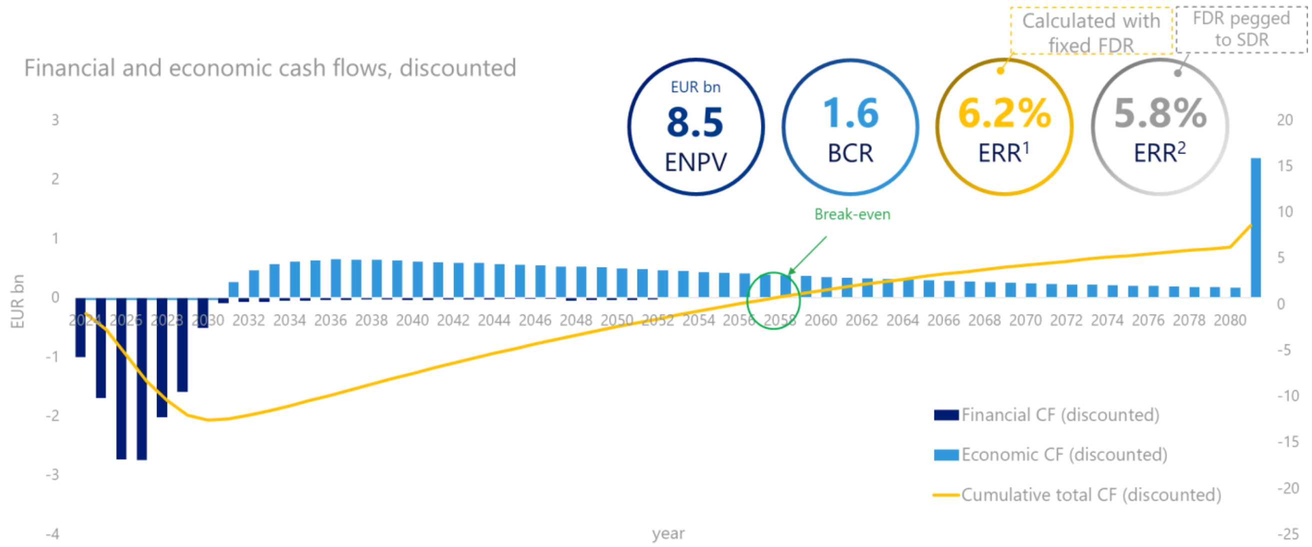


Figure 184: Financial and economic cash flows, discounted

Expanding on these results, the **sensitivity analysis of the ENPV integrates both financial and socio-economic dimensions to provide detailed insights into the project's resilience and viability under varying parameters**. The base case ENPV at EUR 8.5 bn shows a strong confidence interval between EUR 1.1 and 14.7 bn, resulting from the cumulative effects of the worst- and best-case scenarios in both financial NPV and net economic benefits.

[82] The ERR of 6.2% relies on the assumption of a fixed FDR. If the FDR is pegged to the SDR, as mandated by EU guidelines, the ERR adjusts to 5.8%, still surpassing the applied SDR. However, this approach overlooks the fundamental differences between FDR and SDR, which are typically distinct. Therefore, adhering to the method using a fixed FDR is recommended for a more accurate representation of the project's economic viability.

[83] SDR = Social Discount Rate

This analysis concludes that while there is a very limited probability of a negative ENPV, the project demonstrates significant robustness to changes in key parameters.

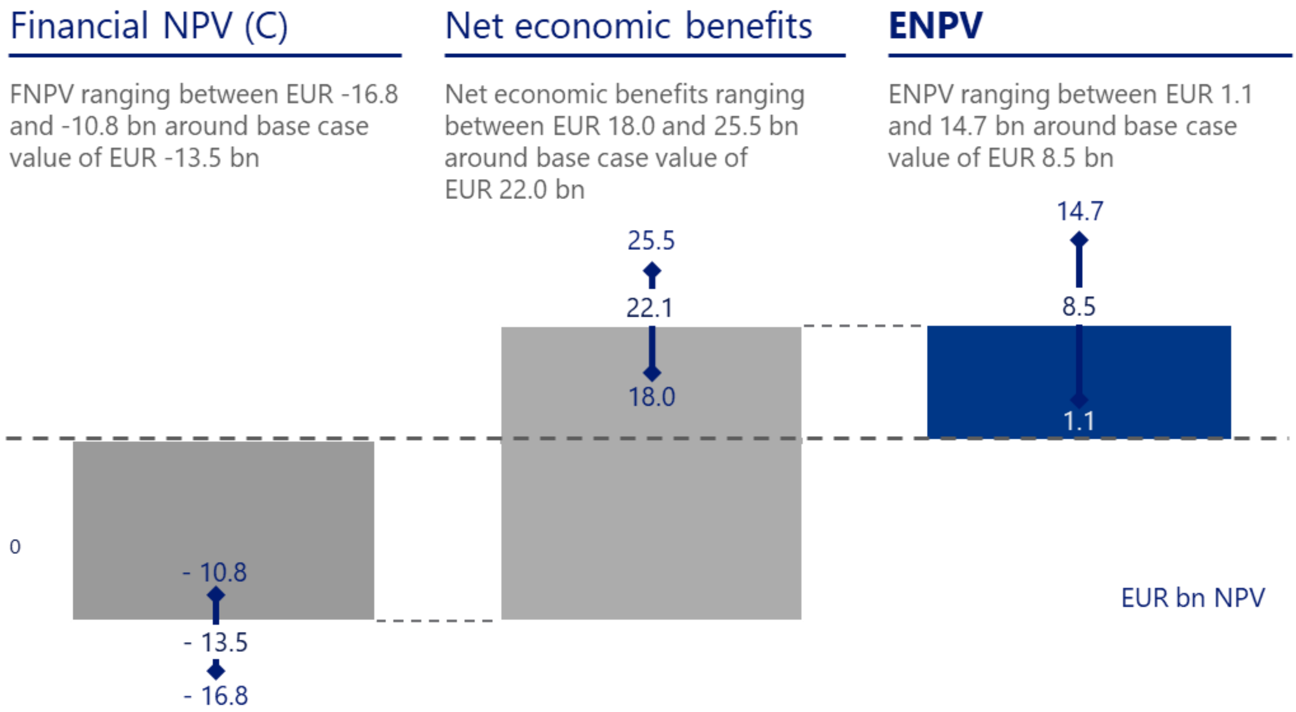


Figure 185: ENPV sensitivity analysis, discounted[84]

Following the analysis of the project's economic performance indicators, the **subsequent chapters on scenario analysis, risk assessment, and wider economic impact** analysis support the contextualization of these findings leading to a full understanding of the project's broader socio-economic implications and viability.

[84] Values might not add up due to rounding

13 Phase 1 Extended Scenario

This chapter presents a **high-level cost-benefit impact estimation for the Extended Scenario** related to Phase 1 of Rail Baltica Global Project. In the context of the Extended Scenario, **RB plans to implement three main components** to further increase the project's economic benefits.

The key scenario components are:

1. **Earlier operational start of RB1:** passenger operations on the existing 1520 mm gauge RB1 line connecting Kaunas and the Polish border start from 2028 following a construction spend on making the line operations (e.g. signaling). Additional stations are utilized along its route.
2. **Change of scope elements:** change in PTOs such as the inclusion of a major passenger station in Kaunas and four freight terminals in Salaspils, Panevėžys, Kaunas and Marijampolė with related services also adjusted to align to changing scope and demand.
3. **Application of variable-gauge rolling stock**: construction of gauge-changing mechanism and equipment on the Kaunas-Vilnius O/D to enable direct connectivity and reduced travel times between Vilnius and long-distance locations such as Tallinn or Warsaw.

As Phase 1 is expected to be completed by 2030, these additional changes and investments can provide **earlier direct access to Rail Baltica for a broader population, facilitating quicker connections to major and an increased number of Baltic cities**. The analysis does not extend to the validation of inputs and key assumptions of RB as detailed input collection methodologies and underlying assumptions were not available. The purpose of this chapter, therefore, is to deliver a high-level analysis of the potential impacts of the additional scope elements and service changes in an aggregate form and in addition, providing a high-level deep dive into the contribution of each of the scenario component.

The chapter begins by outlining the key changes in infrastructure, capital expenditures and service concept, establishing the **scope of the Extended Scenario** compared to the previously analyzed scope and set-up. It then provides an overview of the differences in **demand** as well as a **financial analysis** and **socio-economic analysis** of these investments. It concludes by comparing the **net economic benefits of the Extended Scenario** to that of Rail Baltica Phase 1, then showcasing the impact of high level ENPV drivers such as the FNPV or Economic impact NPV contribution of the **scenario components**. For ease of understanding, in the following chapter the Phase 1 scope of the Rail Baltica Global Project will be referred to as the "Base Case," while the inclusion of these additional scope elements will be termed the "Extended Scenario."

13.1 Extended Scenario Scope Definition

13.1.1 CAPEX Changes

The aim of this section is to provide an overview of the scope of the Extended Scenario and related capital expenditures based on inputs from RBR. The Extended Scenario comprises changes on the mainline as well as point-type objects (additional passenger stations and freight terminals) and related global CAPEX items. These investments would result in an overall **EUR 0.9 bn increase in capital expenditures** on 2023 End of Year (EoY) prices.

As seen on the figure below, this overall increase in capital expenditure derives mainly from the following adjustments:

- Mainline scope increase (EUR 0.4 bn)
- PTO scope change (EUR +0.3 bn and EUR >-0.1)
- Cost increase on existing scope items (EUR <0.1 bn)
- Changes related global cost adjustment (EUR 0.2 bn)

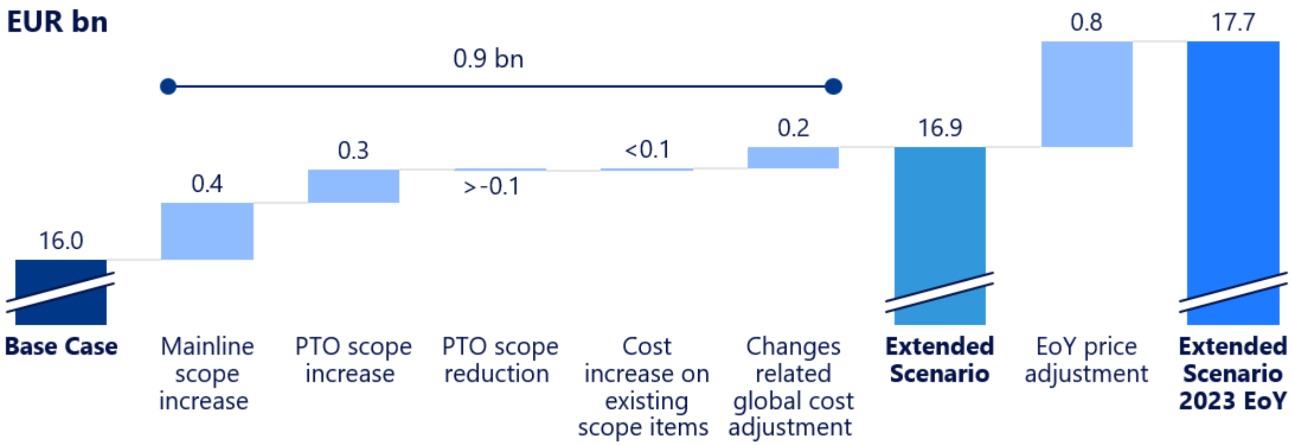


Figure 186: Extended Phase 1 CAPEX Value change per adjustment category, EUR bn

Regarding CAPEX changes per cost category, we can differentiate between three main categories:

- Mainline scope adjustments
- PTO scope adjustments
- Global cost adjustments

Mainline scope increase includes single-track connection to RB1 line at the South and North of Marijampolė, a double track upgrade on LT DS3, DS5 from Phase 1 Base Case single-track section and their related mainline costs (supervision, studies). In addition, further loop/halt construction for Kaunas Airport and layout modification at Vilnius is also included here. (Please see detailed list of items later in the chapter)

Regarding the **adjustment categories related to PTOs**, these refer to additional passenger stations in Kaunas and Vilnius, additional and in some cases extended freight terminals in Salaspils, Marijampolė, Kaunas and Panevėžys, and the postponing of a regional passenger station construction in Pasraučiai to Phase 2.

Lastly, changes related to **global cost adjustments** refer to the changes in ENE, CCS, FIDIC, NoBo, AsBo, indirect costs, PISM, and contingencies (management reserves).

The value changes within the cost categories (Mainline, PTO, Global) are seen on the figure below. Compared to the Base Case Scenario, the Extended Scenario entails an EUR 1.0 bn increase in expenditures on the mainline infrastructure. Regarding PTOs, the Extended Scenario results in EUR 347 mn increase, similarly, global cost would also increase by EUR 316 mn.

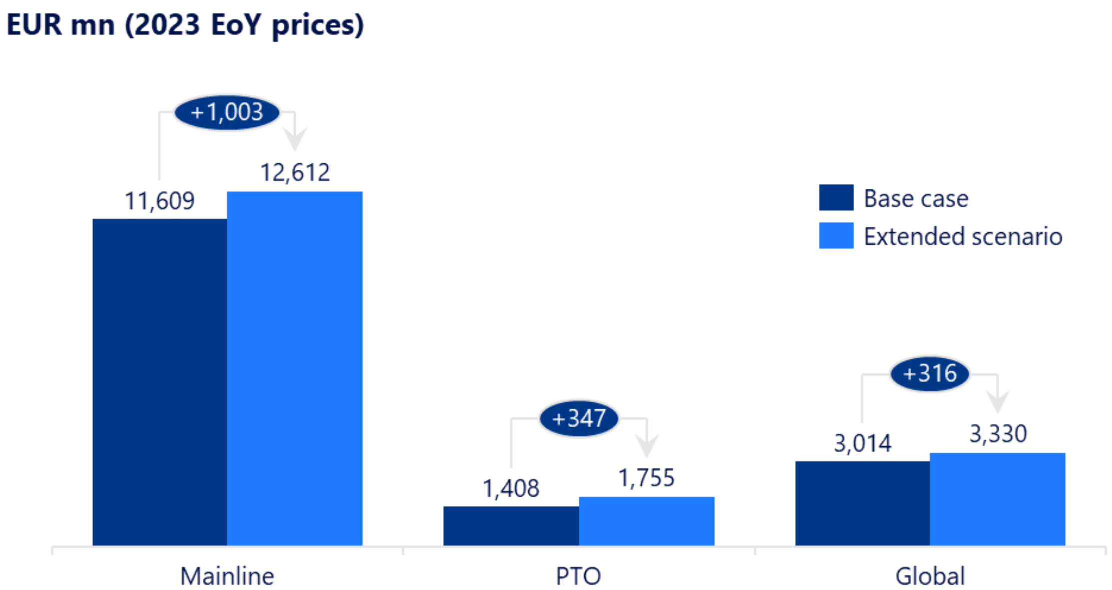


Figure 187: CAPEX value change by cost category, EUR mn (2023 End of Year prices)

Taking a more in-depth overview of PTOs, 2 major passenger stations and **4 freight terminals are allocated capital and are added in the Extended Scenario,** and one passenger station is removed. The **comparison of the number of PTOs** between the Base Case and the Extended Scenario in Phase 1 Base **is illustrated in the figure below.** In the Base Case, there are 37 PTOs, which includes the Polish border station. However, in the Extended Scenario, this number increases to 42 PTOs.

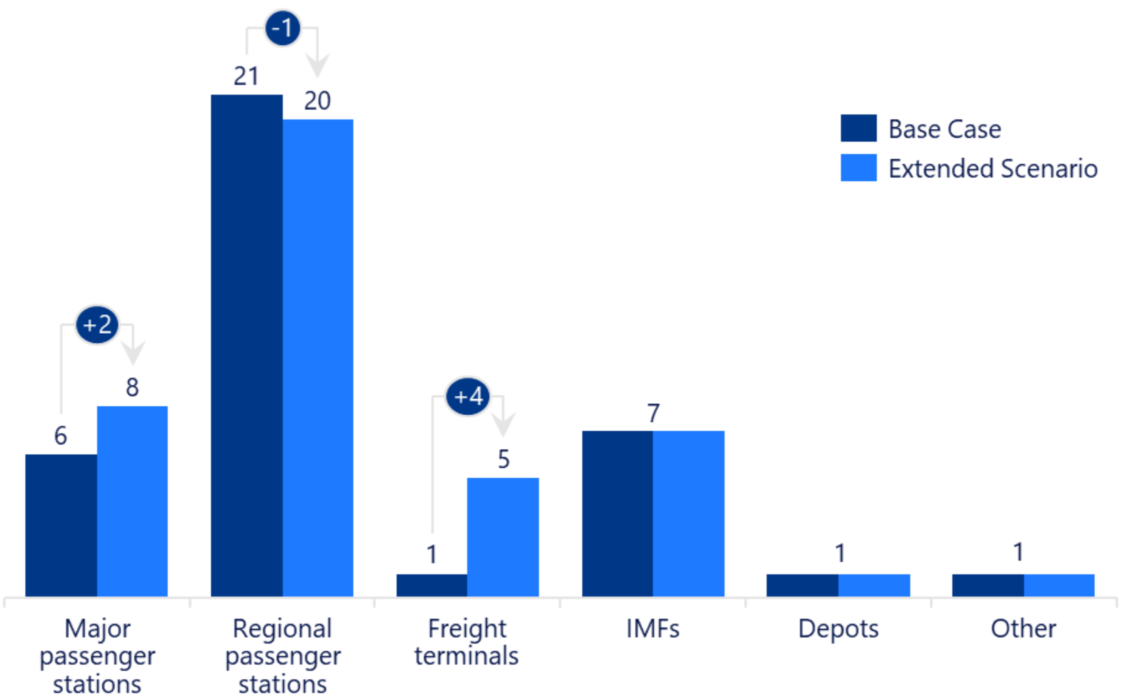


Figure 188: Changes in the number of PTOs

These changes are PTOs are as follows:

- **Major passenger stations** included in Kaunas (Kaunas Airport Station) and in Vilnius (Vilnius International Passenger Station - layout modifications)
- **Regional passenger** station removed in Pasraučiai
- **Freight terminals** included in Marijampolė, Kaunas and Panevėžys and another in Salaspils[85] with lower functionality.

The additional PTOs in the Extended Scenario present an opportunity to potentially unlock greater benefits. By strategically increasing the number of PTOs, this scenario can allow for improved network coverage and enhanced operational flexibility. Overall, in this scenario, the inclusion of 4 freight terminals can significantly enhance freight service coverage. This expanded infrastructure is expected to improve logistical efficiency, supporting better service delivery and optimizing freight handling capacity across the network.

Type	CAPEX element	EE	LV	LT	Total
Mainline	Mainline sections, structures and elements	2 089	4 641	4 684	**11 414**
	ML Construction supervision	44	125	94	**264**
	ML Different studies	7	10	12	**29**
	Design contracts (with IVN-s)+ expertise	41	145	146	**332**
PTO	International passenger station	200	407	106	**713**
	Regional passenger station	21	37	89	**147**
	Freight terminal	84	5	191	**280**
	IMF	121	113	102	**337**
	Depot	-	186	8	**194**
	Other PTO[86]	-	-	4	**4**
Global	AsBo, NoBo	2	3	2	**7**
	ENE	181	277	393	**850**
	CCS	201	263	433	**898**
	Fidic CCS and ENE	8	11	17	**35**
	Indirect cost	61	128	128	**317**
	Contingencies	80	134	133	**346**
Subtotal		**3 141**	**6 486**	**6 542**	**16 169**
Global (other)	Land acquisition	66	183	109[87]	**358**
	PISM	89	148	130	**346**
Total		**3 295**	**6 816**	**6 781**	**16 893**

Figure 189: Extended Scenario CAPEX based on adjustments, EUR mn (RBR project team input; Consultant analysis)

The following map provides a detailed overview of the additional scope elements in the Extended Scenario. It is important to note that while the infrastructure investments impact mainly the Lithuanian section of Rail Baltica,

[85] In Salaspils, sidings and storage facility are already constructed, as well as needed additional infrastructure elements.

[86] Other PTOs include Ülemiste Terminal infrastructure adjustment costs (from 1520 mm gauge to 1435 mm gauge) and Vilnius Airport Station related costs.

[87] Land acquisition costs for PTOs are not included, they are allocated to PTO costs.

service changes and the additional freight service point in Salaspils will have an impact on the operations of RB in other Baltic States as well.

Figure 190: Rail Baltica Phase 1 Extended Scenario infrastructure

13.1.2 Service Concept Changes

This section aims to provide an overview of the changes in service concept in the Rail Baltica Phase 1 Extended Scenario compared to the Base Case both in terms of passenger and freight services.

Passenger Services

Regarding high-speed service, the Extended Scenario entails two significant modifications compared to the Base Case. First, **variable-gauge** or gauge adaptive **rolling stock** are introduced on certain lines (HSP1/VIL1a and VIL5a/HST5b), which **enable direct connectivity from Vilnius to Tallinn and to Warsaw** (or even to Berlin) without the need to transfer in Kaunas. Variable-gauge rolling stock are equipped with adaptable wheelsets, enabling seamless transitions between the 1520 mm gauge on the Kaunas-Vilnius route and the 1435 mm gauge network of Rail Baltica.

Secondly, the Extended Scenario **includes mixed-service lines** (RE/HST2 and RE/HST3a/b), **where high-speed trains operate at regional speeds on certain sections**, specifically on the Tallinn-Salaspils and Rīga Airport-Panevėžys segments.

Regarding **regional services**, which also serve as feeder lines to high-speed services, the frequency of trains decreases compared to the Base Case. In addition, with a combination of two service lines, a direct service (RE7/7a) is established between Rīga airport and Białystok. Moreover, a new line (RE-LT) is established between Panevėžys and Marijampolė which serves the needs of Lithuanian passengers.

The **Extended Scope has no impact on the frequency or operational routes of night services** (NT41) and **shuttle services** (RIX and SAL), as their route or time of operation separates them from other services.

Freight Services

In terms of **freight services**, the Extended Scenario includes **two additional service lines**. The first includes an additional freight service line between Muuga and Warsaw with a stop in Salaspils, while the second contains a new freight service line between Salaspils and Marijampolė with stops at Panevėžys and Palemonas.

The following table presents the service concept for passenger and freight services in the Extended Scenario:

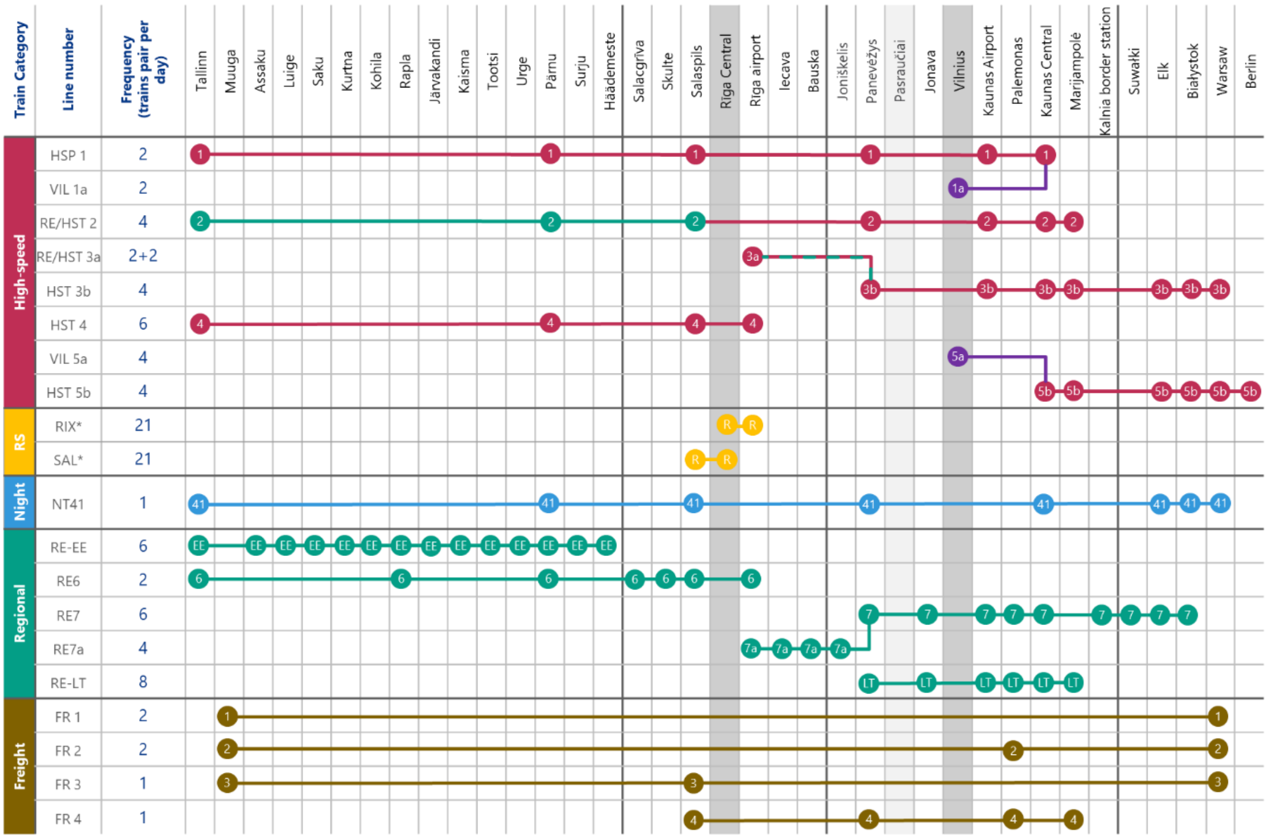


Figure 191: Service concept for train lines in the Extended Scenario[88] (RBR Project Team Input, 2024)

13.2 Traffic Demand

This chapter aims to provide an overview on passenger and freight demand changes in the Rail Baltica Phase 1 Extended Scenario compared to the Base Case. When analyzing the demand impact of the Extended Scenario, **the two main dimensions** of the analysis to consider **are the impact on induced demand and modal shift to rail, and to Rail Baltica specifically**.

13.2.1 Passenger Traffic

Regarding passenger demand in terms of modal shift and induced demand, **the Extended Scenario is expected to increase incremental rail volumes, as well as RB passenger volumes compared to the Base Case**

[88] The hypothesis of a seamless shuttle service RIX-RCS-Salaspils was tested. The results from the demand model shows that this service would have a positive impact on the Salaspils station (10%) and RIX station (7%) shuttle service passenger turnover. However, the improved alternative has a negative impact on the Misa-RIX Rail Baltica section, with passenger volume on the section dropping by 9%. The difference in overall Rail Baltica travelled passenger km in Latvia is insignificantly negative (1% drop), (RBR Project Team Input, 2024). SAL shuttle service is not included in the financial model, as it will operate on an existing track, which is not part of the current assessment.

throughout Phase 1 operations, driven by the following factors in each country (please see annual volume potential for 2031 without ramp-up in the below figure).

- In **Estonia**, both incremental rail volumes and Rail Baltica volumes experience a slight decrease compared to the Base Case, driven by a reduction in service frequency to better align with infrastructure capacity.
- Similarly, in **Latvia**, the reduced frequency of regional services to meet network capacity limits leads to a decrease in RB passenger volumes is mitigated by higher volumes on the frequent 1520mm shuttle between RIX and RCS. Additionally, limited direct access to Rīga Central Station and more precise modeling between Skulte and Salaspils drive traffic from RB to 1520 mm services.
- However, these slight decreases in RB volumes in Estonia and Latvia are offset by a significant increase in **Lithuania**. This growth is due to the introduction of direct services to and from Vilnius through the utilization of variable-gauge rolling stock. Moreover, additional regional and HST stations is Kaunas and Marijampolė attract further passengers, offering improved connectivity across high-density areas in Lithuania and to/from Poland and Europe.

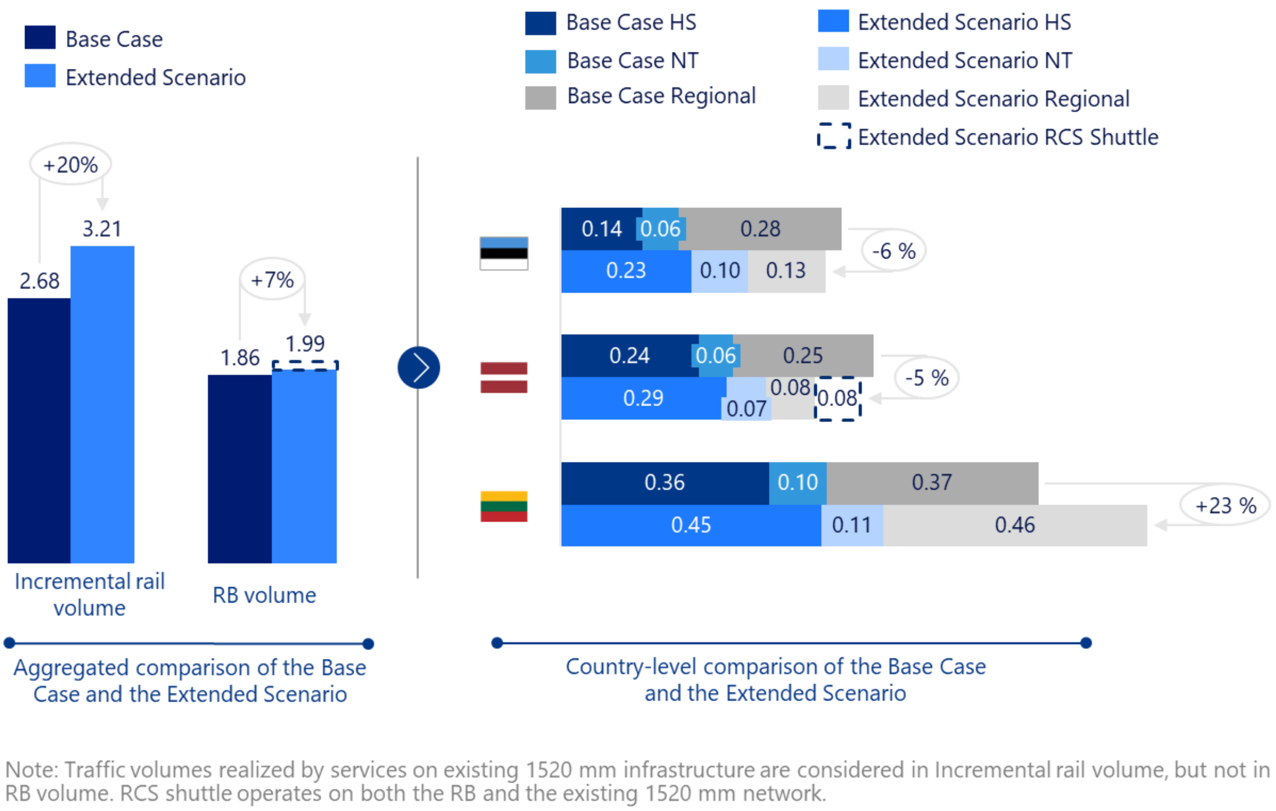
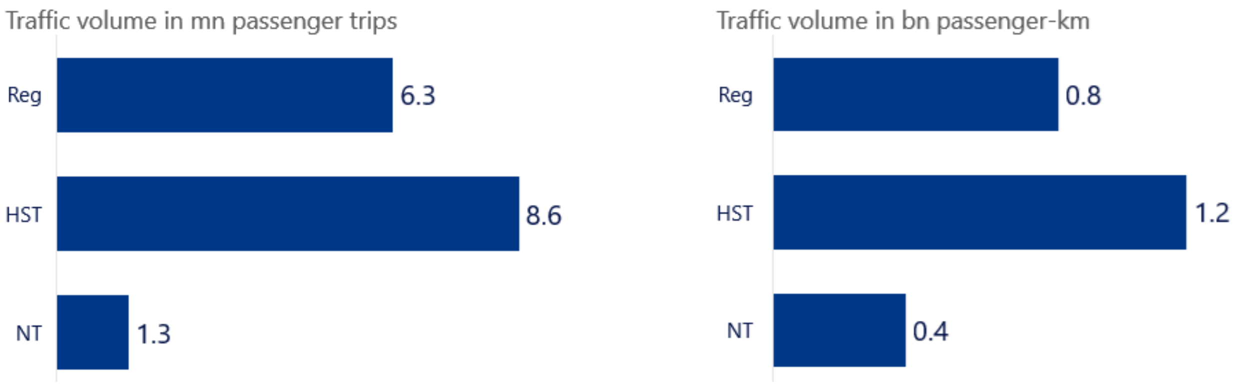


Figure 192: Changes in modal shift and induced demand, 2031 without ramp-up, bn pkm

Within the context of the Extended Scenario, **passenger operations are expected to start from 2029 on RB1** between Kaunas to the Polish border, serving an additional annual passenger volume of 85 mn pkm until the start of Phase 1 operations in 2031.

By 2045, RB Phase 1 is expected to carry **16.2 mn trips of passengers (2.4 bn passenger-km)**, with ~53% of the trips realized on high-speed services. This pattern in the result of a higher relative capacity share of high speed services in the Extended Scenario compared to Base Case, as well as the consequent limitation of regional capacity.



193: Figure: Passenger traffic on RB Phase 1 ExtSc in 2045 (mn pax trips and bn pkm)

13.2.2 Freight Traffic

Regarding freight transportation, the Extended Scenario also entails **increased incremental rail, and Rail Baltica volumes** compared to the Base Case (please see annual volume potential for 2031 without ramp-up in the below figure). On a country basis, increased Rail Baltica freight volumes are driven by the following factors.

- In **Estonia**, Rail Baltica freight volumes experience an overall growth due to the increase in the frequency of unitised services resulting in the volume growth of unitised goods. However, the increase in the volume of unitised services slightly decreases demand for non-unitised goods.
- In **Latvia**, Rail Baltia volumes witness a similar growth, driven by the increase in services boosting the volume of unitised freight. In addition, the freight terminal in Salaspils further increases capacity and demand for unitised freight transportation. Demand for non-unitised goods on the other hand remain constant.
- Lastly, in the case of **Lithuania**, the increase in the frequency of unitised services drive the volume growth of unitised services, limiting demand for non-unitised services. Further, additional terminals have the potential to decrease transport distances due to more densely located loading/unloading points offering better connectivity via adjacent rail/truck services.

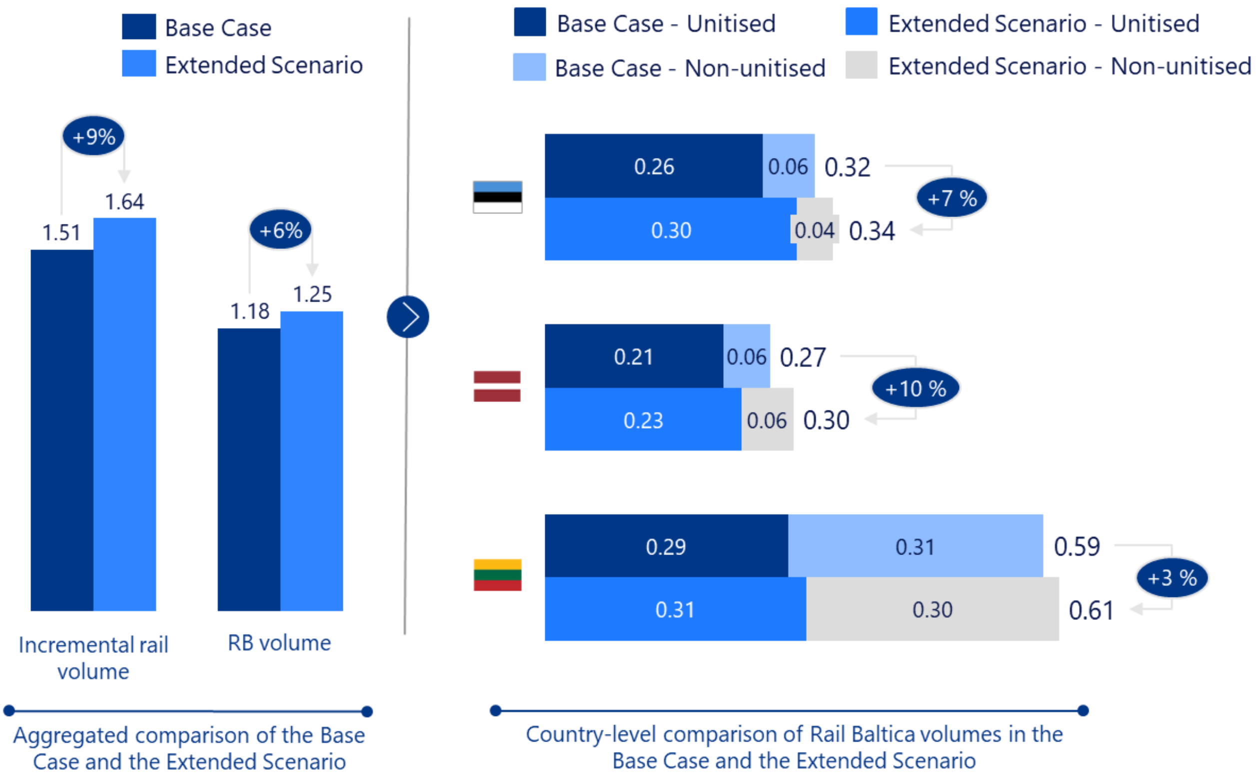


Figure 194: Changes in modal shift and induced demand, 2031 without ramp-up, bn tkm

By 2045, RB Phase 1 is expected to carry **9.6 mn tons (1.7 bn ton-km)**, with ~67% of the volume (in pkm) realized on unitized RB services.

13.3 Financial Analysis

Following the observed changes in CAPEX and traffic demand, this chapter provides a **high-level financial analysis of both the Extended Scenario including the assumptions on Phased Section Opening**. It begins with the evaluation of the overall operational and CAPEX NPVs within the Extended Scenario, assessing the impacts of individual components, drawing attention to key differences compared to the Base Case. This approach provides a comprehensive view of the financial implications and segment-specific changes introduced by the extended and phased development plans.

The total FNPV(C) of the Extended Scenario amounts to EUR -14.2 bn, reflecting a decrease of c. EUR 0.7bn (4.8%) compared to the Base Case. The following figure offers an overview of the total FNPV(C) and its composition, showing the contributions from four major components and a breakdown for segment service types that shape the overall result:

Major NPV component	NPV subcomponents	FNPV(C) (EUR mn)	Share in total (%)
Main operations NPV		**-1,431**	**10.07%**
NPV	High-speed NPV	-769	5.41%
	Night NPV	-27	0.19%
	Regional NPV	-524	3.69%
	Unitised NPV	-85	0.60%
	Non-unitised NPV	-26	0.18%
Other operations NPV		**201**	**-1.41%**
	Stations NPV	4	-0.03%
	Terminals NPV	103	-0.72%
	Ancillary NPV	29	-0.21%
	Electricity NPV	65	-0.46%
Residual value NPV		**4**	**-0.03%**
CAPEX NPV		**-12,983**	**91.37%**
Total FNPV(C)		**-14,209**	

Figure 195: Financial NPV(C) component overview

When comparing the shifts in major NPV components to the Base Case, it is evident **that discounted CAPEX remains the largest contributor**, after a decrease to EUR -13.0 bn (from EUR -12.3 bn) following increases in scope, it retained its share of total NPV at 91.37%. The changes in NPV for main and other operations reflect an improved financial performance in the freight segment, driven in part by the potential of additional terminals boosting demand. This increased demand positively impacts both main and other operations, highlighting the freight segment's role in strengthening overall financial outcomes.

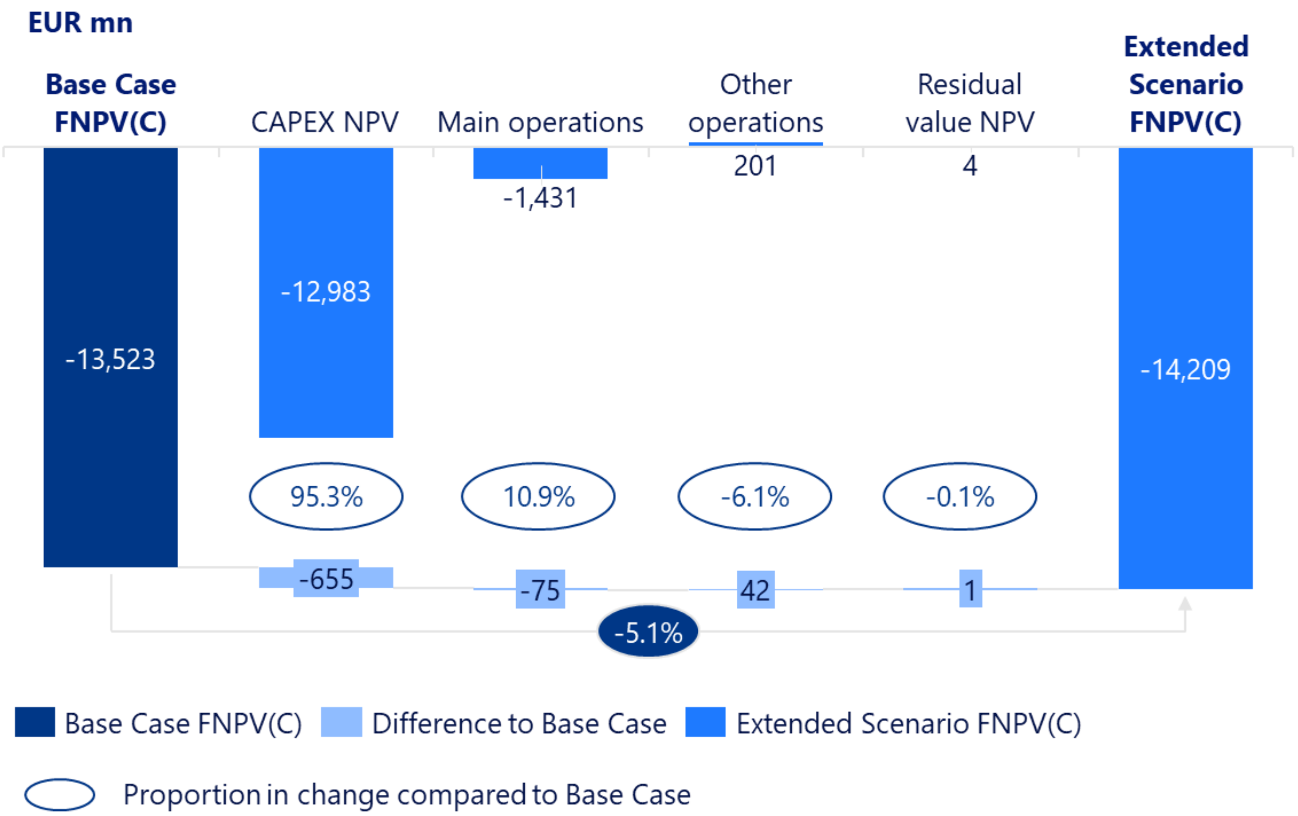


Figure 196: Base Case and Extended Scenario FNPV(C) component comparison, EUR mn

13.3.1 Main Operations

The **main operations NPV in the Extended Scenario is EUR -1.4 bn**, representing a decrease of EUR 75 mn from the Base Case, which is a -5.5% change. This decrease is primarily driven by the increased cost allocation to the **freight segment during direct cost modelling**, induced by the increased train kilometers in the Extended Scenario.

In contrast, the **passenger segment** experiences a more balanced impact. While regional segment NPV increased by 33%, these gains were offset by decreased NPV of the High-speed segment due to its greater share in total train kilometers, resulting in a net effect that does not significantly alter the passenger segment's financial position. As described later, this still results in a greater socio-economic impact, therefore seems warranted.

The separate analysis of various scenario components indicates a negative impact on the financial results. This is largely because the additional initial investment has only a marginal effect on main operations revenues, while the increased OPEX and asset renewal costs - and their distribution across segments - substantially affect profitability. Despite the Extended Scenario's lower FNPV, the economic impact is strong enough to turn the ENPV of nearly all scenario components positive.

The following figure illustrates the impact of Extended Scenario to the main operations subcomponents:

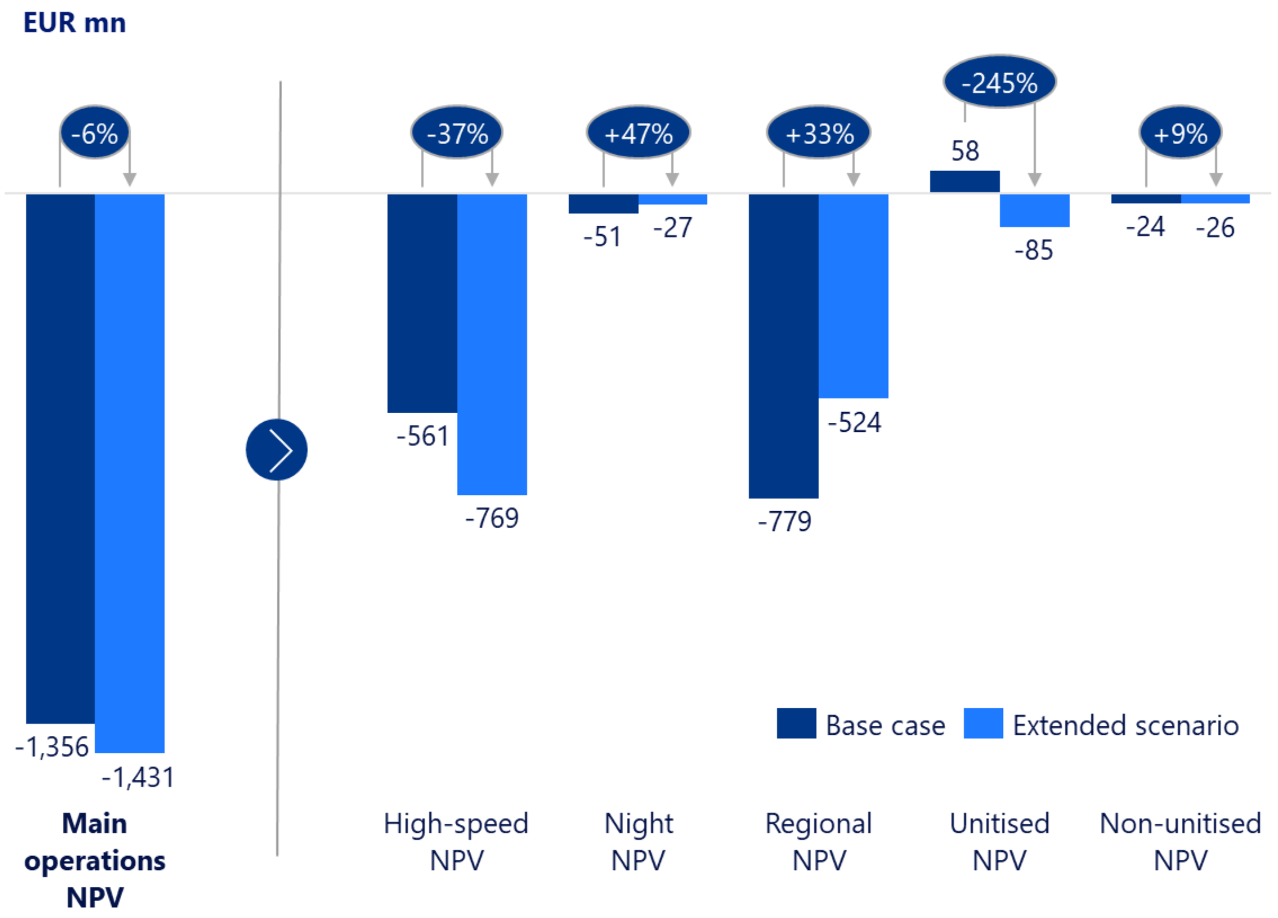


Figure 197: Base Case and Extended Scenario FNPV(C) main operations comparison, EUR mn

13.3.2 Other Operations

As seen on the figure below, **other operations[89] NPV experienced a positive overall impact** under the Extended Scenario, increasing by 27% compared to the Base Case.

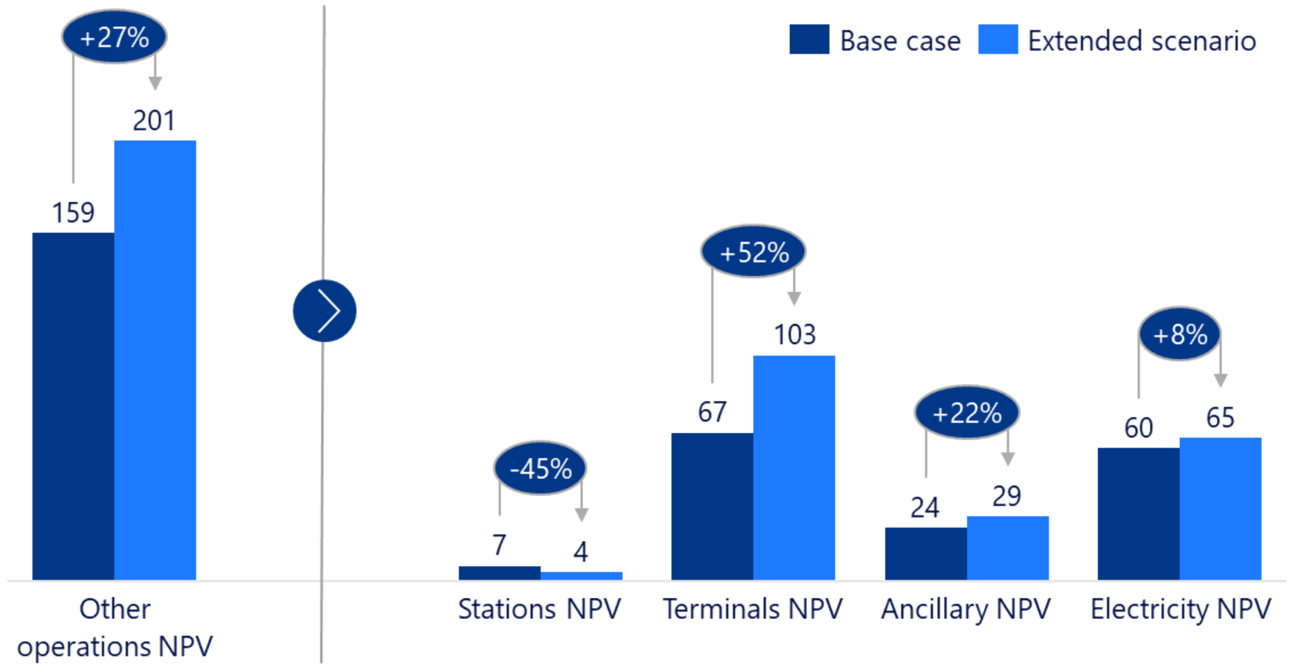


Figure 198: Base Case and Extended Scenario FNPV(C) other operations comparison (EUR mn)

Compared to the Base Case, terminal segment NPV experiences the greatest increase (52%) within the Extended Scenario contributing to the other operations positive business case by additional EUR 35.2 mn. This growth reflects the increased demand and revenue associated with the expanded terminal infrastructure, which intensifies loading and unloading activities.

On the other hand, the introduction of new scenario components decreased the Stations NPV by 45%. The addition of new stations, and the recategorization of Jonava stop to station increased the overall operational cost of stations, and in the new service concept the number of stops per year has decreased, reducing the revenue streams for this segment.

Other segments do not experience similar changes, as their primary revenue sources are not directly influenced by the scenario components. Consequently, the positive impact of the Extended Scenario is largely concentrated in the addition of new scope elements, while the other scenario components have no significant effect.

13.3.3 Financial sustainability

The sustainability analysis of the Extended Scenario indicates that **the project will require external financing throughout its life cycle, as it is not expected to generate sufficient revenue to cover all costs incurred,** resulting in a cash flow gap through operational years**, and meet its financial obligations over the long term**.

[89] Stations, Terminals, Ancillary services and Electricity resale

It is important to note that future externalities could make the business case for the project positive, even if European connectivity is not yet predictable for the infrastructure.

The following figure shows the average annual **additional cash flow gap coverage requirement during the operational phase, from 2031 to 2080 for each country,** distributed across all major cost items based on their proportion in total expenses. It is currently estimated that the total additional funding needed for operations will be around **EUR 276 mn annually in the Extended Scenario.**

Cash flow coverage component	Estonia	Latvia	Lithuania	Total
General costs (non-rebalancing)	6.0	51.0	32.5	89.5
Maintenance and repair	7.3	46.9	41.5	95.7
Asset renewal	6.9	44.5	39.3	90.7
Total	**20.3**	**142.4**	**113.3**	**275.9**

Figure 199: Average annual cash flow gap coverage need of the countries per major cost categories, EUR mn

The figure above indicates that the majority of the cash flow gap coverage, approximately 68%, is allocated to asset value rebalancing costs, with the remaining portion used to cover general cost deficits such as material, personnel, and interest expenses. On a country-specific level, Latvia and Lithuania have significantly higher annual subsidy requirements to bridge their total cash flow gaps, with average annual needs of EUR 142.4 million and EUR 113.3 million, respectively. This is primarily due to their higher initial CAPEX and interest expenses. Estonia, by contrast, has a much lower average annual subsidy need of just EUR 20.3 million.

13.4 Socio-Economic Analysis

The aim of this section is to provide a high-level socio-economic impact analysis of RB Phase 1 Extended Scenario. The section begins with providing an overview of the changes in the socio-economic impact components, followed by the assessment of the main drivers behind these changes.

As seen on the figure below, the **total discounted benefits of the Extended Scenario amount to EUR 24.3 bn**, reflecting a **10.1% increase in socio-economic benefits compared to the Base Case**. The overall increase in socio-economic components results mainly from the gains in passenger and freight shipper impacts, along with improvements in the transport value chain. Meanwhile, labor impacts remain mostly unchanged, and environmental impact benefits somewhat decrease compared to the Base Case.

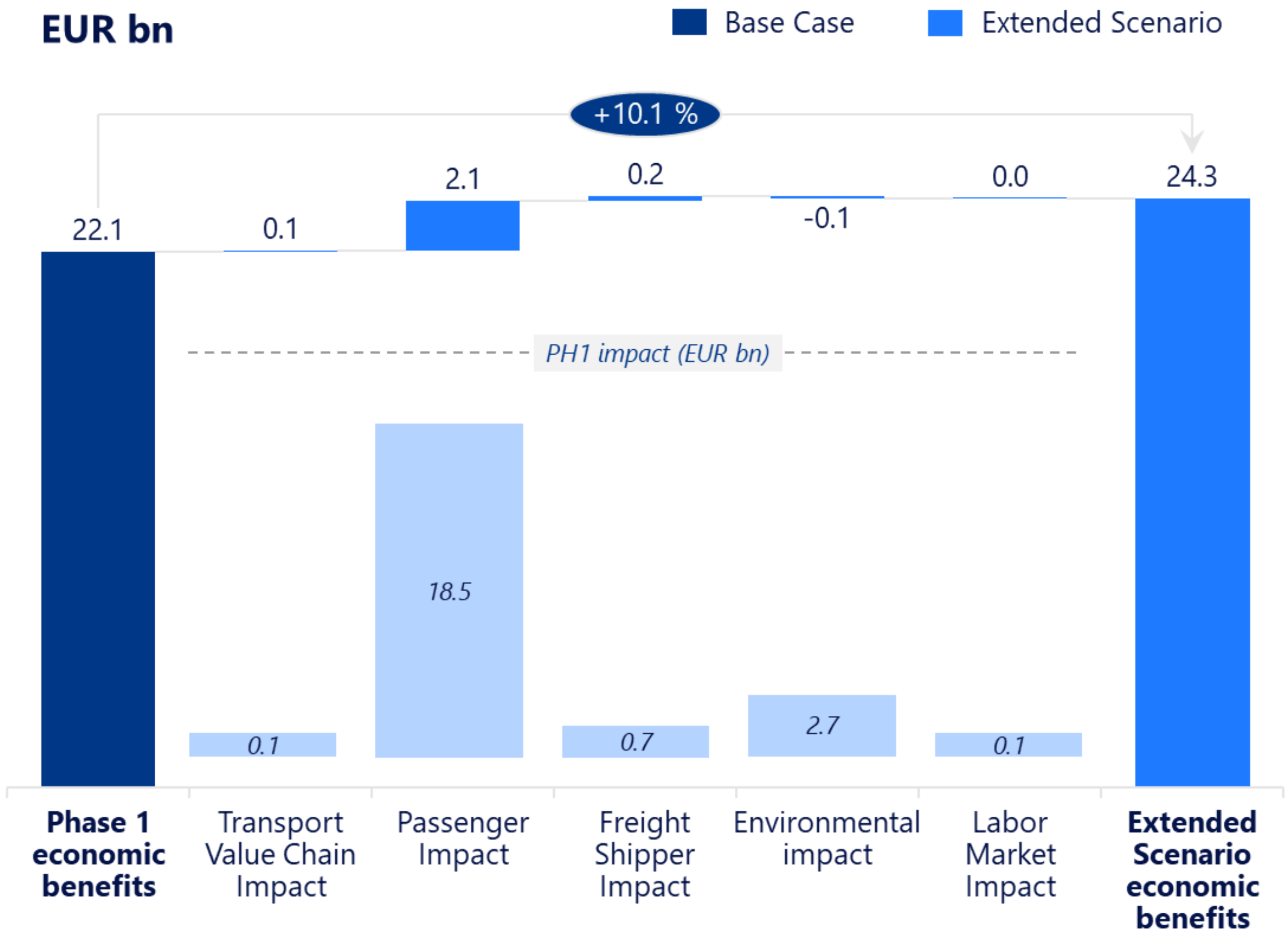


Figure 200: Overview of changes in socio-economic component in the Extended Scenario compared to the Base Case, EUR bn NPV

These incremental changes in the socio-economic components between Extended Scenario and Base Case are driven by increases in both passenger and freight demand:

- **Transport value chain** incremental impact of EUR 0.1 bn is driven by increasing induced passenger demand and subsequent profitability of mainly rail and air operators. Convenient connection to Vilnius, Kaunas airport, Marijampolė, and frequent RCS-RIX shuttles provide attractive services to/from high-density Origin-Destination pairs (O/Ds)

- **Passenger impact** increase of EUR 2.1 bn is driven by high induced passenger demand on key O/D pairs between high-density zones due to convenient connections to Vilnius, Kaunas airport, Marijampolė, and frequent RCS-RIX shuttles. Higher penetration of HSR services and direct connectivity to Vilnius further supports higher modal shares.

- **Freight shipper impact** incrementally increased by EUR 0.2 bn due to higher modal shift from truck to rail, with additional freight terminals, lines and service frequencies offering significant capacities along shorter, intra-Baltic routes as well as to/from Poland.

- **Environmental impact** incrementally decreased by EUR 0.1 bn compared to Base Case, with the positive impact of more significant modal shift in freight being offset by high induced demand limiting environmental benefits.

- **Labor market impact** with an incremental impact of EUR 0.0 bn is similar to Base Case with no significant change to the labor demand of RB during operations.

13.5 Conclusion

Considering both financial and socio-economic impacts, Rail Baltica Phase 1 Extended Scenario is expected to generate EUR 10.1 bn ENPV. This corresponds to **a benefit-cost ratio (BCR) of 1.7** and an **economic rate of return (ERR) equal to 6.3%**.[90]

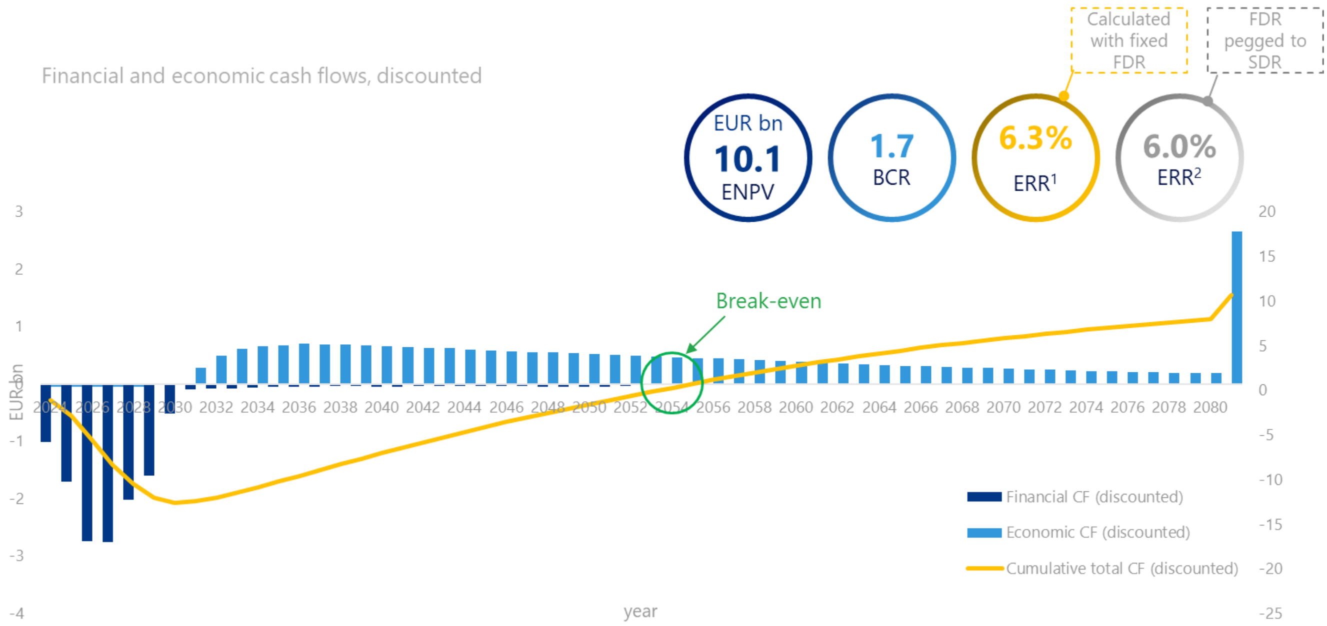


Figure 201: Financial and economic cash flows, discounted

[90] The ERR of 6.3% relies on the assumption of a fixed FDR. If the FDR is pegged to the SDR, as mandated by EU guidelines, the ERR adjusts to 6.0%, still surpassing the applied SDR. However, this approach overlooks the fundamental differences between FDR and SDR, which are typically distinct. Therefore, adhering to the method using a fixed FDR is recommended for a more accurate representation of the project's economic viability.

As seen on the figure below Extended Scenario ENPV at EUR 10.1 bn shows a **strong confidence interval between EUR 2.3 and 16.5 bn** resulting from the cumulative effects of the worst- and best-case scenarios in both financial NPV and net economic benefits.

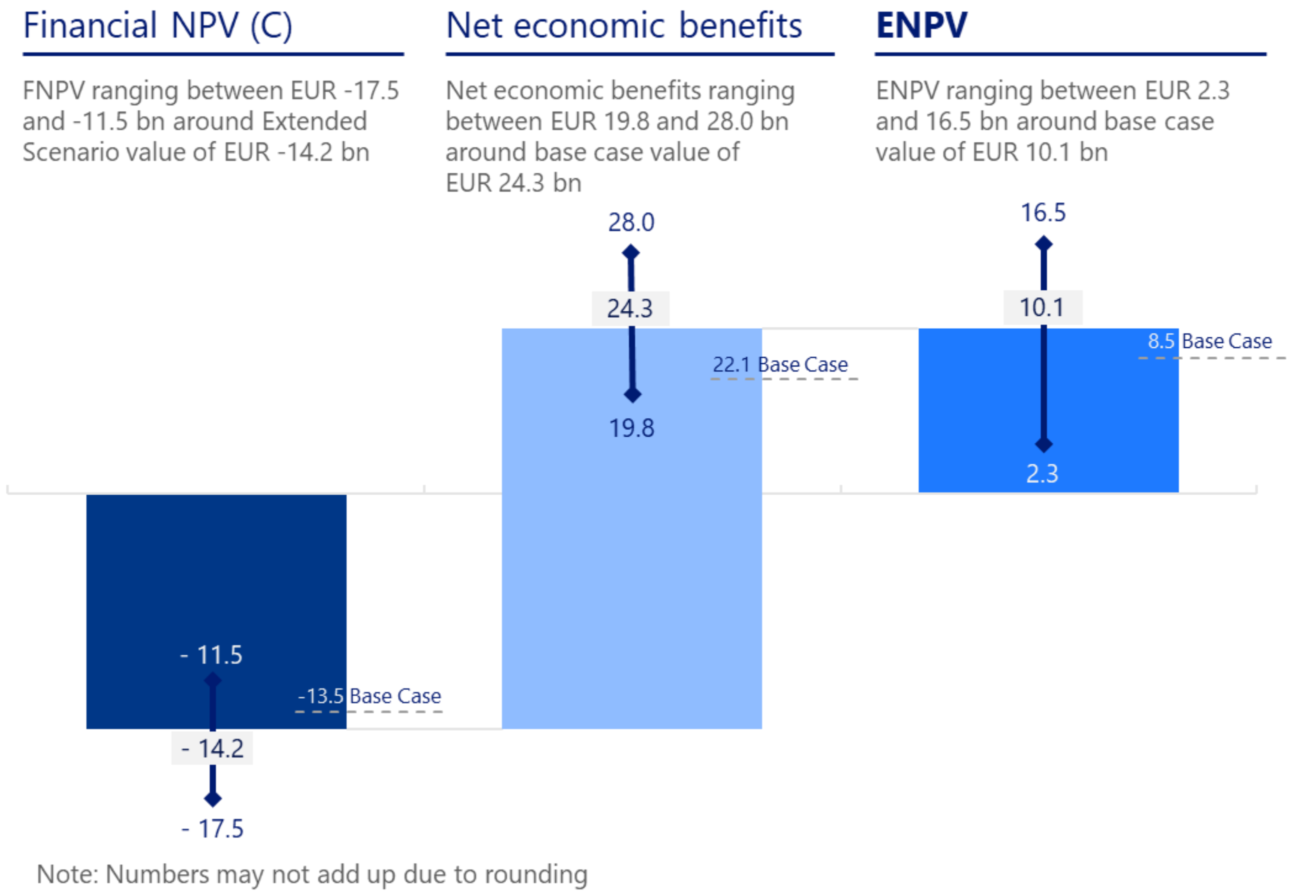
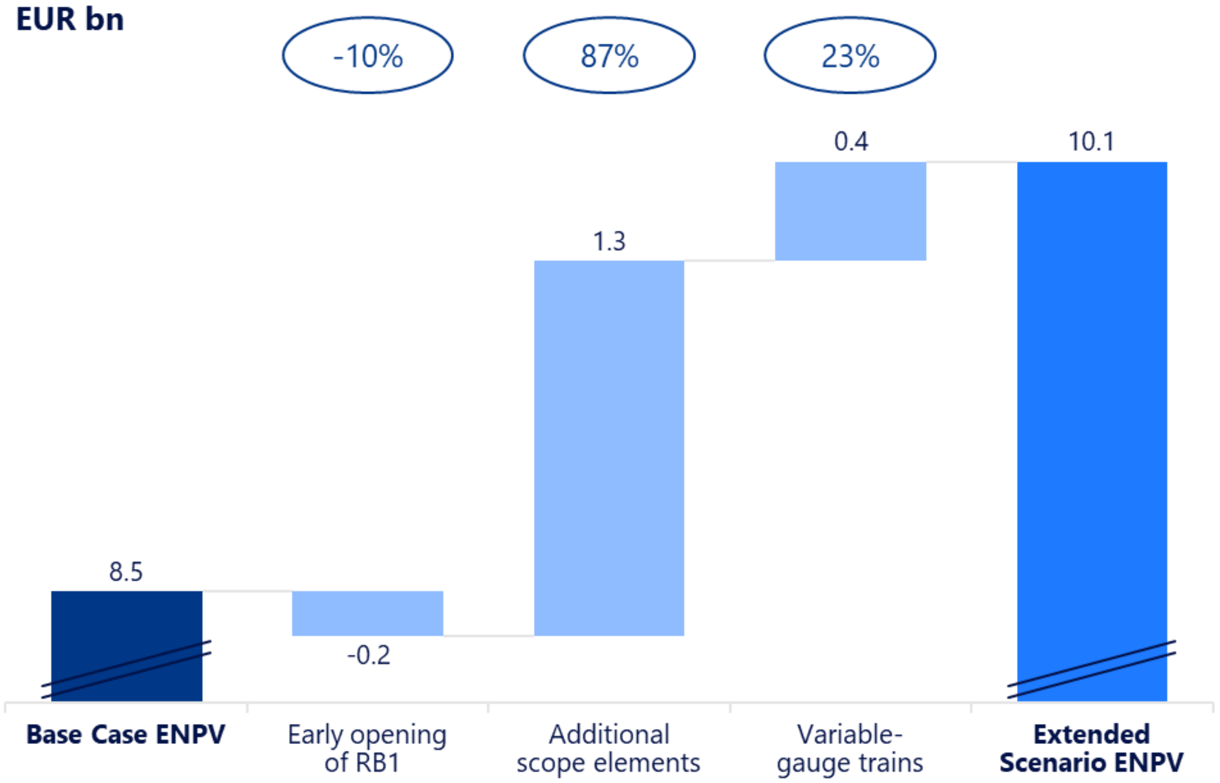


Figure 202: Comparison of the ENPVs of Base Case and Extended Scenario

Based on the analysis, **the Extended Scenario** is **EUR 1.5 bn** (18%) higher than the Base Case **ENPV**. This underpins that inclusion of additional scope elements and the application of variable gauge rolling stock can enhance the short-term economic benefits of Rail Baltica Phase 1.

The following sub-sections provide an **overview of the impact of the individual components within the Extended Scenario**. The purpose of the Extended Scenario is the estimation of the overall scenario impact, yet the analysis tries to identify specific contributions on a higher level related to scenario components. As seen on the figure below, the inclusion of additional scope elements accounts for EUR 1.3 bn (87%) of additional benefits, followed by the EUR 0.4 bn (23%) from the introduction of variable-gauge trains, and a negative contribution of EUR -0.2 bn (-12%) from the early opening of the RB1 line.



Note: Numbers may not add up due to rounding

Figure 203: Total ENPV impact of Extended Scenario components

13.5.1 Impact of Earlier Operational Start of RB1

The earlier opening of RB1 section between Mockava and Kaunas in 2028 allows for passenger transportation before the completion of RB Phase 1, thereby enhancing connectivity.

From a **demand** perspective, phased section opening is relevant in the first two years of operations, when there would not yet be any passenger traffic in the Base Case. During this period, annual passenger demand **is forecasted at 85 mn pkm** (within the range of 75 - 95 mn pkm). This accounts for ~5% of annual RB Phase 1 Extended Scenario volumes, significantly limited by the lack of adjacent RB infrastructure, HSR services and connections beyond Kaunas/PK border. Demand is primarily generated by passengers traveling on the between the Polish border and Kaunas, point-to-point along the RB1 line, as well as transferring to/from Vilnius, between the existing 1520mm Kaunas-Vilnius line and RB1.

The **financial impact** of the early opening of the RB1 line is **EUR -238 mn.** This is primarily driven by relatively high upfront CAPEX (EUR 261.3 mn) and annual operating costs (EUR 6.5 mn) exceeding anticipated revenues (EUR 2.1 mn). The negative FNPV suggests that early operations on the RB1 line could increase the overall funding requirement for Rail Baltica.

The **economic impact** of the phased section opening is **EUR 80 mn**. This relatively small economic impact is due to the short timeframe of operations, and consequently the relatively small cumulative demand generated.

Additionally, it is important to note, that as at this stage, RB Phase 1 will not be operational yet, therefore the generated demand of RB1 is limited by the lack of connectivity to other Baltic and Polish destinations.

Considering both financial and economic impact of operating RB1 in 2028-30, the **overall ENPV impact** is expected at **EUR -158 mn**, driven by negative financial outlook outweighing limited socio-economic benefits for such short operational duration.

The core business case for this scenario component likely cannot be enhanced enough to break even (achieve a non-negative ENPV) through main value levers, as the future IM likely could not 1) attract enough additional passengers, or 2) raise TAC and/or final customer prices high enough, or 3) delay the CAPEX investment long enough to increase NPV of benefits. However, despite the unfavorable ENPV, early operations could serve as a valuable platform for testing service models, managing future ridership expectations, and fostering international confidence in or socio-economic engagement with the Rail Baltica project.

13.5.2 Impact of Change in PTOs and Related Services

Change in passenger stations in Lithuania and additional freight terminals, such as Salaspils in Latvia as well as the increased frequency of services as described above, allows for enhanced access to Rail Baltica for passengers and businesses. From passenger side this results in a **demand increase of 116 mn pkm** accounting for 6.3% of total RB passenger volume. Regarding freight the Extended Scenario entails a demand increase of 112 mn tkm and amounting to 7.2% of total RB freight volume.

As for its **financial impact**, the additional PTOs, and modified services **account for EUR -421 mn**. Despite the high initial CAPEX requirements, this scenario component has a substantial positive impact on terminal profitability, boosting the other operations NPV by EUR 37 mn. However, the NPV for passenger and freight operations does not follow the same positive trend. The additional revenue generated from increased demand is insufficient to offset the higher costs associated with the significant upfront CAPEX, resulting in a less favorable financial outcome for these segments by EUR -92 mn decrease compared to the base case.

The financial impact is offset by the **economic benefits accounting for EUR 1.7 bn**. Economic benefits are generated through both passenger and freight services. The significant increase in freight terminals allows for higher freight volumes, benefiting the transport value chain and freight shippers. Moreover, the additional stations and increased frequency of passenger services boost passenger benefits and enhance benefits along the transport value chain.

Summing up the financial and socio-economic impacts **the ENPV of the additional PTOs and service changes amount to EUR 1.3 bn**, reflecting the substantial added value of these scope elements. [91]

---

[91] Additional terminals within this scope element carry also an additional risk of potentially not fulfilling estimated loading and unloading capacities, resulting in underutilized infrastructure and limitations in operational efficiencies.

13.5.3 Impact of Variable-Gauge Trains[92]

The introduction of variable-gauge rolling-stock enable connects Vilnius directly to the Rail Baltica network, without the need to transfer to regional services on the Kaunas-Vilnius route. This allows smoother travel between Vilnius and other RB Phase 1 destinations. The **demand** generated with the introduction of **variable-gauge rolling stock is EUR 20 mn pkm** annually, accounting for 1.1% of total demand within the Extended Scenario (in 2046). [93]

Regarding its **financial impact**, the introduction of variable-gauge rolling stock **results in a EUR -28.2 mn FNPV**, accounting for 0.2% of the total NPV of Rail Baltica Phase 1 Extended Scenario. From a strictly financial perspective, the impact of this investment is minimal. It results in a slight 2% increase of the main operational NPV and 3% of the other operations NPV.[94]

The **economic impact** of these rolling-stock is **EUR 387.3 mn**, accounting for 1.6% of total benefits. This overall increase in socio-economic benefits, derives from an increase in passenger benefits (+1.5%), transport value chain benefits (+4.1), labor market impact (+0.7%) and a slight decrease in environmental impact benefits (-0.3%), while freight shipper impact remain unchanged. Consequently, the **ENPV contribution** of the introduction of variable-gauge rolling stock **is EUR 359 mn**.

---

[92] The granularity of extended scenario CBA is not equal to a detailed business case analysis for the implementation of separate scope components, in particular the variable-gauge train equipment. Further investigations could be carried out by the infrastructure manager in case more detailed analysis was necessary.

[93] The level of passenger demand increase from a direct connection of Vilnius with variable-gauge trains is based on assumptions on the impact of the lack of the need to transfer trains, which potentially could be further tested to make a more precise assumption and estimation of ridership or revenues.

[94] However, it is important to note potential risks associated with variable-gauge trains. Additionally, the operation of variable-gauge trains might incur higher OPEX expenses for railway undertakings due to the increased wheel wear due to differences in wheel/rail geometry and rail hardness. Furthermore, the service level decrease with associated lower-equipped trainsets might decrease demand for the services. These risks warrant focus on prudent financial planning and cost control to prepare for possible downsides.

14 Risk and Regulatory

Rail Baltica, with its extensive scope and international reach, faces a unique set of risks and regulatory challenges. This chapter provides a detailed analysis of these aspects, essential for the project's successful execution and compliance with legal standards. The first section addresses the **risks associated with the project**, providing a comprehensive overview of potential challenges, and outlining strategies for risk mitigation. The second section focuses on the **regulatory framework key for RB**. This includes environmental regulations, railway industry standards, and competition laws. The aim is to detail most important regulatory requirements the project must consider on a strategic level. This section also discusses the implications of these regulations on project planning, execution, and long-term operation.

In summary, this chapter serves as a crucial guide to understanding and managing the risks and regulatory requirements of the RB’s project, emphasizing the importance of these elements on a strategic level in ensuring the project's successful and compliant implementation.

14.1 Risks and Mitigation

In this section, risks faced by RB are assessed by looking at large risk categories, evaluating their likelihood and potential impact, and further proposing mitigation measures to manage them. It is important to highlight that this section addresses broad project considerations. The **identified risks are not associated with any particular entity** and are rather viewed holistically, reflecting the project's cross-border scope.

Qualitative risk analysis is paramount to deal with the uncertainty that always permeates investment projects as it provides the opportunity to anticipate potential risk sources and foresee mitigation measures.

Risks are identified based on **four phase categories**: risks concerning the design phase, construction phase, operational phase, and a general overarching phase (a fourth category covering risks which span across the entire life of the project). The topic categories analyzed within each phase are the following: regulatory (which are further explored in this section as well), operational, financial, strategic, political, and geopolitical.

To map risks, the following approach is used. The likelihood of the respective risk event is categorized into **five probability clusters**:

1. Very unlikely (0–10 % probability)
2. Unlikely (10–33 % probability)
3. About as likely as not (33–66 % probability)
4. Likely (66–90 % probability)
5. Very likely (90–100 % probability)

The potential impact classification is also performed in **five impact dimensions**:

1. No relevant effect, even without remedial actions.
2. Minor loss of the benefit generated by the project, minimally affecting the project long run effects; however, remedial or corrective actions are needed.
3. Moderate: Loss generated by the project, even in the medium-long run. Remedial actions may correct the problem.
4. Significant: High loss generated by the project; the occurrence of the risk causes a loss of the primary function(s) of the project. Remedial actions, even large in scope, are not enough to avoid serious damage.
5. Critical: Project failure that may result in serious or even total loss of the project functions. Main project effects in the medium-long term do not materialize.

The combination between risk probability and potential impact results in **4 aggregate risk levels**: low, moderate, high and very high. Following this methodology, a total amount of 76 risks is identified across all project phases, the majority being rather moderate risks (see figure below).

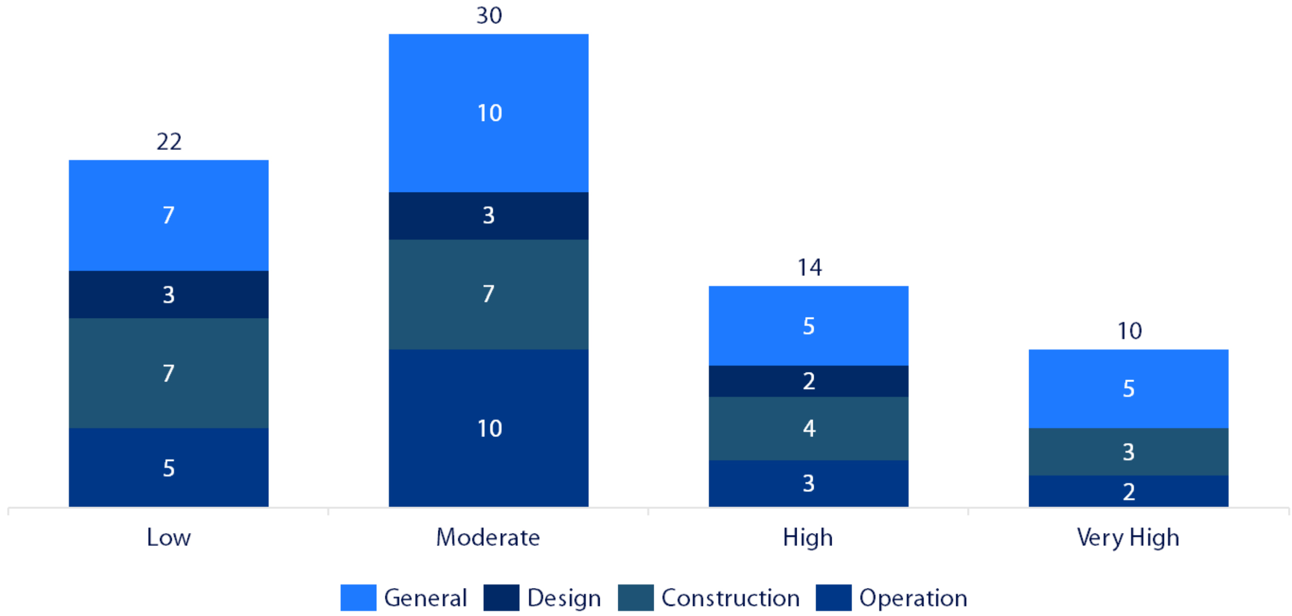


Figure 204: Aggregate risk levels overview (Consultant team analysis)

For a more detailed break-down, the following figure provides an overview of the allocation of risks within each phase of the project. In the design phase, risks are scattered among low, moderate and high-risk levels, but no very high risks have been identified. In the construction phase, most of the identified risks are evaluated as low and moderate. In the operational phase, most of the identified risks are evaluated as low or moderate, as well. Last category of risks are general risks, i.e., risks present during the entire project. Majority of them are evaluated to be moderate risks. For a detailed overview of the identified risks, please refer to *Appendix – Risk Mapping*.

General risk

Probability/ Impact	Very unlikely (1)	Unlikely (2)	About as likely as not (3)	Likely (4)	Very likely (5)
No effect (1)		1			
Minor (2)	1		1	1	
Moderate (3)	3	3	4		
Critical (4)	1	1	4	3	
Catastrophic (5)	1	1	1	1	

Design phase risks

Probability/ Impact	Very unlikely (1)	Unlikely (2)	About as likely as not (3)	Likely (4)	Very likely (5)
No effect (1)					
Minor (2)		1		2	
Moderate (3)	1	1		1	
Critical (4)	1		1		
Catastrophic (5)					

Construction phase risks

Probability/ Impact	Very unlikely (1)	Unlikely (2)	About as likely as not (3)	Likely (4)	Very likely (5)
No effect (1)	1	1			
Minor (2)	2	1	1		
Moderate (3)		1	1	1	
Critical (4)	2	4	2		1
Catastrophic (5)		1	2		

Operations phase risks

Probability/ Impact	Very unlikely (1)	Unlikely (2)	About as likely as not (3)	Likely (4)	Very likely (5)
No effect (1)					
Minor (2)		3	2		
Moderate (3)	1	4		2	
Critical (4)		4	1	1	
Catastrophic (5)	1		1		

Low risk · Moderate risk · High risk · Very High risk

Figure 205: Risks categorization by phases (Consultant team analysis)

Out of this framework, **10 risks labeled with "very high"** aggregate risk scores emerge. Short description of each of these risks, including reasoning behind their impact categorization, as well as mitigation strategies for each of them are detailed in the following.

14.1.1 General Risks

General very high risks that affect the project entirely are mostly financial and strategic - **financial risks** include (#10) reduced EU funding and (#6) lack of funding leading to delays or stoppages (from non-EU sources); **strategic** ones encompass (#12) lack of proper organization and governance with sufficient autonomy, transparency, and/or efficiency in decision making, (#19) inconsistent quality and non-compliant processes across RB, and (#20) delayed decision making.

Reduced EU Funding (#10 in *Appendix – Risk mapping*)

Funds from the European Union are expected to constitute a substantial portion of the budget for the project. Their reduction could stem from shifts in EU policy priorities, budgetary constraints, or changes in economic conditions. Such a decrease in funding could lead to significant financial shortfalls, impacting the project's scope, timeline, and execution.

The **risk of reduced EU funding for RB is rated as 3 on a probability scale of 1 to 5**. This moderate rating reflects a balance between the EU's historical commitment to infrastructure development and the unpredictability of funding allocations, which can be influenced by changing political and economic landscapes. While the EU has shown a strong inclination to support trans-European transport networks, written commitment for the full required value has not been provided, and external factors such as economic fluctuations or shifts in policy focus can also impact funding availability.

On the impact scale, this risk would score a 5, indicating a high impact on the project. A significant reduction in EU funds could lead to drastic project downscaling, delays, or even jeopardize its overall realization. Given the scale and importance of RB, any substantial funding shortfall would have a profound and direct impact on its completion and success.

Mitigating the risk of reduced EU funding involves proactive and strategic approaches. Engaging in continuous dialogue with EU authorities is crucial to secure ongoing commitments and stay aligned with EU funding policies. This dialogue helps in understanding and adapting to the evolving priorities and requirements of EU funding bodies. Moreover, some form of official involvement of EU representatives in project governance and steering decision could be considered resulting in increased transparency and alignment to the EU's expectations. Simultaneously, exploring alternative financing options is imperative to compensate for potential reductions in EU funding. This could include seeking private investments, public-private partnerships, or other governmental financial support. By diversifying the funding sources, RB can enhance its financial stability and resilience against fluctuations in EU funding. Final financiers of RBGP are the three Baltic states who could leverage various opportunities to increase their funding (for details please see *Financing Plan* section).

Lack of Funding Leading to Delays or Stoppages (from non-EU sources) (#6 in *Appendix – Risk mapping*)

This risk involves the potential shortfall in financial contributions from non-EU sources, which could stem from economic constraints, shifting priorities, or political changes in these countries. Such a funding gap could hinder the project's progress, leading to delays in construction, scaling down of project components, or in extreme cases, halting certain aspects of the project altogether.

This risk is assigned a score of 4 out of 5 for likelihood, meaning there is a high probability of limited third party funding. Funding partners other than the EU might decide to allocate their capital into other projects. This could be due to changes in their economic situations, policy shifts, or other priorities taking precedence over their contribution to RB. Furthermore, a project that is not expected to generate positive financial return might not be very attractive to investors.

The impact of a funding shortfall from non-EU sources is rated as 4 out of 5. While the project is primarily EU-funded, the contribution of non-EU sources is still significant. Lack of funding could lead to notable delays and require a reevaluation of project scope and timelines. However, since the project has multiple sources of funding and a strong EU backing, it may still proceed, albeit at a slower pace or reduced scale, hence not warranting the maximum impact score of 5.

To **mitigate the risk** of high funding uncertainty, RB needs to plan and prepare funding estimations for the entirety of the project. The project team should tailor their strategic spending approach based on these estimations with flexibility to adjust non-critical path spending as needed to align with forecasted funds. In the event of potential funding reductions, it is essential to align the delivery strategy and spending plans with funding authorities. This alignment allows for the implementation of discrete, affordable delivery stages, ensuring that the project continues to make progress and deliver value, even in the face of funding challenges. This approach helps in maintaining project momentum and adapting to financial constraints while striving to meet the project's overarching goals. In addition, the three Baltic states – final beneficiaries of socio-economic gains – could create safeguards to offset impact of less attractive financial performance. These safeguards could potentially include multi-annual contracts and various forms of subsidies, or operational and financial guarantees.

Lack of Organization and Governance with Sufficient Autonomy, Transparency, and/or Efficiency in Decision-making (#12 in *Appendix – Risk mapping*)

In the context of RB, a significant risk is a potentially suboptimal organization and governance with sufficient autonomy, transparency, and efficiency in decision-making. Given the project's complexity and multiple stakeholder's involvement, there is a heightened risk of bureaucratic inefficiencies, unclear lines of authority, and decision-making bottlenecks. This could lead to delays, increased costs, and a potential dilution of the project's strategic objectives.

This risk is assigned a score of 4 out of 5 for likelihood, indicating a high probability. The reasoning behind this is the inherent complexity of large-scale infrastructure projects like RB, which involve multiple stakeholders, cross-border coordination, and extensive regulatory frameworks. Such complexity often breeds organizational challenges, including issues with governance and decision-making autonomy and efficiency. Moreover, the dynamic nature of long-term projects can lead to evolving governance needs, which might not be promptly addressed. Furthermore, this risk is already materializing in the project, slowing-down decision-making.

On the impact scale, this risk would also rate a 4 out of 5. Poor organizational structure and governance can significantly impede the project's progress, leading to inefficiencies, miscommunications, and delays. It can also result in suboptimal decision-making, affecting the project's quality and financial health. While not necessarily catastrophic, these issues can substantially derail the project's timeline and increase costs, thereby having a high impact on its overall success.

To **mitigate this risk**, it is crucial to establish a clear organizational and decision-making structure with defined responsibilities, which are to some extent already in place. This structure should be capable of evolving to reflect the project's progression. As the project moves forward, it is important to recognize that leadership themes and operational scaling may need to transition across different organizational segments. Such an adaptive organizational approach is aimed at ensuring alignment with the project's evolving demands and stages. Some form of a mechanism to watch out for needed organizational changes can help in maintaining a governance structure that is efficient, transparent, and capable of effective decision making. This generally involves 1) a responsible group/person (e.g., typically a board member and/or their direct reports), 2) clear escalation paths to end decision makers (e.g., steerco involving beneficiaries), and 3) if necessary, possibility to adjust the organizational design. The frequency of these reviews has to be set in a need-based way to make sure they are not overwhelming for the organization. In addition, frequent involvement of the final decision makers or delegation of authority coupled with clear decision-making routes can enable a more efficient and adaptive approach needed.

Inconsistent Quality and Non-compliant Processes across Rail Baltica (#19 in *Appendix – Risk mapping*)

This risk stems from the project extensive scope involving various contractors and entities across different countries, each with their own working standards and regulatory requirements. Inconsistencies in quality and deviations from standard processes can undermine the efficiency, safety, and integrity of the infrastructure, leading to potential failures and noncompliance with international and regional standards.

This risk is assigned a score of 4 out of 5 for likelihood, indicating a high probability. The diverse nature of stakeholders involved in RB and the complexity of coordinating across different regulatory environments with limited coordination power of RBR make it challenging to maintain consistent quality and standards. While efforts are often made to standardize processes, the risk remains significant due to varying interests of stakeholders in applying standardized processes.

On the impact scale, this risk scores a 5, reflecting a very high impact on the project. Inconsistent quality and noncompliance with established processes can have severe consequences for RB. It could lead to critical infrastructure failures, safety hazards, legal and financial penalties, a loss of public trust, and decreased customer satisfaction. Such issues could not only delay the project but also increase costs substantially and potentially compromise the project's overall objectives.

Mitigating this risk typically involves the appointment of a dedicated quality manager is crucial for overseeing and harmonizing quality standards across the project. The implementation of a standardized Quality Management System (QMS) across RB could supporting consistent quality and compliance with processes. Establishing clear quality, compliance standards, guidelines, and protocols for all project parties ensures uniformity in execution. Regular quality audits and process assessments are essential to identify and address any inconsistencies or noncompliance. Employing quality management software facilitates automated quality control processes and real-time monitoring. Training and awareness programs are necessary to educate all project parties about the importance of adhering to these standards. Furthermore, establishing a corrective action process enables prompt resolution of any identified quality or compliance issues, ensuring the project maintains its integrity and adheres to the highest standards. In addition, increasing coordination through different mechanisms such as stronger enforcement of standards or increasing coordinating power through delegated authority of final decision makers are also important enablers of an optimal quality management and standards across stakeholders.

Delayed Decision Making (#20 in *Appendix – Risk mapping*)

This risk stems from the complexities of managing a multi-national project, coordinating among various stakeholders, and navigating bureaucratic processes. Delays in making crucial decisions can result from challenges in reaching consensus, ambiguity in roles and responsibilities, or lengthy approval processes. Such delays can lead to a chain reaction, impacting various facets of the project, including timeline, budget, and overall project momentum.

The likelihood of delayed decision making in the context of RB is rated as 4 out of 5, indicating a high probability. The project's extensive scope, involving multiple countries and stakeholders, inherently increases the complexity and potential for delays in reaching decisions. Additionally, the necessity to align diverse interests and regulatory requirements across borders can further exacerbate the challenge of timely decision-making.

On an impact scale, this risk would be rated as 4 out of 5, signifying a high impact on the project. Delays in decision-making can lead to project inefficiencies, extended timelines, increased costs, and potential loss of stakeholder confidence. While not immediately catastrophic, such delays can cumulatively have a significant negative impact on the overall success and delivery of the project.

To **mitigate this risk**, it is essential to establish an optimized and well-functioning organizational structure. This includes forming a group of key decision-makers who have clear and defined authority to make timely decisions. Implementing clear decision-making protocols and assigning specific responsibilities for key decisions can streamline the process. Additionally, setting frequent steering meetings and defined deadlines for decision making helps in maintaining project momentum. Implementing a group with decision power, such as a steering committee or executive board, can facilitate quicker resolution of critical issues and ensure that decisions are made efficiently and effectively. This structured approach to decision-making will aid in reducing delays and maintaining the overall progress and integrity of RB.

14.1.2 Construction Phase Risks

Very high risks in the construction phase are two **operational** risks namely (#45) insufficient contractor capacities throughout the length of the project, and (#47) construction delay. One **strategic risk** present is (#52) construction site interface risk.

Insufficient Contractor Capacities Throughout the Project (#45 in *Appendix – Risk mapping*)

Insufficient contractor capacities throughout RB project poses a very high risk. This issue pertains to the possibility that contractors may not have adequate resources, expertise, or manpower to fulfill their obligations effectively. Given the project's scale and complexity, the need for specialized skills and substantial resources is critical. Inadequate capacities can lead to delays, substandard work, or even the inability to complete certain project segments, impacting the overall progression and quality of the infrastructure development.

This risk is given a likelihood score of 3 out of 5, suggesting a moderate probability. While rigorous contractor selection processes are likely in place for a project of this magnitude, unforeseen challenges in resource allocation, financial stability, or technical expertise among contractors can still arise. The dynamic nature of long-term projects like RB, combined with market fluctuations and resource availability, contributes to this level of risk.

The impact of insufficient contractor capacities is rated as 5 out of 5, indicating a very high impact on the project. Contractor deficiencies can critically disrupt project timelines, increase costs, and compromise the quality and safety of the infrastructure. This could potentially lead to substantial rework, legal challenges, and damage to stakeholder trust, significantly hampering the project's successful completion.

Mitigating this risk involves implementing a rigorous contractor selection and evaluation process to ensure that contractors possess the necessary capacities and resources. Establishing clear contract terms and Service Level Agreements (SLAs) that outline performance expectations, timelines, and capacity requirements is essential. Regular contractor performance reviews help in early identification and resolution of capacity issues. Developing a contingency plan for potential contractor capacity shortfalls is crucial, which may include identifying alternative contractors or additional resources. Engaging with contractors to foster capacity building and continuous improvement ensures ongoing capability enhancement. Additionally, utilizing a centralized project management system to monitor contractor performance and capacity in real time provides a comprehensive overview, enabling proactive management and quick response to early warning signs to emerging capacity issues.

Construction Delay (#47 in *Appendix – Risk mapping*)

Construction delay is a prominent risk in RB. This risk encompasses delays due to unforeseen circumstances such as logistical challenges, technical difficulties, contractor issues, regulatory hurdles, or environmental factors. Given the project's complexity, involving extensive coordination across different countries and stakeholders, such delays are a significant concern. They can result in prolonged timelines, increased costs, and potential breach of contractual deadlines.

The risk of construction delays is rated a 5 out of 5 for likelihood, indicating it is very likely. Large infrastructure projects like RB are inherently prone to delays due to their scale, complexity, and the multitude of variables involved. Factors such as weather conditions, technical challenges, coordination among various contractors, and regulatory approvals can all contribute to potential delays. Furthermore, such delays have already appeared throughout the project and current timeline is observed to have limited or no buffer for delays.

This risk is rated as 4 out of 5 in terms of impact. Construction delays can lead to significant repercussions, including cost overruns, funding issues, and negative stakeholder sentiment. However, the impact score for this risk is not at its maximum because, despite potential delays, the overarching consensus and commitment to the RB project ensure its eventual realization. Even in the face of delays, the foundational support and strategic importance of the project suggest that it will proceed, albeit with adjusted timelines.

To **mitigate the risk** of construction delays in RB, a multifaceted approach is necessary. Initially, robust project planning with detailed, realistic timelines and built-in buffers for potential delays is crucial. This should be complemented by a comprehensive risk assessment to identify and strategize against potential delay causes. Effective contractor management, including the selection of contractors with strong track records and adequate resources, is key. Implementing rigorous monitoring and reporting mechanisms will ensure that progress is closely tracked, and issues are addressed promptly. Open and continuous communication with all stakeholders, including contractors, government bodies, and the public, is essential for managing expectations and addressing concerns swiftly. Additionally, having well-developed contingency plans for known risks, such as adverse weather or supply chain disruptions, allows for quick response and minimization of delay impacts. Moreover, maintaining flexibility in resource allocation to address changing project needs and avoid bottlenecks will be instrumental in keeping the project on track. Additionally, maintaining an effective governance structure, activist project management and delivery rhythm with clear decision-making allocation, escalation routes and authority delegated for coordination are crucial for keeping and evolving the delivery roadmap. These strategies collectively aim to enhance project resilience against delays, ensuring more efficient and timely completion of RB.

Evaluating the **quantified implications on the financial net present value (FNPV) in conjunction with the socioeconomic benefits**, it is evident that construction delays exert a more pronounced impact on the FNPV than on the socioeconomic benefits. This significant influence can primarily be ascribed to the substantial contribution of capital expenditure (CAPEX) to the overall negative FNPV. As construction delays necessitate the postponement of CAPEX allocations to future periods, they consequently elicit a notable reduction in the net present value.

The base case scenario FNPV and socio-economic benefits are EUR -13.5 bn and EUR 22.1 bn respectively. The maximum impact on both figures is 10 years of delay in construction, increasing the negative FNPV to EUR -6.4 bn and lowering the socio-economic benefit to EUR 18.0 bn. The positive impact of EUR 3.1 bn additional on net benefits is attributable to the large CAPEX investment postponed to later years, being discounted on a larger factor. As analyzed above, further factors have to be considered such as losing willingness of financiers to continue to back the project, public and political opinion changing from supportive, or suppliers losing their belief in the feasibility of development.

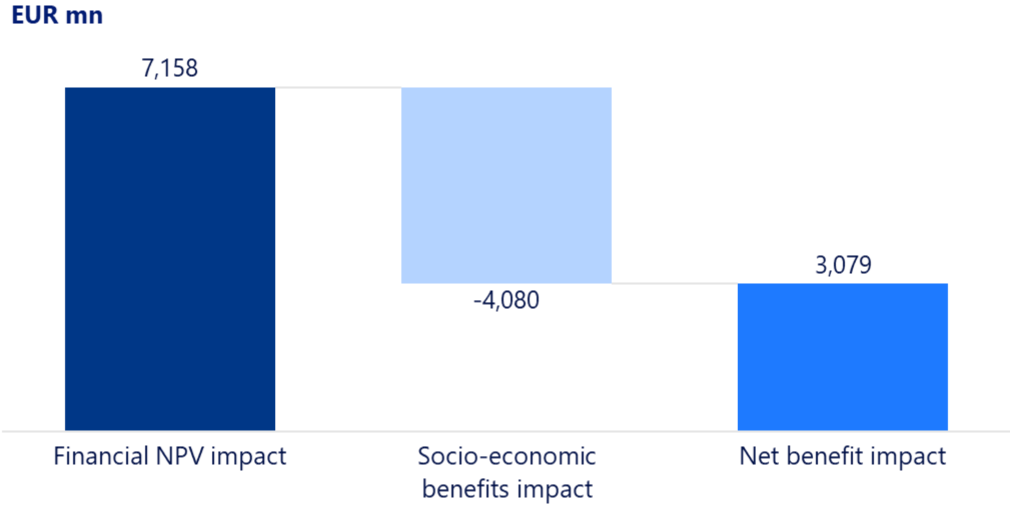


Figure 206: Construction delay impact on FNPV, and socio-economic benefits (Consultant team analysis)[95]

An additional long-term delay risk to consider is the delay or lack of building subsequent phases or the full scope configuration of Rail Baltica Global Project. The target full scope is planned to have a greater catchment area with higher number of PTOs and double track along the route, thus it is planned to provide even better connectivity opportunities which might be lost. This opportunity cost is represented in the infrastructure's lowered ability to impact and create opportunities for a higher number of passengers and businesses both directly and indirectly. Potential passengers would lose access to a higher number of planned stations decreasing their mobility options and efficiency. Businesses would lose access to a greater number of passengers, and to a better freight service through lower numbers of terminals and less flexibility and frequency of freight services. This would also mean that further, wider economic impacts are also negatively impacted.

Construction Site Interface Risk (#52 in *Appendix – Risk mapping*)

Construction site interface risk in RB involves the potential complications arising from the interaction and coordination between different construction sites and teams. This includes challenges in managing overlapping activities, resources, and timelines, particularly given the project's transnational nature and the involvement of multiple contractors. Such risks can lead to miscommunication, resource conflicts, delays, and safety issues on the construction sites.

This risk is rated a 3 out of 5 for likelihood, indicating a moderate probability. While there are inherent challenges in coordinating activities across various construction sites in a large-scale, multi-country project like RB, effective project management and communication strategies can significantly mitigate these risks. The

[95] FNPV value is in absolute terms, it is forecasted to be negative. Please note, the following calculation employs a simplified approach to estimating impact. CAPEX multiplier due to delays in construction is not considered, however different phasing of investment is. The phasing due to uncertainty surrounding investment is assumed to be linear for years following the base case estimated finish of 2030.

likelihood reflects the balance between the complexity of managing multiple interfaces and the typically robust management structures in place for such large infrastructure projects.

The impact of construction site interface risks is scored as 5, denoting a very high impact on the project. Poor coordination and management of site interfaces can lead to significant construction delays, increased costs, and potential safety hazards. These issues can cumulatively have a critical impact on the project's overall timeline, budget, and safety record, which are key to the success and reputation of RB.

Mitigating construction site interface risks involves implementing a detailed site interface management plan to effectively coordinate between different contractors and project teams. Establishing clear guidelines for site access, communication, and coordination is essential for smooth operations. Utilizing a centralized coordination platform can enhance real-time communication and resource allocation. Regular coordination meetings should be conducted to proactively address interface issues and ensure alignment among teams. Developing a comprehensive risk assessment and mitigation strategy specifically for potential interface risks is crucial. Engaging with construction management experts can provide valuable guidance in managing complex site interfaces. Lastly, implementing a feedback mechanism to capture and learn from on-site experiences will continuously improve the efficiency and effectiveness of site interface management, thereby reducing the risk and enhancing overall project performance.

14.1.3 Operation Phase Risks

Operation phase may be harmed by the **strategic risks** of (#69) lack of interest from RUs to operate, and (#70) misalignment of long-term operational goals and strategies among countries.

Lack of Interest from Railway Undertakings to Operate (#69 in *Appendix – Risk mapping*)

A significant potential risk for RB is the lack of interest from RUs to operate the service. This risk involves the possibility that RUs may not find the route commercially attractive or feasible, possibly due to concerns about profitability, market demand, or operational challenges. The absence of RUs willing to engage could severely impact the project's utilization and its ability to meet intended transport and economic objectives.

This risk is rated a 4 out of 5 for likelihood. While RB is a major infrastructure project with significant potential, uncertainties in market attractiveness, competition with other modes of transport, and operational challenges could deter RUs. The score reflects a balance between the project's inherent attractiveness due to its scale and significance, and the commercial considerations that RUs will weigh in their decisions.

On the impact scale, this risk would score a 4 out of 5, signifying a very high impact. The success of RB heavily relies on active participation from RUs. In the absence of their full participation, substantial operational losses could occur, necessitating an increase in subsidies.

To **mitigate this risk**, it is crucial to develop strategies aimed at attracting RUs. This can include offering incentives or crafting tailored agreements that make operation on RB line more appealing and economically viable for RUs. However, it is important to ensure that these strategies and agreements are designed in compliance with the principles of equity, non-discrimination, and transparency, as mandated by the Directive 2012/34. Such incentives could involve financial benefits, or operational support. Additionally, conducting early market testing can provide insights into the expectations and requirements of potential RUs, guiding the development of effective incentive schemes. These strategies not only aim to attract initial RUs but also foster competition within the railway system, which can lead to better services and increased efficiency in operations. This proactive approach in engaging with potential RUs and addressing their concerns will be key in ensuring the successful utilization of RB infrastructure.

Misalignment of Long-term Operational Goals and Strategies among Countries (#70 in *Appendix – Risk mapping*)

RB, involving multiple countries, faces the risk of misalignment in long-term operational goals and strategies. This risk stems from the potential divergence in national priorities, economic objectives, and strategic visions of the participating countries. Such misalignments can lead to inconsistencies in the project's execution, funding, and future operational management, potentially impacting project delivery and the overall integration and effectiveness of the rail network.

The likelihood of this risk is rated as 3 out of 5. While the participating countries have committed to implementing the RB line, variations in political, economic, and social landscapes can influence their long-term goals and strategies. The moderate score reflects this possibility, balanced against the existing multilateral agreements and shared objectives that underpin the project.

The **impact** of misaligned long-term goals and strategies among the participating countries is **rated at 5 out of 5**, indicating a very high impact. Such misalignment can lead to significant challenges in the project's sustainability, operational efficiency, and potential expansions or enhancements. It could also result in operational inefficiencies, increased costs, and reduced benefits for the involved regions, thereby affecting the overall success and utility of the project.

To **mitigate this risk**, it is crucial to establish shared long-term operational goals and strategies that align with the visions of all participating countries. This involves creating a collaborative and inclusive governance framework that ensures consistent and ongoing collaboration among the countries. Such a framework should facilitate frequent dialogue, review of strategic objectives, and adjustment of operational plans to reflect the evolving needs and priorities of each country. It should also include mechanisms for resolving disputes and ensuring that all parties remain committed to the shared vision and objectives of RB. In addition, synchronization of national laws and codifying international agreements could also strongly contribute to preventing escalation of this risk. These approached can help maintaining alignment and coherence in the project's long-term operational strategies, contributing to its overall success and sustainability.

In conclusion, the comprehensive risk analysis for RB underscores the importance of proactive risk management in ensuring the project's success. The identified risks, ranging from funding shortfalls to stakeholder engagement challenges, highlight the intricate network of factors that must be vigilantly monitored and managed. Mitigating these risks requires not only strategic planning but also adaptive responses to evolving circumstances.

It is crucial to acknowledge that risk management is only one facet of ensuring RB's success. Equally vital is the project's adherence to the regulatory and compliance standards, which form the bedrock of its operational integrity. The two areas are intertwined. Compliance with regulatory standards is, in itself, a risk mitigation strategy, ensuring that the project meets legal requirements, adheres to safety standards, and aligns with environmental principles. The following section delves into the comprehensive regulatory framework that governs RB.

14.2 Regulatory and Compliance

Navigating the complex environment of regulations and ensuring compliance are fundamental for operations. This section explains the most relevant regulatory frameworks affecting RB, involving environmental, railway, and competitors' regulations. The section does not aim to provide legal advice. The objective of the analysis is to present a comprehensive understanding of the most relevant parts of the regulatory landscape to be considered in the context of the project.

With this objective in mind, the section investigates the following three regulatory areas with a more detailed analysis, highlighting the relevance for RB:

1. **Environment**

   Environment related regulations are the **European Green Deal** and **"Fit for 55"** package. These contain the EU's goal of reducing greenhouse gas emissions by 55% by 2030. RB can emerge as a sustainable transportation alternative in the Baltic states, contributing to this goal. However, discussions surrounding **fossil fuel subsidies** are pertinent as they may pose a challenge to RB by potentially diverting resources away from the transportation mode. Additionally, regulations like **Directive 2008/68/EC**, for handling hazardous goods transportation, promote the safe transportation of several goods on the RB line. Furthermore, the **Habitats Directive** delves into ensuring environmental and ecosystem protection during the project's construction phase. This is followed by the **Environmental Noise Directive**, which mandates the assessment and management of noise pollution from major infrastructure projects like RB, ensuring that noise levels are kept within acceptable limits to protect human health and the environment. Finally, the EU's **Environmental Impact Assessment Directive** mandates assessing major infrastructural projects like RB for environmental impacts. RB, securing EIA approvals, demonstrates its commitment to ecological standards, underlining its broader sustainability impact.

2. **Railway**

   Railway related regulations contain the **4th Railway Package**, alongside the **EU Directive 2012/34**. These regulations have the aim to ensure competitiveness and interoperability within the European rail sector. The **minimum access package** ensures fair and non-discriminatory practices for European networks. The alignment with EU's **technical requirements**, especially the revised Technical Specifications for Interoperability[96] (TSIs), it is important for RB's ambition to harmonize operations across Estonia, Latvia, Lithuania and the European network. Finally, EU's state aid railway guidelines aim to transition towards sustainable transport modes, allowing member states to **subsidize** operations like RB.

3. **Competition**

   Heavy goods vehicle bans on high-traffic roads, regulated under policies like the EU's Regulation (EC) No 561/2006, can shift focus towards alternative transport modes like rail, favoring projects like RB. The Baltic states, by maintaining a supportive regulatory environment, can channel traffic onto RB, promoting it as a greener, efficient transportation choice amidst rising **road usage** restrictions for environmental and road safety considerations.

14.2.1 Environment

Green Deal

The European Green Deal represents a broad initiative started by the European Union (EU) with the primary objective of transitioning the continent, as the first in the world, to climate neutrality by the year 2050 and therefore limiting global warming to 1.5 °C this century. At the heart of this attempt are particularly crafted policy measures aimed at significantly reducing greenhouse gas emissions across the board while simultaneously

[96] The Technical Specifications for Interoperability (TSIs) define the technical and operational standards which must be met by each subsystem or part of subsystem to meet the essential requirements and ensure the interoperability of the railway system of the European Union.

promoting sustainable economic growth within the region. One of the north star targets under this initiative is the **reduction of net greenhouse gas emissions by at least 55% by the year 2030**, relative to the emissions levels recorded in 1990. This interim target serves as a crucial milestone on the path to achieving the goal of climate neutrality by 2050. The Green Deal takes a comprehensive approach by extending its goals across various sectors including construction, biodiversity, energy, transport, and food. The policy initiatives captured within the Green Deal are tailored to expedite the EU's green transition (European Commission, 2019c). An example of initiative with the power to influence RB is the target for **emission reductions** among **road heavy vehicles**.

In 2023, the European Commission proposed a revision of the Regulation on CO2 emission standards for **road heavy-duty vehicles**. If adopted, the proposal would introduce new, stronger CO2 emission standards for heavy-duty vehicles from 2030 onwards and extend the scope of the Regulation to cover smaller trucks, city buses, long-distance buses and trailers (European Commission, 2023g). However, with regards to the truck segment, achieving the EU target will require huge investments not only to upgrade the fleets, but also to consolidate accompanying infrastructure and component parts, such as batteries or charging facilities. Because zero-emissions trucks are significantly more expensive than their diesel counterparts currently, and the freight industry runs on extremely tight profit margins, complying to this new policy may push many smaller companies out of the market, as they will charge a much higher price to recover their investments. Even though this regulation negatively impacts the road transportation sector, it presents opportunities for railways – such as RB – to capture a part of the freight transport that trucks used to carry.

Fit for 55

The EU's "Fit for 55" is a package constituting of REDIII (Renewable Energy Directive), which is the consolidated version of REDII. REDIII encompasses various initiatives aimed at aligning various sectors with the broader objective of reducing greenhouse gas emissions by 55% by 2030 (Green Deal). These initiatives come as a range of legislative tools designed to transform the economy and society towards a greener, fairer, and more prosperous future. It includes measures like EU-wide carbon pricing for transport, improvements in vehicle efficiency, a switch to low-carbon fuels, and an overhaul of the EU emissions trading system (EU ETS) (European Council, 2023). Three regulations proposed in the Fit for 55 package and addressed within REDII and REDIII (Renewable Energy Directive) that may significantly affect RB are **ReFuelEU Aviation**, **carbon pricing for transportation,** and **Alternative Fuels Infrastructure Regulation.**

The **ReFuelEU Aviation** sets out EU-wide harmonized rules for the promotion of sustainable aviation fuels (SAF), with an increasing minimum share of SAF required to be blended with kerosene by aviation fuel suppliers and supplied to EU airports (European Commission, 2023a). The ReFuelEU Aviation initiative applies to all airlines operating in Europe, regardless of their origin. The primary challenge for SAF deployment is its cost, being 3 to 5 times higher than conventional jet fuel (RHG, 2023). This cost gap is attributed to SAF's newer, pricier production methods. Adopting SAF would have significant consequences for the passenger segment, as it would cause ticket prices for air transportation to increase, in order for airlines to afford to meet the EU standard – the International Council on Clean Transportation predicts sustainability measures will drive up ticket prices by 22% by 2050 compared to where they would otherwise stand (The Business Times, 2023). The European airline market has mostly small players that generate less revenue in comparison to their global peers, therefore European carriers encounter more significant financial challenges when adopting SAF that their counterparts. Larger and more profitable airlines can afford switching easier to sustainable fuels without causing a major impact on the ticket fare for consumers. In light of this, European carriers may have to increase the price of tickets more significantly, which may hinder their competitiveness, as it poses the risk of the fare exceeding the consumers' willingness to pay, especially in the context of travel to neighboring countries. This represents an opportunity for RB to become a substitute for passenger air transport – the project could emerge as a viable alternative, which offers passengers a more affordable and eco-friendly travel option.

The second regulation that may have an influence on RB is **carbon pricing**, an approach to reducing carbon emissions that uses market mechanisms to pass the cost of emitting on to the emitters, with the broad goal of discouraging the use of carbon dioxide-emitting fossil fuels (Carbon Pricing Leadership Coalition, 2023). This regulation encompasses various instruments that can be adopted by market players depending on their needs, such as a carbon tax, an emission trading system, a crediting mechanism, or a results-based climate finance framework. As the goals and mechanisms of the tools are quite similar, the focus will be on the **EU Emissions Trading System**, also abbreviated as ETC. This directive sets a decreasing annual cap on greenhouse gas emissions for covered entities, aligning with EU's climate goals. Entities must hold emission allowances, purchasable or receivable for free from the EU carbon market, equal to their emissions, facing fines otherwise. They can trade allowances, promoting emissions reduction as entities can sell excess allowances. Since 2005, the EU ETS has reduced emissions from power and industry plants by 37% (European Council, 2022). When looking at the rail segment in particular, railways are generally more energy-efficient and emit fewer greenhouse gases per passenger or tkm than road or air transport. Therefore, under a carbon pricing or ETS regime in particular that would be expanded to address the carbon footprint of the entire transportation industry, RUs would likely face lower costs compared to those in higher-emitting sectors. For example, if the Baltic states implement a carbon pricing mechanism where entities have to pay for their emissions, RB may have to pay less, and its pricing towards its freight and passenger services may be minimally affected. This would generate a competitive advantage in relation to its peers in the maritime, air, or road transport segments, as they may have to increase their prices to match their CO2 emissions quota, and potentially lose traffic volume as a consequence.

Finally, Under the "Fit for 55" package, the **Alternative Fuels Infrastructure Regulation** focuses on the deployment of interoperable and user-friendly infrastructure across the EU for recharging BEVs and refueling FCVs (European Parliament, 2023a). This regulation includes proposed mandatory targets for alternative fuels infrastructure, which are pivotal in supporting the penetration and market growth of cleaner vehicles. It aims to guarantee infrastructure coverage even in rural and remote areas, ensuring a uniform transition to cleaner transport solutions throughout the EU. Because a crucial element of this regulation is the development of a widespread BEVs and FCVs network, service facilities on key routes like those that RB is planned to serve may become instrumental. Integrating recharging/refueling stations at RB facilities would align with EU goals for regular station placement along principal transport corridors, significantly aiding in the creation of a comprehensive network.

Fossil Fuels Subsidies

Fossil fuel subsidies remained relatively stable, at about EUR 56 bn (2022 prices), over the period 2015-2021 (European Environment Agency, 2023a). The EU’s Eighth Environment Action Program, in line with EU and international commitments, calls for an immediate phase out of fossil fuel subsidies. However, EU Member States have no concrete plans on how and by when they will phase out these subsidies, therefore, it remains unlikely that the EU will make much progress towards phasing out fossil fuel subsidies by 2030 as planned (European Environment Agency, 2023a).

This misalignment may have unfavorable financial impacts on the transportation sector, with respect to rail, from three angles: **competitive disadvantages**, **reduced incentives for rail subsidies**, and, finally, **delayed adoption of sustainable practices**.

The lower prices for fossil fuels, driven by subsidies, can make rail transportation, especially electric or alternatively fueled trains, **less economically competitive** compared to road or air transport which predominantly relies on fossil fuels (International Monetary Fund, 2023). Because fossil fuels are the primary resource which road or air transportation modes use to operate, it is a key driver of the price they charge to passengers or freight companies. Therefore, continuing to subsidize such fuels would make road and air transportation more competitive and cost-effective. Similarly, governments might be **less inclined to provide subsidies for rail transportation** if substantial amounts are already being allocated to fossil fuel subsidies. Lastly, rail transport has numerous improvement opportunities in terms of sustainability through the development of alternative drives, increased operational efficiency. However, the presence of fossil fuel subsidies might **slow down the adoption of such sustainable practices** as they make fossil fuels cheaper compared to alternative, more sustainable ones (Boston Consulting Group, 2022).

Directive 2008/68/EC

This directive by the European Union governs the inland transport of dangerous goods by road, rail, and inland waterway within or between Member States of the European Union, with a prime focus on ensuring high levels of safety and environmental protection. For IMs overseeing railway networks, this directive mandates rigorous safety management, necessitating the implementation of systems to identify and mitigate risks associated with the transportation of hazardous goods. The compliance with the directive's safety measures is imperative to prevent accidents and ensure safe transit of dangerous goods across the rail network.

IMs need to design operational protocols accordingly to meet the directive's required technical and operational requirements, ensuring the safe and efficient transportation of hazardous goods. This might include modifications in the scheduling, routing, and handling of hazardous goods to adhere to the safety requirements laid down by the directive. Additionally, an environmental management plan must be established to respond appropriately to potential accidents (European Union, 2008).

The Habitats Directive

Due to human activities, there is a large-scale disappearance and degradation of many natural areas and of the species that live in them within the EU. The Habitats Directive, adopted in 1992, aims to protect the wildlife by ensuring that the species and habitats are properly conservated and bound to thrive in the long term. Apart from all forms of deliberate capture or killing in the wild, all Member States must prohibit deterioration or destruction of animal habitats under any form (European Commission, 2023h).

This directive is highly significant in the context of RB, given the project's extensive construction activities. Therefore, it is crucial to ensure that such activities do not adversely impact any national sites or species declared under the list of Sites of Community Importance (SCIs). However, even if the project strives to minimize environmental damage through employing various initiatives, such the construction of forest bridges designed to preserve animal migration routes, adoption of noise reduction measures, and the establishment of micro-restriction zones for bird protection, it remains important to adhere to legal guidelines and continually monitor local developments to proactively address any other unforeseen environmental impacts that may emerge.

The Environmental Noise Directive

The Environmental Noise Directive is of also of significant importance to RB. This directive focuses on assessing and managing environmental noise, which is particularly relevant for major transportation infrastructure projects like RB. The directive requires member states to determine exposure to environmental noise through noise mapping and to adopt action plans to reduce noise levels, especially in areas where exposure levels can harm human health **(European Parliament and Council of the European Union, 2002)**. For RB, adherence to the END involves conducting comprehensive noise assessments, mapping noise exposure, and implementing effective noise mitigation measures. The directive emphasizes the importance of public information and consultation, ensuring transparency and community involvement in the decision-making process. Compliance with the END is not just a regulatory requirement for RB but also a commitment to sustainable and responsible development.

Environmental Impact Assessment (EIA)

The European Union's Environmental Impact Assessment (EIA) Directive (2011/92/EU as amended by 2014/52/EU) mandates that major infrastructure projects like RB within the EU must first be assessed for their impact on the environment before they can proceed. This assessment includes typically the following areas:

- Air Quality
- Water Quality and Hydrology
- Noise and Vibration
- Soil and Land
- Flora and Fauna
- Cultural and Heritage Resources
- Traffic and Transportation
- Human Health and Safety
- Socio-Economic Aspects
- Climate Change and Greenhouse Gas Emissions
- Waste Management
- Cumulative Effects

Therefore, several areas must be assessed if they match the requirements of the Environmental Impact Assessment (EIA) . The main goal of the EIA is to inform decision-making and promote sustainable development by evaluating, mitigating, and documenting the potential environmental impacts of proposed projects before they are carried out (European Parliament, 2014).

The Environmental Impact Assessment is currently ongoing for RB.

14.2.2 Railway

4th Railway Package

The 4th railway package, adopted by the EU in 2016, is a comprehensive set of reforms aimed at revitalizing the rail sector, enhancing its competitiveness, and ensuring its integration within the European transport system. It contains three pillars: technical, market, and governance. The technical pillar streamlines authorization and certification processes for railway vehicles and undertakings, fostering interoperability and safety across the EU. The market pillar promotes open access and competition by mandating fair and non-discriminatory practices, especially in domestic passenger rail services. The governance pillar restructures the roles of IMs and RUs to avoid conflicts of interest and ensure effective service provision. Through these reforms, the 4th railway package endeavors to create a Single European Railway Area, enhancing rail's appeal as a sustainable and efficient mode of transport (European Commission, 2016).

The 4th Railway Package has direct impact on RB. The technical pillar requires RB to comply with technical specifications and operational requirements that facilitate seamless cross-border rail services. Under the market pillar, RB is required to promote open access and fair competition within its network, ensuring non-discriminatory practices in service provision. While the establishment of PSOs for passenger services on the RB line is a necessary step, it should not hinder open access operators from offering their services. This balance is crucial to ensure that the RB infrastructure can be used competitively by various RUs. Lastly, the governance aspect requires a clear distinction of roles between IMs and RUs to avoid conflicts of interest, ensuring effective service provision and fair market practices.

Directive 2012/34

Regarding to EU Directive 2012/34 IMs must provide fair access to RUs, carriers, and other eligible applicants, operating on the European railway network. This open access principle extends to both domestic and international rail services. Member states have the option to exclude certain networks and services from this access rule, like local and regional standalone networks, networks serving only urban or suburban passenger rail services, or those with a track gauge different from the main EU rail network. The Directive outlines key provisions detailing the processes for allocating railway infrastructure capacity and the methods for calculating and collecting infrastructure charges (European Union, 2012).

According to EU Directive 2012/34, the IM needs to provide fair access to the network. In compliance with this directive, countries establish transport authorities or implement other monitoring and control structures in existing governmental agencies or authorities. These authorities have the task to oversee the IMs and ensure compliant behavior.

The European Commission is proposing a modification to the existing EU framework (Directive 2012/34/EU) concerning capacity allocation. As of today, capacity allocation is mainly conducted during the time tabling periods of the IMs. Therefore, RUs typically reserve their access slots far in advance. For additional individual train runs serving transport needs at short notice, capacity can be allocated following ad hoc requests only if left-over capacity is available. The regulation will enable RUs to request and receive infrastructure capacity whenever needed, according to market demands, moving away from the current practice of submitting requests within strict deadlines. Additionally, it will facilitate railway companies in submitting and receiving responses to their capacity requests all in one location, thanks to improved interoperable ICT tools. This would not just increase capacities of the network but also efficiency. Overall, the availability and therefore, the utilization of infrastructure would increase. RB can benefit from such changes in regulations since the new and modern infrastructure can be utilized more effectively and increase TAC revenues for the IM. Due to the flexibility and short-term planning options the attractiveness of railway transport can increase significantly (European Commission, 2023i).

Minimum Access Package

The minimum access package for railways outlines a set of basic services that IMs must provide to RUs and other eligible entities to ensure fair and non-discriminatory access to the railway network (as EU Directive 2012/34). This package is designed to facilitate the smooth operation of railway services across the network, promoting competition and interoperability. By providing essential services like track access, train path allocation, and related operational services, the minimum access package aims to create the same opportunities for all RUs, thereby fostering a more integrated and competitive railway market. This regulation emphasizes that charges for the minimum access package and access to infrastructure connecting service facilities should be determined based on the actual costs directly related to operating the train service. This principle is crucial for ensuring fair and transparent pricing for access to railway infrastructure (DB Netze AG, 2021).

In RB's case, future IMs, must establish this cost-based pricing system in order to fulfill the regulatory requirements for European track accesses.

Technical Requirements

The technical requirements for railways in the EU are principally governed by the Technical Specifications for Interoperability (TSIs). These specifications define the technical and operational requirements that need to be met by each subsystem or part of a subsystem to fulfill essential prerequisites and ensure the interoperability of the railway system across the European Union. The TSIs cover various aspects of rail operations and infrastructure, ensuring a harmonized and integrated rail network across EU member states. These TSIs cover infrastructure, energy, noise, rolling stock, safety, CCS, operation and traffic management, persons with disabilities and reduced mobility, and telematics applications. For each of those subsystems, the essential requirements need to be specified. The essential requirements can be summarized as safety, reliability and availability, health, environmental protection, technical compatibility, and accessibility. On September 8, 2023, the European Commission published a package of revised TSIs aimed at enhancing rail interoperability across borders. These new EU requirements are set to come into force on September 28, 2023, with a requirement for each Member State to notify the European Commission of their compliance by March 28, 2024 (European Union Agency for Railways, 2023). This update emphasizes enhancing the European Rail Traffic Management System (ERTMS) by standardizing operational rules and introducing new requirements for ERTMS-related engineering information and safety instructions. It also mandates improved information sharing between IMs and railway companies.

For RB, adhering to the European Union's TSIs is essential and mandatory. While an extensive range of TSIs exists, a detailed analysis of each exceeds the scope of this business plan. Some TSIs are directly relevant to RB in the development phase, but for ensuring interoperability of services Technical Specifications for Interoperability need to be comprehensively considered; for example, Infrastructure TSI specifically covers aspects such as line layout, track parameters, switches and crossings, platforms, and the resistance of tracks and structures to traffic loads. Other TSIs are more relevant for future operations; for example, the Telematics TSI aims to harmonize and standardize procedures, data, and messages exchanged between IMs, RUs, and other stakeholders. This specification encompasses two primary elements:

- Applications for Passenger Services: These include systems providing passengers with information before and during their journey, reservation and payment systems, luggage management, and management of connections between trains and other transport modes.
- Applications for Freight Services: This part covers information systems for real-time monitoring of freight and trains, marshalling and allocation systems, reservation, payment, and invoicing systems, management of connections with other modes of transport, and production of electronic accompanying documents.

Furthermore, noise emissions from railways are governed by the Technical Specification for Interoperability on Noise (Noise TSI). The vision behind this TSI is to set an optimal level of harmonization regarding specifications on rolling stock subsystems, such as locomotives, passenger rolling stock, and freight wagons, to limit the noise emission of the railway system across the EU. The aim of this TSI is to lower the noise pollution caused from rolling stock for around 12 mn EU inhabitants which are affected by railway noise during the day and 9 mn during the night (Directorate-General for Internal Policies of the Union, 2012). Even if Noise TSI is related to rolling stock, there could be interesting implications for RB, such as the quieter route concept. This concept involves designing and routing railways in a way that reduces noise impact, such as using specific materials and technologies, and routing tracks away from densely populated areas. This approach complements the END[97]'s objectives by proactively reducing noise pollution at the source.

Subsidies

The state aid railway guidelines by the European Union are aimed at supporting the shift to more sustainable transport modes in alignment with the EU's Green Deal agenda. Member States are allowed to subsidize rail

---

[97] Railway noise is regulated within the Environmental Noise Directive (END) which sets the requirements for the noise pollution of rail systems. The design and the operation of the rail system should align with these regulations. On the European level there are predefined noise levels for high-speed trains which need to be followed. The noise level should not exceed 87 (250 km/h), 91 (300 km/h) or 92 (320 km/h) dB(A). In stations or in stabling tracks, the noise levels should not exceed 70 dB(A) (European Commission, 2002).

transport operations and intermodal transport solutions as long as they reduce external costs compared to competing transport modes and lower the additional costs for infrastructure use incurred by rail transport. They can also support investments in digitization, interoperability, and noise reduction in rail infrastructure and rolling stock (European Commission, 2023j).

If the nations involved are considering subsidizing railway operations on the RB line, compliance with EU Regulation 1370/2007 is essential in terms of state aid (European Union, 2007). Due to the Green Deal, the possibilities for granting subsidies have expanded, particularly if they facilitate a reduction in external costs relative to competing transport modalities. Through strategic subsidization, the Baltic states can foster an alternative eco-friendly transportation mode, thereby amplifying the socio-economic impact and potentially enhancing the region's competitive advantage.

14.2.3 Competition

Usage of Road

During peak traffic seasons, some countries institute bans on trucks at roads with high traffic to prevent overloading the road infrastructure. In the European Union, such driving bans are orchestrated under Regulation (EC) No 561/2006, which defines the rules on driving times, breaks, and rest periods for drivers of commercial vehicles with a weight over 3.5 tons, aiming to enhance both working conditions and road safety (European Union, 2006). Moreover, some countries like Austria are adopting driving bans for heavy goods vehicles for environmental considerations, prompting a look towards other modes of transportation to compensate for this legislative intervention. These bans can pose challenges in planning and timely delivery of goods. With driving bans gaining traction, the industry is pushed towards exploring alternatives (van den Engel, 2010).

In scenarios where such interventions are implemented by states, rail freight transportation becomes more important. RB can benefit from heavy goods vehicle bans along the North Sea-Baltic corridor, as it may channel traffic onto the tracks, positioning itself as a stream to the Baltic states. On the other hand, a favorable regulatory environment is crucial for the successful operation of RB concerning competition. The Baltic states must foster railway competitiveness through appropriate regulatory measures. Any decisions favoring alternative transportation modes, such as trucks or personal cars, could adversely impact RB. For instance, if tolls for road usage were eliminated, demand for rail transportation might decrease. Thus, it is in the shared interest of the Baltic states to uphold a regulatory framework supportive of transformation to emission free transportation.

15 Wider Economic Impact Analysis

15.1 Introduction

Following the evaluation of economic viability within the CBA framework, the **wider economic impact analysis (WEI) assesses indirect and induced socio-economic impacts of the project**. While the standard CBA framework provides a robust structure to assess financial and direct economic impacts of Rail Baltica within the transport ecosystem, the WEI extends beyond the scope of the standard CBA to capture wider, context-specific impacts of the development, largely restricted by EU guidelines and monetization constraints.

To reflect on these **often overlooked, but significant benefits,** the WEI assesses impacts on economic growth, as well as geopolitical and social benefits in the particular geographic, economic and demographic context of the project.

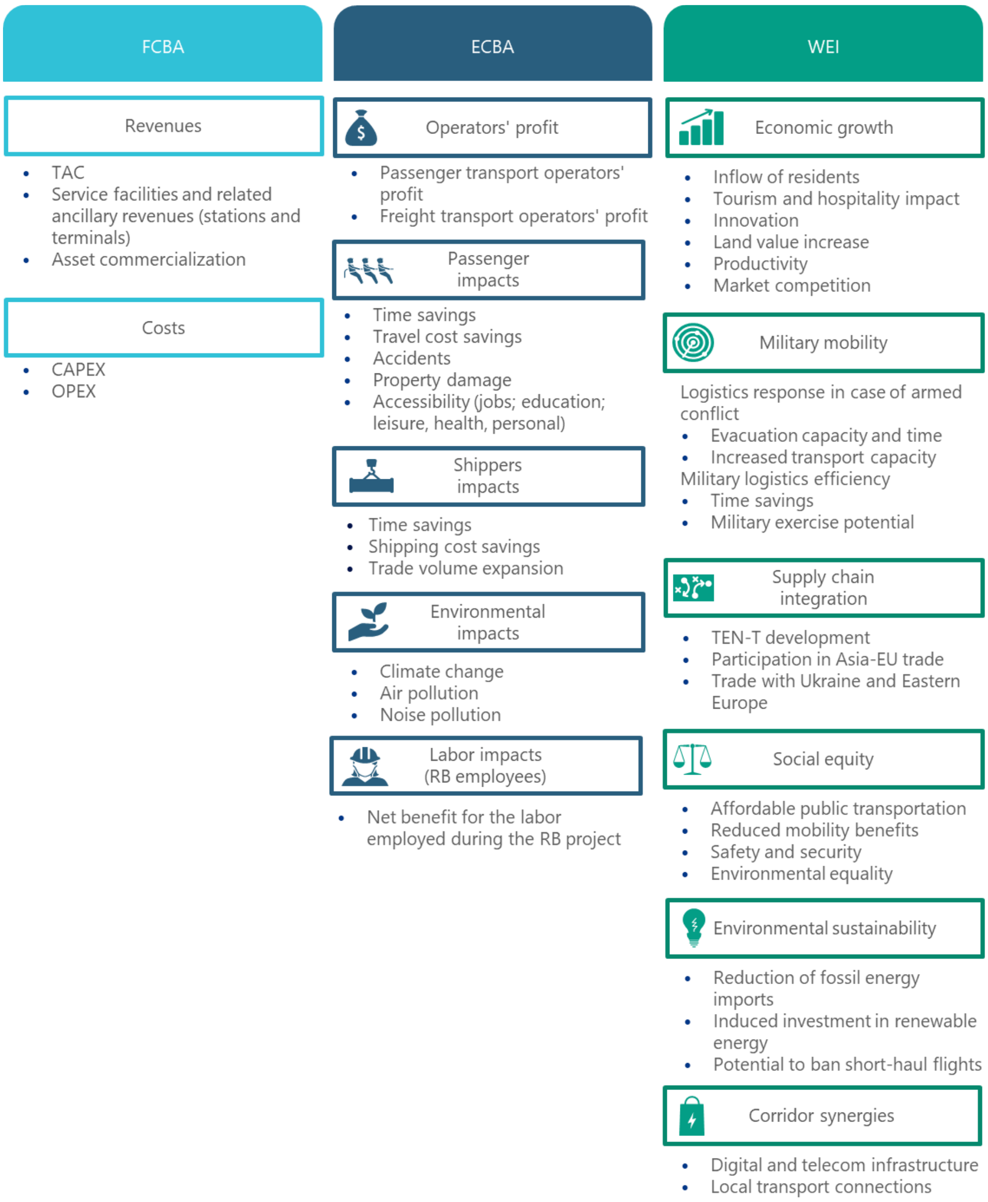


Figure 207: Wider Economic Impact Analysis within the Economic Appraisal framework

The chapter begins with a review of literature on the significance of wider economic impacts (WEI), setting the context for the analysis of key WEI components in the context of the Rail Baltica project.

15.2 General Literature Overview

The methodology for Wider Economic Impact (WEI) assessments is less strictly regulated, and EU guidelines rarely specify exact approaches for analysis. Consequently, this assessment draws on academic literature, Rail Baltica's specific contributions, and expert insights, with each component tailored to meet the unique context and objectives of the Rail Baltica project. In this regard, several **academic and regulatory studies** promote the significance of incorporating wider socio-economic impacts in the economic appraisal of transport projects.

In a contribution to the International Transport Forum, **Venables** (2016) **argues that wider economic impacts typically extend beyond the scope of a conventional transport cost-benefit appraisal (CBA)**. CBA primarily focuses on the user benefits generated by a project, often assuming no alterations in land-use. It is suggested that the standard CBA approach presents an inadequate alignment between the strategic rationale presented in favor of a project and the corresponding economic analysis. Even if the magnitude of these wider economic impacts proves to be limited, the appraisal process must engage with the justifications presented by project promoters and local stakeholders.

The **Transport Analysis Guidance of the UK Department for Transport** (2019) **emphasizes the particular importance of WEI assessment in case significant market failures in secondary markets**, beyond the transport sector, are anticipated to have a substantial impact on the welfare consequences of a transport intervention. It also outlines that the evaluation of a transport scheme's impact on Gross Domestic Product (GDP) should be approached with caution. GDP, while a valuable indicator of economic health, is not a complete measure of the full economic impact and should not be used as a substitute for welfare analysis.

According to the **Economic Appraisal Vademecum** (Worldbank, 2023)**, induced impacts on local economies is recommended to be assessed** in case boosting the economic activity of the region is key objective of the project. Additionally, indirect impacts on complementary markets (e.g., cost savings achieved by the promoter's suppliers, distributors, etc.) can be included, when relevant and if they are not already captured in the shadow prices of the project's inputs and/or outputs.

Graham (2019) **argues that the traditional consumer surplus-based calculation employed in conventional Cost-Benefit Analysis (CBA) encompasses only a portion of the potential advantages offered by transport schemes**. Recent research on WEI has broadened the assessment's purview to encompass effects stemming from externalities and various manifestations of imperfect competition, all substantiated by well-defined theoretical and empirical evidence.

Reflecting on the perspectives provided by scientific and regulatory studies, the **analysis of Rail Baltica's wider economic impact** accounts for the economic impact due existing market imperfections and context-specific benefits as well. First, the incremental GDP contribution of the development will be estimated, supported by the analysis of key growth drivers (e.g., land use change, tourism and hospitality spending, business creation, etc.). Then, the role of Rail Baltica as a critical infrastructure component is assessed to evaluate its impact on the military mobility of the Baltic region, with particular attention to the current geopolitical context. Further, the impact of stronger supply chain integration is studied, as well as social equity benefits. Finally, Rail Baltica's impact on energy security is described, along with potential corridor synergies.

15.3 Wider Economic Impact Overview

Rail Baltica Phase 1 has a **significant positive impact beyond the direct users of the line**. This includes monetary economic benefits, such as induced GDP growth, and qualitative effects like improved accessibility for historically underserved communities. Furthermore, Rail Baltica has implications on military mobility and supply chains in the Baltics, corridor synergies, and environmental sustainability. Key analysis results are outlined below, with further details covered in the following chapters.

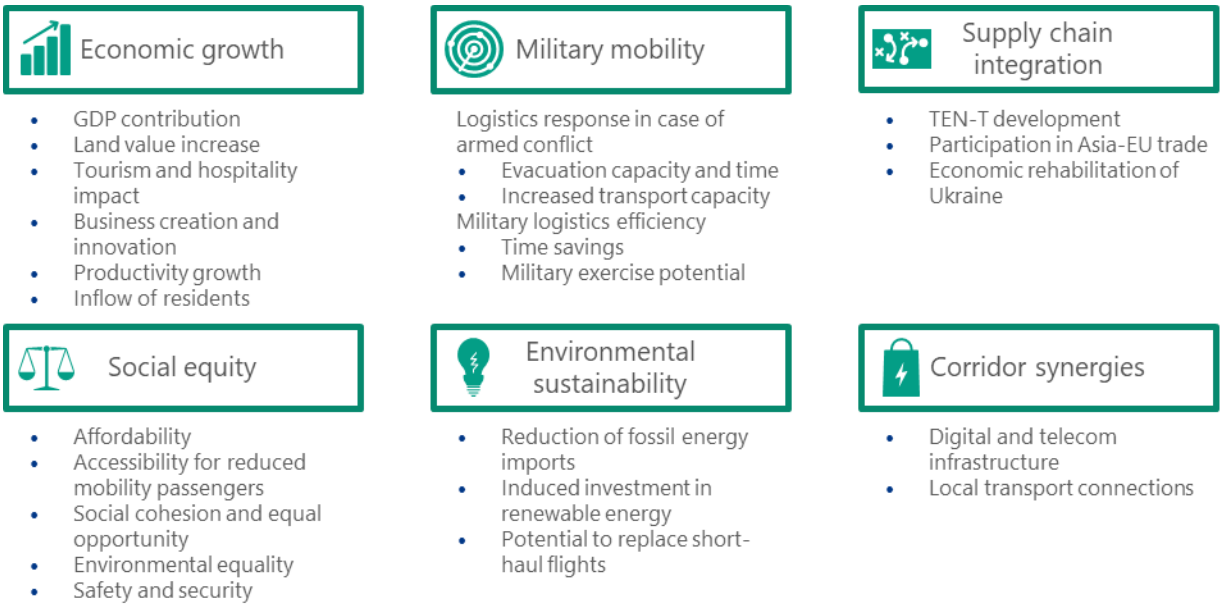


Figure 208: Wider Economic Impact Analysis

Economic growth

Rail Baltica Phase 1 is expected to boost GDP of the Baltic region by 0.5-0.7 pp in additional yearly growth, or EUR 16.5-23.0 bn in the operational phase until 2105[98], composed of direct, indirect and indirect impact components. Direct impacts (EUR 2.5 bn) are accounted for in the economic CBA, while indirect and induced GDP impacts (EUR 14.0-20.5 bn) of the investment feed the economy of the catchment area through multiple drivers, as listed below:

- **Increased traffic and spending of both urban and rural areas** are anticipated to drive a 10-20% increase in land value in areas with international or regional RB stations according to benchmarks of comparable rail developments.[99]

[98] On top of wider economic impacts during the operational phase, the investment during construction feeding through the economy also mitigates the financial burden of the project. While it is important to consider impacts during the construction period in the evaluation of the project's feasibility, construction investment is primarily considered as the cost of the project, in line with CBA guidelines.

[99] Consultant expert benchmarking of 3 comparable rail investments across multiple geographies

- **Tourism and hospitality demand is expected to increase** by 25-30% in terms of foreign traffic based on benchmarks of similar projects[100].
- **Innovation and expertise agglomeration** has the potential to result in an uptake in the number of new businesses and startups (Lu Y., 2022).
- **Labor productivity is anticipated to grow** through agglomeration effects (Hiramatsu, 2018).
- **Net inflow of residents has the potential to increase** due to improved connectivity and better employment opportunities, reducing the overall shrinking rate of the population (Blanquart, 2017).
- **Market competition is expected increase** due to reduced shipping times and higher concentration of businesses (Cartmell, 2018).

Military mobility impacts[101]

In addition, Rail Baltica Phase 1 has the potential to become a game changer to the military mobility strategy of the Baltic states, with regards to the provided capacity and the connection to the 1435 mm network. Rail Baltica is designed to operate as dual-use civilian/military infrastructure, with rolling stock capacity to accommodate military transport demand.

Through its potential to enable movements of military units in a single transport, as well as to reduce loading and unloading times, RB is expected to play a crucial role in military logistics both in case of armed conflict and peacetime. Some examples are listed below to highlight the potential key role of RB for military mobility purposes:

- **In case of armed conflict, Rail Baltica would increase civilian movement capacity**
- By establishing a high-speed North-South railway axis, **transport time would decrease along key population clusters**.
- RB infrastructure to play a pivotal role in **enabling efficient logistics and transportation during peacetime military operations**, in line with increasing allied deployments in the eastern flank of NATO.
- Through the ability to transport military units, Rail Baltica would **enable military movements without major disruptions to road traffic**, as well as time savings related to unloading/loading time per transport at PL/LT border.

Supply chain integration

Apart from military mobility, Rail Baltica Phase 1 enables efficient integration into global supply chains, ensuring the swift movement of goods to and from international markets, promoting economic development, and supporting EU transport development objectives. Rail Baltica, connected to both top two priority axes of TEN-T, would contribute 3% of total investment required for the completion of the core TEN-T network by 2030, and 24%

[100] Consultant expert benchmarking of 6 comparable rail investments across multiple geographies

[101] Quantified results of the impact assessment related to military mobility in the Wider Economic Impact analysis are not included in the publicly accessible version of the CBA report due to restricted access to information.

of the Baltic – Adriatic corridor (which would be directly connected to the Rail Baltica line via Warsaw)[102] (Jensen, 2020; German Federal Ministry for Digital and Transport, 2023).

Further, increased freight handling capacity would allow more freight to be transported along the northern flank of the Asia – EU land corridor, resulting in induced foreign investment and wider access to goods and services.

Additional capacity also plays a vital role in rebuilding healthy and efficient trade flows in countries impacted by the war in Ukraine, especially with Ukrainian grain transport challenges. The Rail Baltica project stands to participate in the reconstruction efforts, building on the relative importance of rail capacity within Ukraine (Kosse, 2023).

In terms of new services, more reliable and faster transport modes are expected to allow e-commerce players to offer time-sensitive shipping offerings (e.g., overnight shipping).

Social equity

Rail Baltica Phase 1 promotes social equity by serving marginalized passenger segments. Its regional services have the potential to provide 269,000 low-income residents with affordable public transportation options for commuting and personal trips. Additionally, 47,000 passengers with reduced mobility, who currently face limited access to public transportation, could benefit from high-quality rail services[103]. Improved accessibility through Rail Baltica is also expected to enable 90 to 110 students per year to pursue university studies by enhancing their access to educational institutions based on Rail Baltica TDM (2024).

Marginalized communities currently underserved by public transportation would realize benefits due to decrease of pollution and accidents in areas with high car usage. Additionally, **high-speed rail developments have the potential to improve women's travel safety**, contributing to their social inclusion and integration into the labor market given the studies analyzing such phenomena on metro stations (Pogonyi, 2019).

Environmental sustainability

Rail Baltica aims to be entirely powered by renewable electricity sources, in alignment with the European Union's carbon neutrality target for 2050. Consequently, the project has the potential to reduce the annual demand for fossil fuels in the Baltics between 1.6% and 1.9%. By reducing fossil fuel dependency through a modal shift from combustion engine vehicles, RB would contribute to electricity independence in the region, a key target of the European Union.

---

[102] Calculating with a CAPEX value of EUR 17 bn for Rail Baltica, EUR 550 bn for the total completion of the core TEN-T network by (German Federal Ministry for Digital and Transport, 2023), and EUR 71.66 bn for the Baltic – Adriatic corridor (Jensen, 2020)

[103] The population of Rail Baltica's catchment area was examined taking into account the corresponding countries' relative income poverty index. In cities with regional stations and a population greater than 25,000, the entire city's population is included within the core catchment area. For smaller cities, populations within a 4.8-kilometer radius of the station were considered. The number of impact residents is based on the assumption to reach 30% of the catchment area`s reduced mobility passenger population to reflect their increased difficulties in accessing nearby stations.

The project's commitment to renewable electricity could lead to an **induced investment in the region for offshore wind energy** production of EUR 135 mn to cover the electricity need of the newly built rail. By helping the renewable energy sector reach economies of scale, it promotes an economically sustainable shift towards renewable power in transportation.

RB has the potential to make the Baltic region a global leader in **reducing short-haul flights**. A limitation or outright ban in short-term flights in the region would lead to substantial emission savings amounting to EUR 5.9 mn.

Corridor synergies

In addition to the earlier mentioned beneficial impacts, Rail Baltica Phase 1 has the potential to unlock corridor synergies through "Dig once" benefits in the deployment of innovative technologies along line through realizing cost synergies, providing services which are not profitable as a standalone business unit. RB set the general conditions for service providers to have access to dark fiber optic as well as 5G mobile infrastructure, unlocking up to 20% in deployment cost synergies based on case studies (Christina Biedny, 2021). Rail Baltica is also expected to induce investment in adjacent transport infrastructure to realize cost and revenue synergies.

15.4 Economic Growth in the Catchment Area

This section assesses the anticipated economic impacts of Rail Baltica Phase 1 in the Baltic region during the operational phase, considered as a key objective of the investment. The analysis offers a thorough evaluation of direct, indirect, and induced economic advantages, in line with EU guidelines for assessing local economic impacts[104] (European Commission, 2021a).

Beyond the wider economic impacts during the operational phase, the **investment made during the construction period also stimulates economic activity, helping to offset the project's financial burden**. While it is important to consider the economic effects of the construction phase when evaluating the project's feasibility, construction investment is primarily regarded as a project cost, not a benefit, in accordance with CBA guidelines.

Drawing from empirical data and benchmarks from similar projects, as well as scientific literature, the potential influence on GDP growth is supported by further assessment of impacts on **land value, tourism, business innovation, increased market competition, inflow of new residents** and **labor productivity**. The methodology employed to estimate the economic impact of RB is detailed below alongside the calculation breakdown.

15.4.1 GDP Contribution of Rail Baltica

Rail Baltica Phase 1 holds transformative potential **for catalyzing economic growth within its catchment area**. Benchmarks from comparable rail development projects suggest an annual incremental boost of 0.5-0.7 pp to the

---

[104] The Economic Appraisal Vademecum 2021-2027 recommends excluding the assessment of induced benefits on local economies due to potential displacement effects. However, the assessment is encouraged in case boosting economic growth of the region is a key objective of the project, as in the case of Rail Baltica.

region's economic growth[105], with a preliminary discounted net benefit estimated to range between EUR 17 and 23 bn over the project's lifespan split across the three Baltic countries.[106]

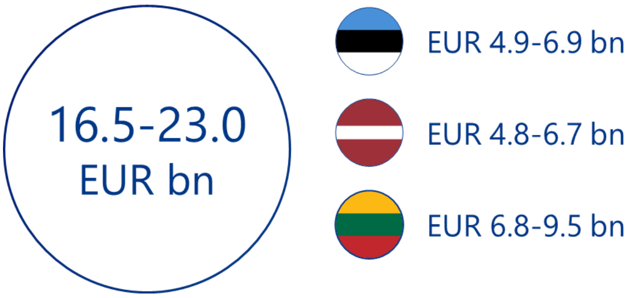


Figure 209: Net discounted additional GDP by country and the evolution of GDP (2019-2105) of the catchment area (compared to GDP without RB Phase 1)[107]

The **incremental GDP contribution of RB Phase 1 partially includes direct benefits already captured in the CBA** (EUR 2.5 bn), as well as additional indirect and induced economic benefits (EUR 14.0-20.5 bn), as presented in the following figure.

To estimate the additional wider economic impact on GDP net of direct benefits already accounted for in the ECBA, direct benefits are segmented based on their contribution to GDP. Among direct economic impact components, impacts on the transport value chain, business passenger time savings, enhanced job and education opportunities and labor benefits directly contribute to GDP, while remaining impact components do not or indirectly effect economic performance.

More specifically, monetary benefits including cost savings and freight shipper benefits only contribute to GDP through operators' profits while externalities such as accidents and environmental benefits do not directly contribute to GDP.

Figure 210: Overlap between direct socio-economic impact components and GDP contribution

---

[105] Consultant expert benchmarking of comparable rail investments across multiple geographies

[106] Until 2105, discounted

[107] Values might not add up due to rounding

In contrast to Economic CBA impact calculations, the **approach for estimating incremental GDP growth impact follows a top-down methodology** based on empirical evidence to enable a comprehensive estimation of interdependent benefit components.

The initial step of the assessment **establishes of a baseline GDP growth trajectory** in the local and regional catchment area of Rail Baltica Phase 1, only considering areas within the Baltic countries. This refers to the metropolitan hubs with RB Phase 1 train stations and surrounding within a shorter than 1 hour commute (approximately 80 km radius from RB Phase 1 stations).

Figure 211: GDP contribution calculation

Metropolitan areas alone account for a combined 53% of GDP and, with the addition of the surrounding area, the **overall considered catchment area accounts for 80.7% of GDP**, assuming non-urban areas contribute uniformly to GDP.

Figure 212: Catchment area for Rail Baltica considering a Local and Regional level

The second step of the methodology is the **calculation of incremental GDP growth** induced by rail infrastructure development. To benchmark this increment, comparable projects across different geographies are analyzed, where similar investments related to rail development have led to additional GDP growth ranging from 0.5% to 0.7%.[108] Given the current underdevelopment of rail infrastructure of the Baltics, Rail Baltica Phase 1 is expected to drive faster growth than Western European examples with higher without-project connectivity.

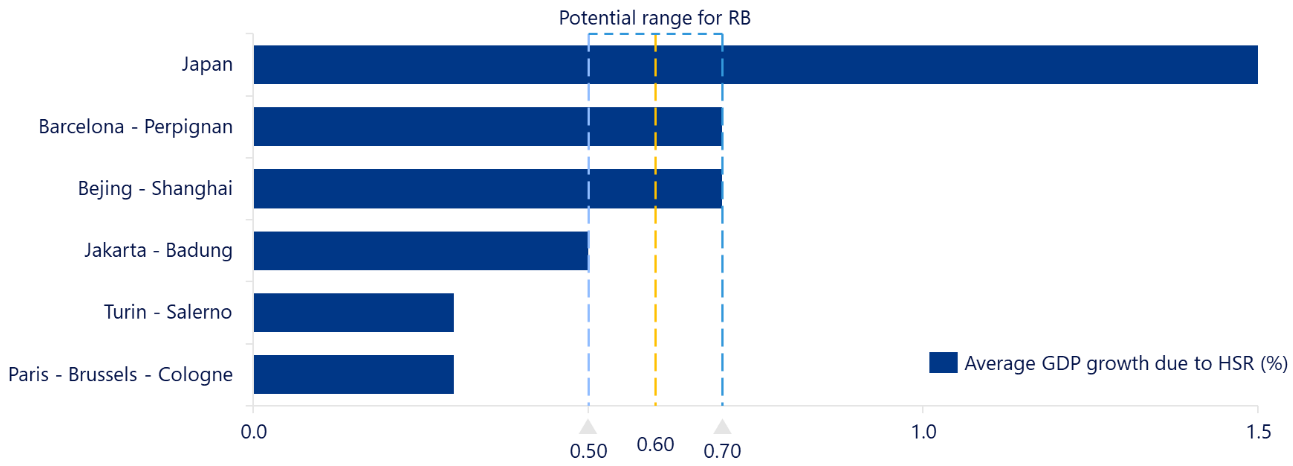


Figure 213: Incremental GDP growth benchmarks

This increment is a **composite outcome of several interrelated factors**, each playing a distinctive role in contributing to economic growth. Key components of incremental GDP growth include land value increase, tourism and hospitality sector growth, improvement in new businesses and improved agglomeration dynamics. Land value appreciation, projected at a substantial 10% to 20%, driven by improved accessibility and connectivity. Furthermore, the tourism and hospitality sector are expected to experience noteworthy growth, spanning between 15% and 30%, owing to increased regional attractiveness. The creation of new businesses is anticipated to increase, driven by better commercial opportunities and connectivity. Lastly, improved agglomeration dynamics are projected to yield productivity gains. These combined factors synergistically contribute to the incremental GDP growth stimulated by Rail Baltica.

While the economic benefits of RB Phase 1 are promising, it is essential to recognize and address **potential risks and uncertainties**. One notable risk is the possibility of lower-than-expected baseline GDP growth, which could limit the project's incremental economic impact. Variability in construction timelines, demographic trends and market conditions also presents inherent risks that could influence the ultimate wider economic benefits. Additionally, global economic dynamics and unforeseen events, such as geopolitical shifts or economic crises, can introduce uncertainties into the project's economic outcomes. A detailed risk analysis is conducted within the Rail Baltica Economic Appraisal.

To provide an in-depth understanding of the top-down estimation of economic growth benefits and associated risks, **the next chapter analyzes key economic drivers in the context of high-speed**, regional and freight rail

[108] Consultant expert benchmarking of six comparable rail investments across multiple geographies. Japan is considered as an outlier due to high deviation from average. Western European examples (Turin – Salerno and Paris – Brussels – Cologne) are excluded due elevated level of existing infrastructure.

development. It is important to note that these quantifications aim to provide insights into the drivers of GDP growth and not an exhaustive list of its components.

15.4.2 Land Value Increase

Transport investments significantly influence land use and value. Although the rise in land value can be quantified, much of this increase represents capitalized benefits already considered in the project's Economic CBA (such as time savings and improved accessibility). Consequently, CBA guidelines advise against quantifying this land value increment. However, given the project's aim to stimulate economic growth in the surrounding area, the increase in land value is assessed in a non-monetary manner.

Accounting for **the impact of both high-speed and regional stations in urban and rural environments, Rail Baltica Phase 1 is expected to** induce land values increase of 10-20% **based on empirical studies of comparable rail projects according to consultant benchmarks and Song et al.** (2019)**.**[109]

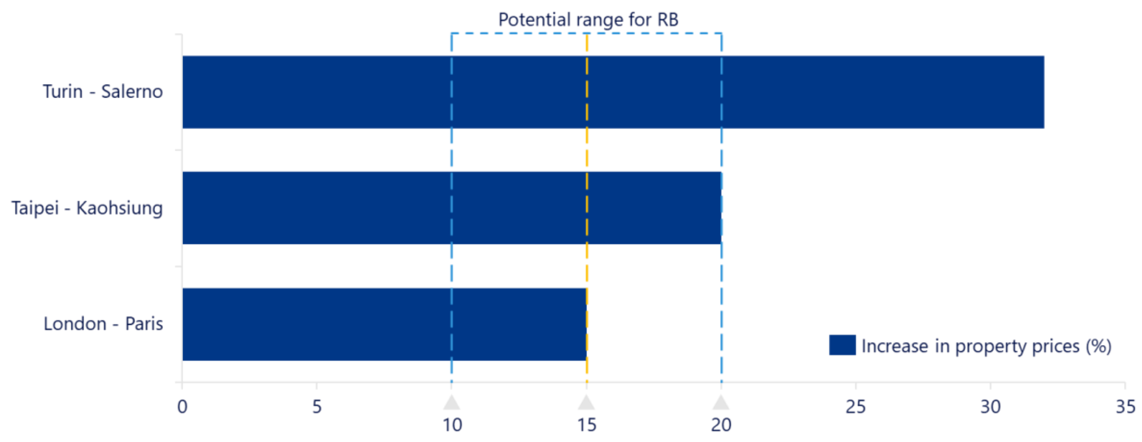


Figure 214: Increase in property prices (%) experienced in similar rail infrastructure projects

The drivers of this increase are high-speed and regional stations and services, resulting in enhanced connectivity and improving future opportunities for rural areas as well.

High-speed stations, often located near major urban areas, are likely to become hubs of development. Their ability to open connections between major cities makes them and their surrounding area prime locations for businesses, housing, and commercial centers. As a result, the land near these stations is expected to see an increase in value.

With 48% of passengers using regional services, the vicinity of these stations is likely to form local commercial hubs benefiting from mainly commuting traffic (Rail Baltica TDM, 2024). Consequently, there will be a growing demand for housing, commercial properties, and facilities related to transport, thereby increasing land values in traditionally lesser-developed regions.

While the intrinsic value of land in established urban centers is expected to rise swiftly due to enhanced connectivity and the subsequent inflow of businesses and consumers, rural areas are subject to a more intricate transformation. Changes in land use will encompass multiple sectors, from industrial zones benefiting from streamlined transport facilities to previously agricultural terrains gaining newfound value from potential tourism

---

[109] External benchmarks on land value increase induced by comparable rail developments.

or leisure-oriented uses. As a subsequent impact of land value increase in areas favored by the development, a less significant decrease is expected in geographies with persistently low connectivity to economic clusters.

15.4.3 Tourism and Hospitality

The **tourism and hospitality sector is a primary beneficiary** of the high-speed and night of Rail Baltic Phase 1 train services in particular. As seen on the figure below, international benchmark projects experienced foreign passenger traffic increase between ~2-3% to 50%. Taking the benchmark average and staying conservative despite of the greenfield investment nature of the project (resulting in creating the first high speed line in the Baltics, Rail Baltica Phase 1 is expected to add 25-30%[110] in tourism and hospitality traffic based on benchmarks of similar rail projects.

The **increase in spending is largely driven by passenger arrivals with RB Phase 1** from within the region and neighboring countries across the region, as well as international passengers motivated by increased mobility across the Baltics.

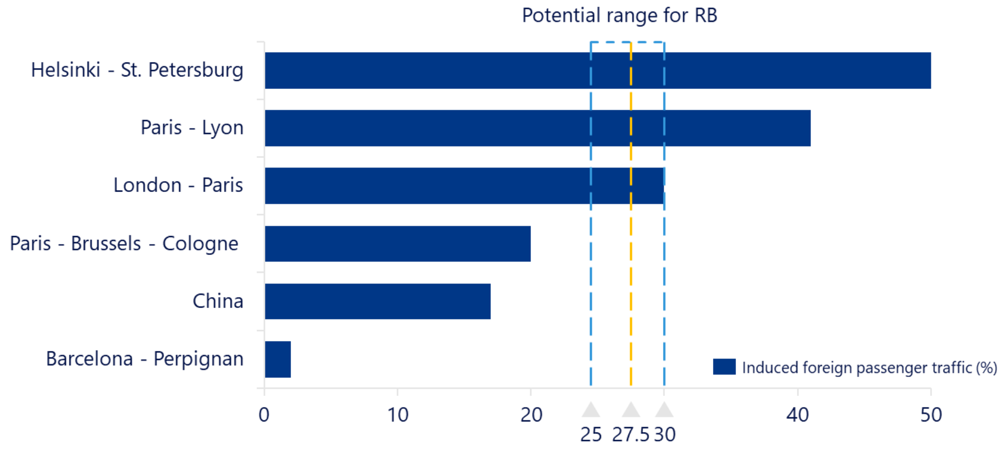


Figure 215: Induced foreign passenger traffic experienced in similar rail infrastructure projects

Rail Baltica Phase 1 offers passengers **a swift, flexible alternative to air and car travel,** especially for those from proximate origins. For distant travelers, it could provide seamless access to key regional highlights via high-speed rail. This connectivity not only could facilitate exploration of multiple destinations in a single trip but also showcases the Baltics' rich natural and cultural assets, catering to tourists' demand for diversified and convenient itineraries.

Rail Baltica Phase 1 is expected to drive **economic benefits across multiple hospitality segments** (Campa, 2016). Hotels and hostels especially along the route, are expected to see increased demand, potentially catalyzing further investment. Restaurants can anticipate a surge in patrons, diversifying food offerings. Major attractions and localized experiences, from museums to historical sites, can attract more visitors. Additionally, the region's potential as an event hotspot will be leveraged, all while promoting sustainable, eco-friendly travel. Importantly, Rail Baltica is anticipated to also spotlight lesser-known towns, enriching their local economies through increased tourism.

---

[110] External benchmarks of comparable rail projects

15.4.4 New Business Creation and Innovation

Historically, there is both political and industry support behind the concept that transportation infrastructure investments such as RB Phase 1 have the potential to **drive business growth and innovation**. Not only is mobility enhanced by such investments, connecting underserviced areas, and allowing for access to better job opportunities, but new businesses are created causing a boost in local employment.

However, there is a lack of consistent academic literature confirming this hypothesis with evidence not pointing in a clear direction. In this context, the **following subsection aims to provide support for the positive implications** of infrastructure investments for businesses and innovation with RB serving as a prime example for the Baltic region, based on scientific literature.

Rail Baltica's development has the potential **drive business and technological growth in the region**. As traveler and resident numbers grow, there is expected to be a higher demand for goods and services. This would boost the hospitality sector around stations, increase retail offerings tailored to traveler needs, prompt the establishment of workspaces near transport hubs, accelerate real estate investments along the route, create opportunities for new first and last-mile carriers and necessitate expanded operational services to maintain quality and customer satisfaction.

With the modern infrastructural and service ecosystem of Rail Baltica Phase 1, a **significant boost towards new venture opportunities and for innovative business models** can be expected. According to Du (2022) there is an inherent incentive for companies to invest in research and development, creating innovative solutions tailored for the changing landscape. This could range from tech startups developing smart ticketing systems or travel apps optimized for the Rail Baltica route to sustainable and green technologies targeting eco-conscious travelers.

The implementation of high-speed rail specifically has also shown to foster urban traditional and green innovation. Chang Ma (2023) analyses urban panel data from 285 prefecture-level cities in China from 2003 to 2019 to estimate the impact of opening a HSR on urban innovation. The results of the study show increased urban green innovation in cities with a more pronounced effect in smaller centers.

15.4.5 Productivity Growth and Agglomeration Effects

Rail Baltica’s direct connectivity after Phase 1 implementation is anticipated to **increase productivity across sectors**. By cutting transportation time and costs, businesses could operate faster**,** and supply chains would become more efficient. Improved workforce mobility means businesses access a wider talent range and employees spend less time in transit, leading to higher productivity and job satisfaction. A report by the Banque the France (Claire, 2017) shows the positive impact of the TGV (the French high-speed rail) on productivity with industries benefiting from increased profit margins in the range of 0.6 to 1.9 percent.

Furthermore, Graham (2019) analyses the impact of transport investments in relation to productivity benefits via agglomeration economies. The latter are achieved when agents benefit from being in proximity to other agents. The study estimates the effect on total factor productivity and outlines the **positive relationship between transport investments and increased productivity**. The results of the study show however that the effects of agglomeration diminish more rapidly as the distance from the source increases. Consequently, the area immediately surrounding RB Phase 1 train stations is set to mostly benefit in terms of agglomeration economy productivity.

A major investment in infrastructure also stimulates the economy with **economies of scale and an improving job market.** In an empirical study of the Shinkansen line, Hiramatsu (2018) has observed a growth for population, jobs, and economic scale in the regions with improved access. These areas are found to be more productive, while in other in parts of the country with no investments, productivity and population decreased.

15.4.6 Inflow of Residents

Modern train infrastructure can **drive higher immigration and improved mobility of residents**. By connecting remote regions to economic centers, rail networks unlock broader employment, service access, and improved living standards. Better connections to larger urban centers particularly benefit peripheral areas which can now gain access to a large pool of qualified workers.

For potential migrants from specialized professions to basic roles in sectors like construction or hospitality, efficient rail connectivity offers crucial mobility and access. Additionally, introducing a varied workforce can invigorate local economies, filling employment gaps in areas with labor shortages. (Blanquart, 2017).

Rail Baltica Phase 1 is also expected to **attract** diverse businesses, from tech to manufacturing, and thus, **both specialized and general workers**. Such infrastructure can also amplify cultural and leisure attractions, appealing to those seeking vibrant communities. This not only boosts local allure, drawing a larger population, but also catalyzes demographic diversity. By investing in advanced rail systems, regions not only stimulate economic growth but also reshape their demographic landscape.

Drawing parallels from the German example, high-speed rail specifically can lead to **increased commuting between regions**. A reduction in travel time by 1% is associated to a 0.25% increase in commuters between regions (Daniel F Heuermann, 2019). For Rail Baltica, this could not only signify enhanced intra-Baltic mobility but also higher inflows from neighboring states such as Poland. Given the projected 0.7% annual population decline in the Baltic states until 2080 (S&P Capital IQ, 2023a) seen on the figure below, higher inflows from neighboring states might be crucial for sustaining a thriving, balanced society both socially and economically. (S&P Capital IQ, 2023a)

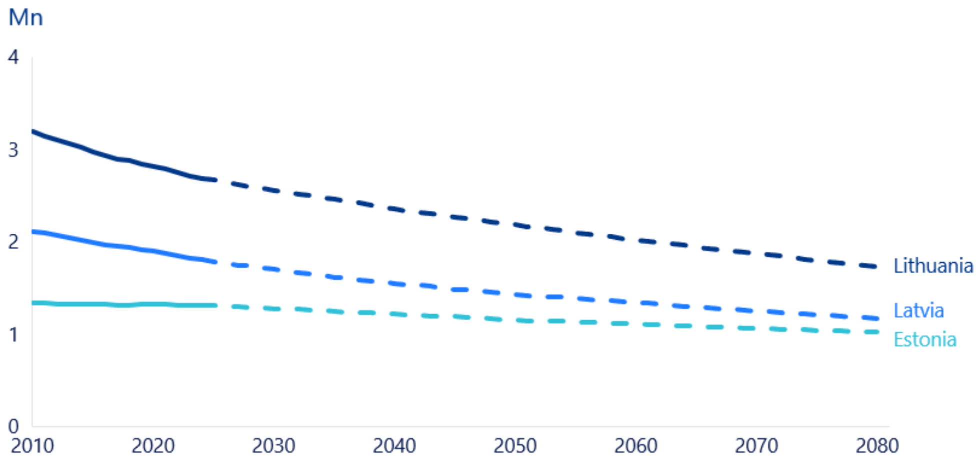


Figure 216: Population decrease in the Baltic states until 2080 (S&P Capital IQ, 2023a)[111]

[111] Data from 2010 to 2023 is categorized as historical, while projections for 2023 to 2053 are provided by S&P Capital IQ and 2053-2080 calculated based on the CAGR of 2043-2053 projections.

15.4.7 Increased Market Competition

The connection Rail Baltica Phase 1 creates between the Baltic states can **intensify market competition, particularly in transportation** due to improved travel efficiency. It is expected to streamline logistics and supply chain management for businesses and promote regional collaborations. According to the research of Ou et al. (2022), expanded connectivity facilitates a wider customer base and leads to more intense competition.

The connection of Rail Baltica Phase 1 to various markets provides businesses with a wider customer base. This expansion could drive heightened competition, necessitating **improved service standards**. As a result, businesses would likely need to innovate more to stay relevant.

A result of the establishment of Rail Baltica Phase 1 is expected to be the enhanced presence of domestic and international businesses in the region. Such a business surge is projected to **create competitive pricing dynamics**. Data from similar infrastructural projects in case studies by the Department for Transport Rail Group of the United Kingdom (2018) indicate that sectors deeply interconnected with rail services might witness price stabilizations due to the increased competition on the market.

Amid these shifts, **consumers are expected to gain the most**. The increased competition promises a wider array of choices, enhanced service standards, and competitive price points. This new market dynamic characteristically leans towards ensuring consumers obtain optimal value from their spendings.

15.5 Enhanced Military Mobility

To reflect on geopolitical benefits beyond economic impact, this chapter assesses the potential of Rail Baltica Phase 1 **to significantly contribute to the military mobility strategy** of the Baltic states, offering enhanced capacity and integration with Europe through the 1435 mm network. Enabled by the dual-use design to serve both civilian and military needs, Rail Baltica possesses the infrastructure and rolling stock capacity to meet requirements **during both peacetime and potential armed conflicts.** Quantified results of the impact assessment are not included in the publicly accessible version of the CBA report due to restricted access to information.

Since EU CBA guidelines do not consider indirect and induced impacts direct benefits of the project, military implications are not part of the standard ECBA. However, given Rail Baltica's geopolitical significance and the Baltic's crucial role in maintaining peace along the Eastern flank of the NATO and EU, **it is recommended to consider its defense logistics impact** during funding allocation discussions.

The analysis of the **geographical focus of military operations** needs enables a deeper understanding of the feasibility of military transports on the RB Phase 1 line. In this context, while most military vehicle transport destinations are located in the Eastern parts of the countries without direct RB-connectivity, last mile segments can be covered by vehicles in a self-driven manner (except for tanks and containers, needing further road transport capacity) due to the short distances in the region.

15.5.1 Enhanced Military Mobility in Armed Conflict

Rail Baltica Phase 1 is designed to serve defense logistics purposes in times of armed conflict, facilitating the **rapid movement of civilians, military personnel, cargo and humanitarian supplies** from and to potential frontlines, thereby reinforcing the defense strategy of the Baltic states. The evaluation of the impact in case of armed conflict is a crucial, as increased capabilities project power of deterrence in times of geopolitical sensitivity and volatility, underlining a strong level of regional and EU-level cohesion.

While in peacetime, military logistics decisions are highly cost-driven, **time efficiency and capacity become the most important decision factors in case of emergency**. Accordingly, the impact of Rail Baltica is assessed along dimensions including civilian movement capacity, military cargo transport capacity and time savings on key routes.

The infrastructural framework of RB Phase 1 promises to enhance **civilian movement capabilities**, with a potential additional capacity daily from the Baltic states towards Poland during emergencies. This not only ensures civilian safety but simultaneously frees up military logistics resources for other strategic deployments.

To **calculate maximum civilian movement capacity**, demographic data is used for the allocation of trains to specific routes. For crisis evacuations, capacity is assumed to be higher than standard operational capacity to derive total daily civilian movement capacities (consultant expert analysis). Such reductions, when translated to strategic mobility, offer a distinct advantage in terms of agility and responsiveness.

Beyond civilian movements, the infrastructural prowess of RB Phase 1 is **expected to enhance the military transport capacities** for defense. It can pave the way for the streamlined movement of troops within the Baltic states and from Poland and increase estimated daily transfer capacity of supplies from Poland to the Baltic states.

Potential capacities are calculated using data from the Rail Baltica model, which provides information on cargo train length, including locomotives and flat wagons. This enables the determination of wagons per train and the maximum payload for each. In crisis scenarios, a freight trains could be dispatched more frequently. A more conservative estimate is also calculated due to organizational complications. These calculations are contingent on the availability of the required rolling stock.

The operational efficiency of Rail Baltica Phase 1 is set to bring about a marked **reduction in transit time** compared to transport by bus to the Polish border, offering a strategic edge during emergencies (Rail Baltica TDM, 2024). **Civilian movement times are assessed** based on track lengths from each Baltic capital to the Polish border, ending at Suwałki (RBR project team input). Assuming a reduced passenger train speed for crisis situations, transit times are calculated for each route. These are contrasted with bus travel times at 70 km/h, underscoring rail's efficiency.

Indeed, it remains imperative to consider the **intrinsic vulnerabilities** associated with such critical infrastructure. The strategic essence of RB Phase 1 also earmarks it as a possible high-priority target during armed conflicts. Military strategists suggest that the long-term sustainability of a frontline might be challenging, with potential damages to this infrastructure in the early stages being highly probable. In this context, RB's most profound benefits are anticipated during the crucial preparatory phase leading up to potential confrontations.

15.5.2 Enhanced Military Mobility in Peacetime

Rail Baltica Phase 1 infrastructure is **positioned to enhance logistics and project power during peacetime military operations** by facilitating the rapid movement of goods and personnel. This capability not only offers additional revenue opportunities during exercises, but also equips the Baltic and NATO armies with improved responsiveness, allowing for the swift transport of equipment and troops during military operations (Biernikowicz, 2021).

Furthermore, **NATO has increased its military presence in the eastern flank of the Alliance** as a response to the military conflict in Ukraine, which has a direct impact on the demand for logistics in the Baltic region (NATO’s military presence in the east of the Alliance, 2023). To serve this increasing demand, modern rail infrastructure is expected provide the optimal solution for military logistics given its optimally balanced speed and capacity characteristics.

Key impacts include road congestion reduction through replacing long military truck convoys, providing additional revenue to RB, and quicker mobilization due to reduced loading / unloading times at the Polish border.

The Baltic states have also made significant investments in military resources and equipment, with Lithuania leading the way by tripling its military budget since 2008. Estonia, Latvia and Lithuania all agreed to spend successively 3% of the GDP on defense in the future. This commitment is expected to drive a greater demand for military transport services (Mark F. Cancian, 2023).

Based on the analysis of expected military movements of military vehicles, equipment, and personnel along the North-South axis[112], RB Phase 1 is expected to provide capacity for NATO transports and national armed forces. This not only promises to **improve the annual economic impact of RB Phase 1,** accounting for expected movements of military vehicles, equipment and personal along the North-South axis, but also stands to elevate the efficiency quotient of military drills.

Further, through the ability to transport military units, Rail Baltica Phase 1 would enable military **movements without major disruptions to road traffic.** The transportation of a full military unit could be alternatively conducted in military truck convoys, causing major disruptions to road traffic mostly taking place on already overloaded single lane roads along the North-South axis, rendering the operation unfeasible on EE-PL routes.

Military logistics entails the transportation of specialized cargo, including heavy machinery and potentially hazardous goods. Relying on rail transport, as opposed to roadways, not only ensures safer and more efficient movement but also **minimizes wear and tear on road infrastructures**. Since military transports on road are often carried with super heavy load vehicles, this can have significant negative effects on the infrastructure (Nguyen Ngoc Thach, 2021). With shifting to rail transport, significant economic savings in terms of maintenance of road infrastructure and bridges can be achieved.

From **logistics operations perspective**, the one-time movement of units provides further benefits through a significant reduction of transport security, as well as time savings related to unloading/loading time per transport at PL/LT border.

Enhanced rail capabilities also enable **swift mobilization and demobilization of heavy forces**, especially in the face of potential adversarial activities. This ensures a dynamic and responsive military strategy, enabling forces to be swiftly moved to counter provocations and equally rapidly repositioned once tensions de-escalate (Biernikowicz, 2021).

Further, the **enhanced rail network is expected to strengthen the military industrial ecosystem** across the region. With better connectivity, there will be a marked improvement in the efficiency of equipment production and maintenance facilities. The strategic positioning of these centers along RB Phase 1 will also enable rapid response capabilities, crucial in times of defense and security needs.

While the prospects seem promising, effective utilization of RB for military purposes demands **intricate collaboration with national and allied military institutions**. Ensuring seamless coordination of cross-border operations and understanding shared objectives is pivotal in maximizing the potential of RB Phase 1 for military logistics.

---

[112] Based on information from NFIU LV and LT, EE MoD

15.6 Improved Global Supply Chain Integration

The following chapter outlines the supply chain impacts of Rail Baltica, reflecting its potential to **support the integration of the Baltic region into the European and global supply chains**. Positioned in a strategic location between Asia, Europe and the Baltic Sea, Rail Baltica Phase 1 can accelerate the flow of goods between international markets, fostering economic development, and aligning with a broader regional growth strategy. In this context, while indirect supply chain implications are not part of core CBA calculations, **it is recommended to Rail Baltica's impact** during funding allocation discussions.

Supply chain benefits are analyzed along three key dimensions focusing on the integration in the European TEN-T network and the Baltic-Adriatic corridor, as well as the capacity contribution to the Asia-EU land corridor. Additionally, supply chain flexibility improvement in the context of the ongoing conflict in Ukraine, and fast commerce shipping opportunities are analyzed to provide a comprehensive overview of supply chain impacts.

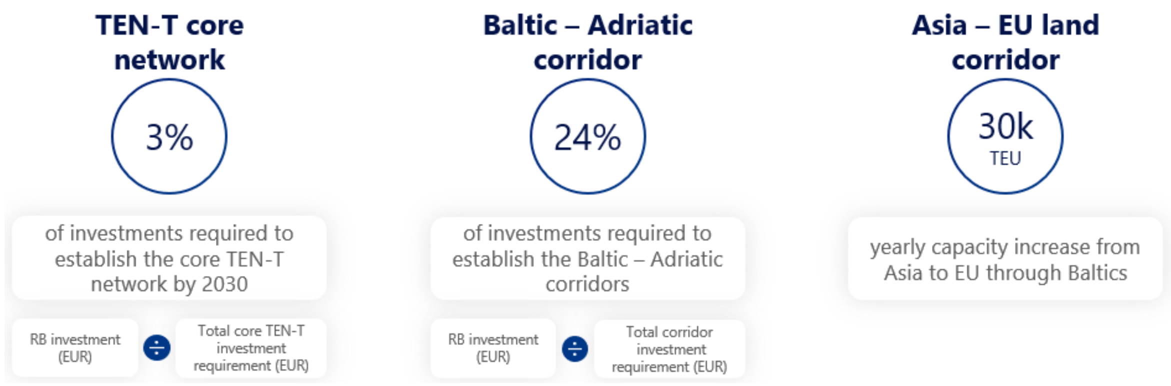


Figure 217: Supply chain chapter overview

15.6.1 TEN-T Core Network and Baltic-Adriatic Corridor

Regarding economic impacts, the **connection to the top priority corridors of the TEN-T network of RB Phase 1** is a key advantage. Representing 3% of the required investments to develop the whole TEN-T core network by 2030, and 24% of the Baltic – Adriatic corridor[113], the successful operationalization of RB Phase 1 could lift the benefits of completing other corridor segments across the North Sea – Baltic and Baltic – Adriatic corridors and incentivize further investments.

15.6.2 Asia – EU Land Corridor

Regarding the **Asia – EU land corridor**, the improved transport capacity offers an opportunity to handle additional 30,000 TEUs[114] through the northern flank of the China – Europe route, with the potential to attract foreign investment and widen access to an array of goods and services. This, however, is contingent upon the economic

[113] Calculating with a CAPEX value of EUR 17 bn for Rail Baltica, EUR 550 bn for the total completion of the core TEN-T network by 2030 (German Federal Ministry for Digital and Transport, 2023), and EUR 71.66 bn for the Baltic – Adriatic corridor (Jensen, 2020)

[114] Source: consultant expert analysis

and technical feasibility of transit between the 1520 mm and 1435 mm networks in combination with current alternatives.

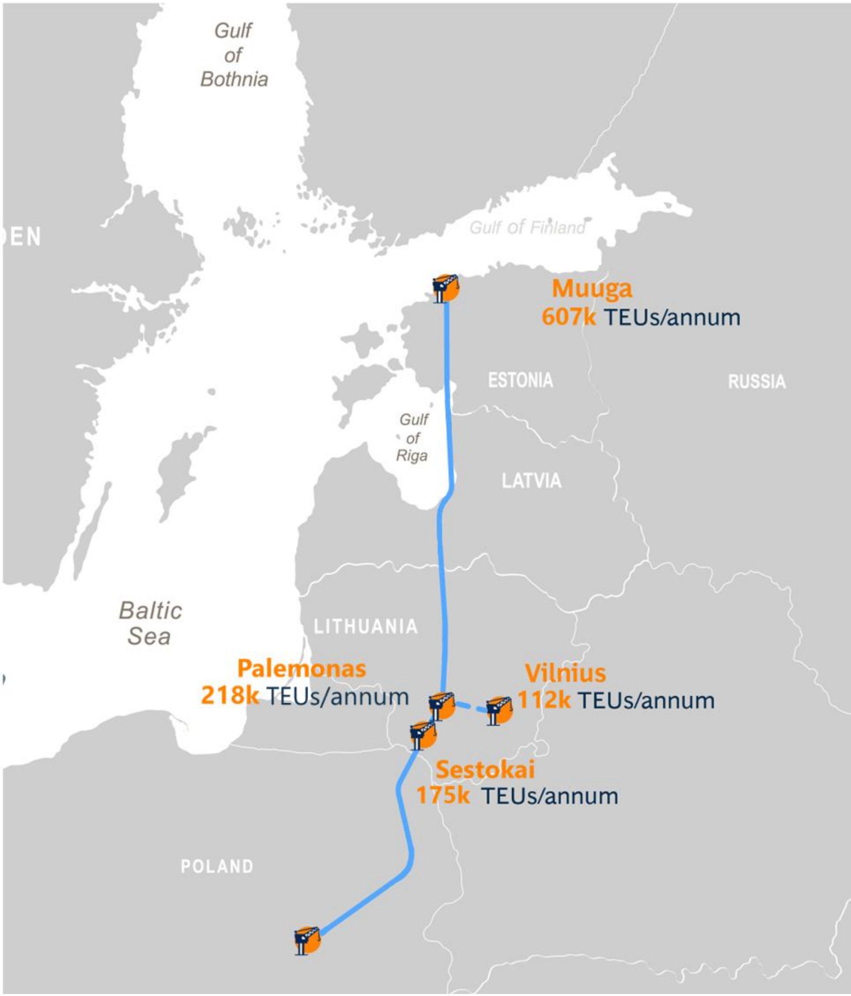


Figure 218: Map of transshipping terminals in the Baltic region (Vilnius connected via 1520 mm line)

15.6.3 Economic Rehabilitation of Ukraine

Moreover, the RB Phase 1 corridor could play an important role in **restoring trade to and from Ukraine and Eastern Europe**. Its additional capacity could inject vitality into trade streams in regions affected by the Ukrainian conflict. Should the conflict persist, RB Phase 1 would serve as a conduit for Ukraine to retain access to Baltic ports.

The post-war infrastructural reconstruction of Ukraine will pose significant challenges, especially given that transport **infrastructure density**, such as roads, waterways, and airports in Ukraine **is in general much lower compared to other EU countries, except for railways** (Kosse, 2023). This suggests that the heavy materials required for the reconstruction will be primarily moved on rail to and from Ukraine. The chart below summarizes the infrastructure density among Eastern European countries by analyzing four main modes of transport, namely railways, roads, waterways and passenger airports.

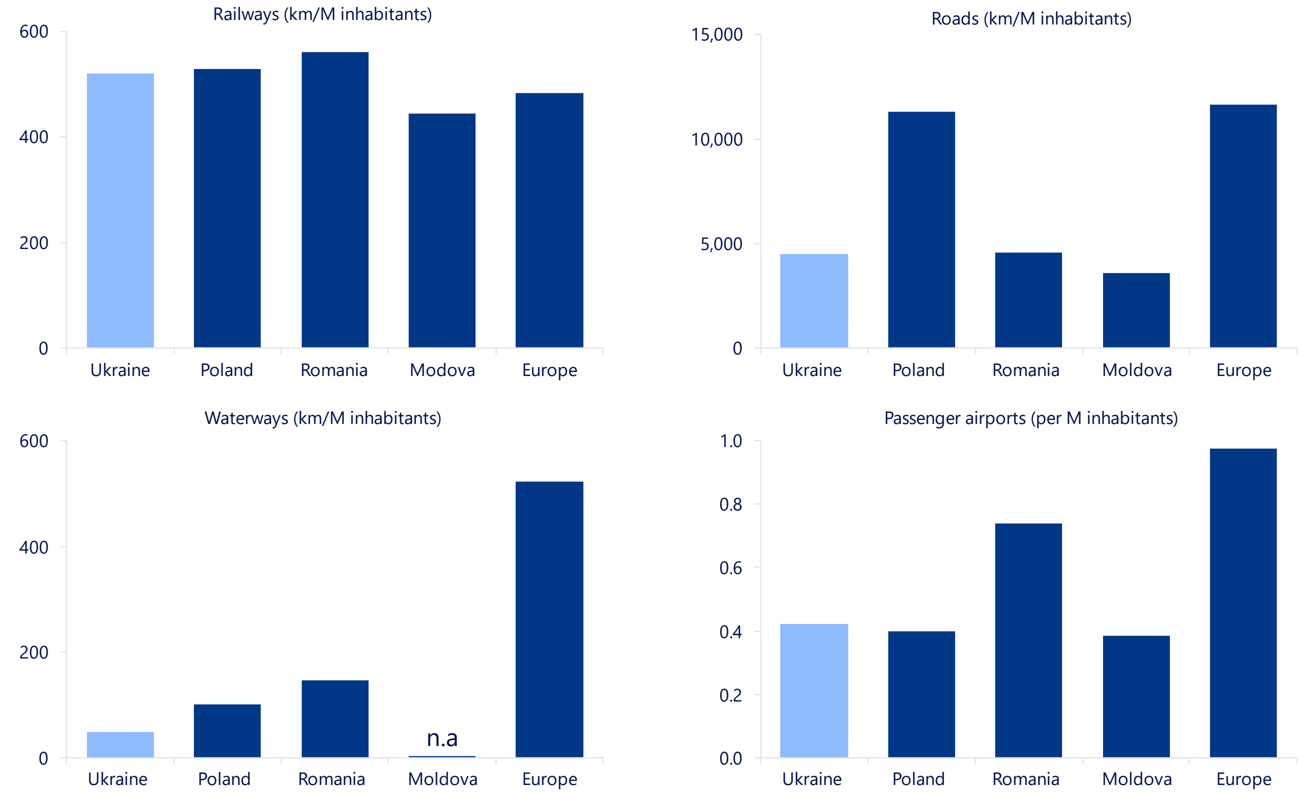


Figure 219: Infrastructure density among Eastern European countries.[115]

In this context, should traditional shipping routes stay blocked, **Rail Baltica Phase 1 has the potential to increase the efficiency of rail transport from Ukraine**, contributing to the security of global supply chains of grain in particular. The logistical issue to switch from Soviet era-wide gauge to European standard 1435 mm gauge will remain, however, the modern Rail Baltica infrastructure has the potential to transport more freight than the current Eastern European rail network and reduce the cost and time spent associated with changing twice between rail gauges (Reuters, 2023). Currently, grain arriving from Ukraine requires two gauge changes, one in Poland and one in Latvia, with the latter potentially to be avoided on the Rail Baltica line.

Within the economic framework of **the e-commerce sector**, the infrastructure provided by Rail Baltica Phase 1 presents an opportunity for enhanced logistical efficiency. The integration of the swift and reliable transit capabilities of Rail Baltica Phase 1 can enable businesses to optimize warehousing locations, streamline supply chain processes, and expedite customs clearances, potentially reducing operational costs and improving the time-value proposition of goods in transit.

The foundation of this analysis rests on a couple of **pivotal assumptions**. Realization of assessed benefits requires that subsequent network developments will support long-term freight transit through the Baltic region. This encompasses enhancements in areas like the TEN-T network segments, border amenities, and intermodal

[115] Source: WorldData.info

terminals. In particular, existing challenges in bridging the transit between the 1520 mm and 1435 mm networks could limit the realization of potential advantages.

15.7 Improved Social Equity

The following chapter focuses on the social implications of Rail Baltica Phase 1 as its regional services aim to **advance social equity by providing sustainable and affordable transportation**, especially for communities currently lacking adequate public transport options.

Promoting social equity is central to Rail Baltica's strategic objectives. Therefore, **for funding applications, it is recommended to include the impact the project could have on dismantling social barriers**. To underscore this recommendation, the European Pillar of Social Rights lists transport (alongside water, energy, sanitation, financial services, and digital communication) among the essential services to which everyone should have access and highlights the necessity to support people in need in accessing them.

Considering this aspect, the **social equality impact of Rail Baltica Phase 1 is considered beyond the Economic CBA framework across several dimensions**. To comprehensively analyze the social implications this chapter focuses on affordability, accessibility for reduced mobility passengers, social closeness and equal opportunities, wellbeing and environmental equality, as well as safety and security.

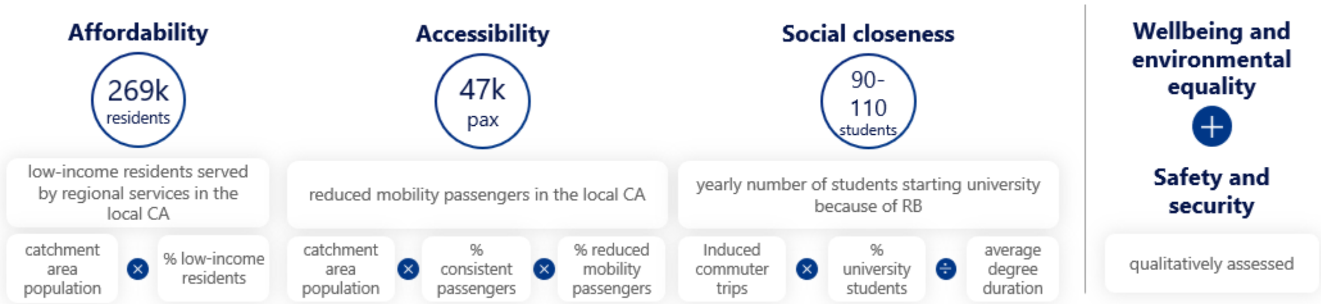


Figure 220: Social equity chapter overview

15.7.1 Affordability

Affordability plays a **crucial role in gauging socio-economic impact**, particularly when it comes to essential services like transportation. Public transportation is a lifeline for numerous low-income households and individuals who can't afford personal vehicles. However, the prohibitive costs associated with public transit can tie communities to their immediate localities, primarily those within walking or cycling distance (Goodman, 2013) depending also on weather conditions.

This mobility constraint hinders access to a wider range of employment opportunities, thus leading to a vicious cycle: reduced income means fewer job opportunities and vice versa. This cycle is often described as the "geographic poverty trap" and **infrastructure investments are proven to be a way out** (Bird, 2019). Moreover, this constraint can also limit access to social and recreational activities, further diminishing the overall quality of life.

Rail Baltica Phase 1 can address this link between low income and limited mobility, potentially improving employment opportunities. Regional services of RB Phase 1 could become the preferred solution for approximately 268,570 low-income residents, which is equivalent to 27% of the Baltic's population living in relative poverty, by presenting an economical commuting option. [116]

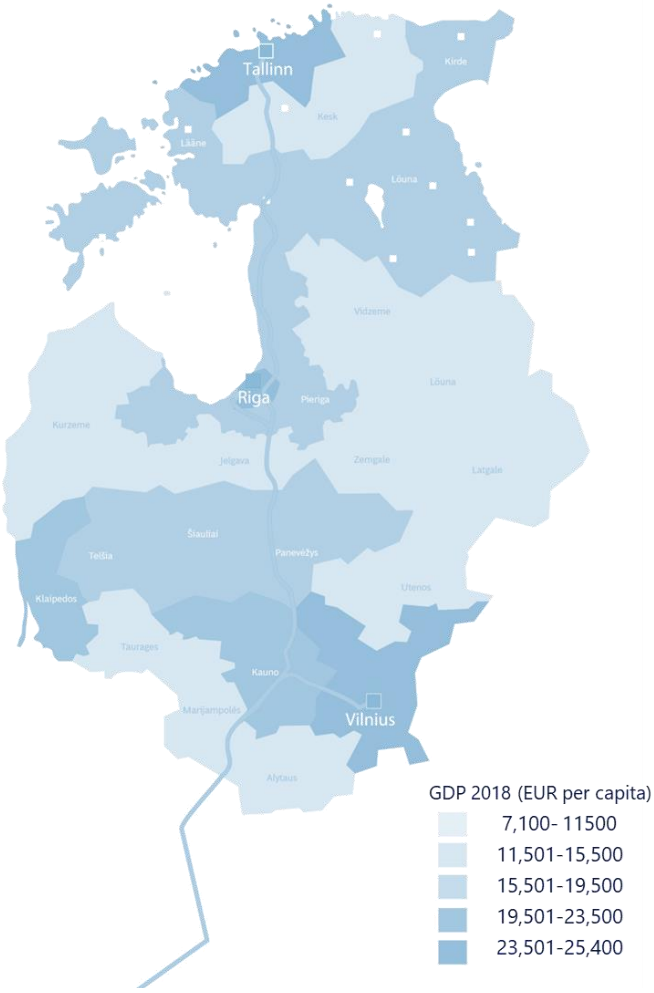


Figure 221: Baltics GDP per capita[117]

The **number of impacted residents is derived** by analyzing the population in the catchment area of Rail Baltica Phase 1 considering the Local level factoring in the share of the population living in relative poverty. In cities with regional stations and a population greater than 25,000, the entire city's population is included within the core

---

[116] Relative income poverty refers to the share of people with household disposable income below 50% of the national median. Relative income poverty indexes are available at:
For Estonia: https://www.oecd.org/estonia/Better-Life-Initiative-country-note-Estonia.pdf
For Latvia: https://www.oecd.org/latvia/Better-Life-Initiative-country-note-Latvia.pdf
For Lithuania: https://www.oecd.org/lithuania/Better-Life-Initiative-country-note-Lithuania.pdf

[117] Source: Rail Baltica

catchment area. For smaller cities, populations within a 4.8-kilometer radius of the station are considered.[118] The detailed specification of catchment areas is provided in the assumptions chapter above.

The **utility of advanced transportation infrastructure extends beyond the immediate benefits** of convenience. In an economic framework, Rail Baltica Phase 1 functions as a critical intervention to address locational disadvantages (Kate Bird, 2010). By offering a cost-effective transportation alternative, it facilitates better access to a diverse range of economic opportunities, spanning employment, education, and healthcare sectors. This enhanced mobility has the potential to mitigate the challenges posed by geographic poverty traps, fostering broader socio-economic development and integration.

15.7.2 Accessibility for Reduced Mobility Passengers

Promoting accessibility and ensuring the well-being of reduced mobility passengers are **fundamental objectives in the development of equal public transportation**. Accessibility for passengers with reduced mobility (RMP) in the Baltic region's current rail services leaves much to be desired. For instance, most Latvian trains lack efficient wheelchair accessibility due to their high-floor design[119], with the recent delivery of 32 new Skoda EMUs serving as an important step towards low-floor services.

Additionally, while Rīga main station is theoretically wheelchair accessible, interviews with individuals with reduced mobility reveal that it remains challenging to navigate independently (Rozenberga, 2018). [120] Boarding trains poses another challenge, as the majority of rolling stock in Lithuania and Latvia lack low-floor boarding options.[121]

In contrast, the Baltic capitals already offer wheelchair accessibility in most non-rail public transportation modes, including buses and trams (Wheelchair Accessible Public Transportation in Tallinn, Estonia, n.d.). This **existing accessibility infrastructure enables reduced mobility passengers** to fully leverage the advantages of accessible trains, allowing them to achieve mobility without the need for private automobiles. Further, Rail Baltica's capacity to enhance the train commuting experience for reduced mobility passengers in these cities may see a notable uptick if it succeeds in reducing travel times or introducing supplementary benefits.

To support the reduced mobility passenger segment, **Rail Baltica is committed to providing accessible rolling stock and stations,** in line with EU mandatory interoperability requirements set out in the TSI related to reduced mobility passengers (European Union, 2019). This move is expected to greatly benefit the reduced mobility passenger's community, especially given that alternative transportation modes are often either disproportionately expensive or unavailable due to accessibility constraints. Rail Baltica Phase 1 's accessible rolling stock and stations are expected to offer independent transportation options for over 47,000 reduced mobility residents, constituting approximately 9% of the total reduced mobility passenger population (Social Insurance Board of Estonia, 2022; European Commission, 2021b; National Audit Office of Lithuania, 2020).

---

[118] Assumption: The population residing within a 4.8-kilometer radius can conveniently reach the station by other means of public transport, car, bicycle, or even on foot.

[119] Consultant team analysis on Latvian rolling stock portfolio

[120] Note: the cited article is from 2018. However, the Rīga station has not been updated since then.

[121] Consultant team analysis of rolling stock operated in Baltic countries

Reduced mobility population with access to services is estimated based on the population within the catchment area of Rail Baltica Phase 1 and each country's reduced mobility index. The catchment area's calculation method is detailed in this chapter's *Affordability* section. While the general population within the catchment area can access Rail Baltica Phase 1 stations in various ways, reduced mobility individuals mainly rely on accessible public transport. It's estimated that 30% of these individuals will consistently use RB Phase 1 stations.

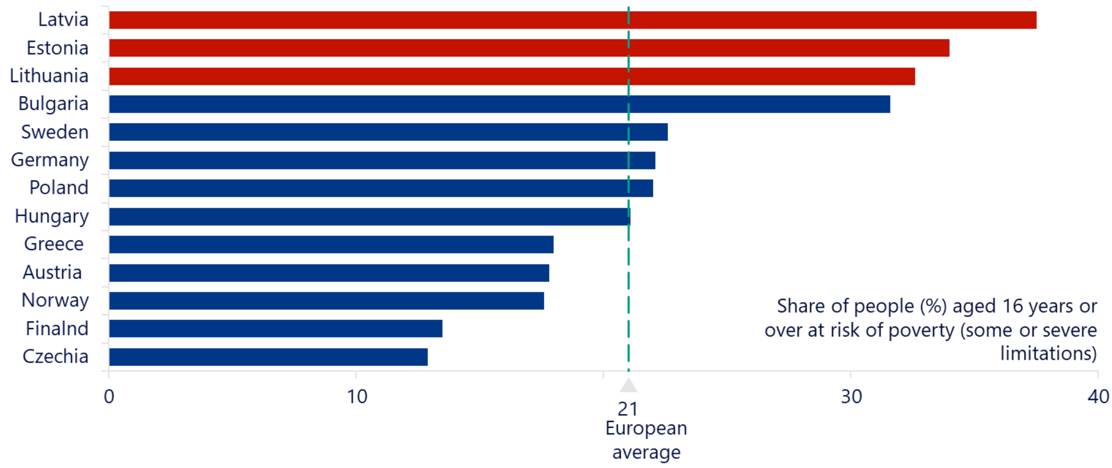


Figure 222: At-risk-of-poverty ratio of reduced mobility passengers for European countries

Furthermore, it is crucial to note that there is a **significant overlap between reduced mobility and low-income populations**, according to the "at risk of poverty or social exclusion" indicator from the European Statistical Agency (2022). This indicator measures various factors, including the percentage of people at risk of poverty, and it is evident that all Baltic countries exhibit rates well above the EU average (see figure above). This is particularly applicable for individuals facing some or severe limitations.

While this indicator encompasses factors beyond mobility, it is worth highlighting that the efforts to improve individual mobility of Rail Baltica Phase 1 can have a disproportionately positive impact in regions facing greater challenges, as opposed to areas where conditions are already favorable.

15.7.3 Social Cohesion and Equal Opportunity

Accessible rail systems play a pivotal role in reducing inequality by promoting **equitable access to education and enhancing employment opportunities**. Rail Baltica Phase 1 will enable students from diverse socio-economic backgrounds, including those in rural areas, to easily reach educational institutions, narrowing educational disparities and contributing to a more educated workforce. The impact on education is estimated to result in 90 to 110 more students starting university every year because of RB Phase 1 (Rail Baltica TDM, 2024).

While education and job accessibility are assessed in the Economic CBA from the perspective of direct transport users, the induced benefits of this impact go beyond individual level. According to Graham (2019), by connecting underserved areas to job centers, rail development creates new employment opportunities. Blanquart (2017) further confirms the additional societal benefits derived from connecting agglomerations and underserved areas to densely populated neighborhoods, leading to a reduction of income inequalities and **fostering a more stable and harmonious society** where wealth and resources are distributed more equitably.

Further, Rail Baltica Phase 1 is anticipated to **facilitate social interactions** by making it easier for individuals to visit friends and family across different regions. This connectivity strengthens social bonds and cultural exchange, fostering a sense of belonging and shared identity. Furthermore, it reduces social isolation, particularly among vulnerable populations like the elderly or those with limited mobility, leading to more inclusive and tightly knit communities.

15.7.4 Wellbeing and Environmental Equality

Beyond the individual health accessibility benefits already captured in the Economic CBA, rail developments, such as Rail Baltica Phase 1, **present indirect advantages to marginalized communities**. Key benefits include health improvement due to transition to eco-friendly transport modes and its impact on air quality, decreased stress levels from vehicle accidents, the mental wellness advantages stemming from decreased urban congestion and noise, and the promotion of active lifestyles through increased use of public transport.

Rail development typically results in a shift towards more sustainable transportation modes, in previously car-oriented neighborhoods. Electric trains, for instance, produce fewer greenhouse gas emissions than private vehicles, leading to improved air quality. Cleaner air **reduces exposure to pollutants, a key driver of respiratory health within impacted communities**. Moreover, the decrease in noise pollution and traffic congestion contributes to reduced stress levels, enhancing mental well-being and overall health.

With fewer vehicles on the road, Rail Baltica Phase 1 is expected to lead to a notable reduction in traffic accidents. This not only saves lives but also **lowers the physical and emotional toll associated with accidents.** Fewer accidents result in reduced strain on emergency healthcare services and less trauma within the community, further promoting overall well-being.

The introduction of efficient rail systems **reduces the stress associated with unpredictable and lengthy commutes**. As constant urban and road noise can directly lead to adverse symptoms such as anxiety, stress, fatigue, headache, as well as sleep disturbances (Jing Ma, 2018), residents experiencing quieter streets with less congestion due to Rail Baltica Phase 1 would likely experience lower stress levels. This reduction in stress not only fosters better mental health but also contributes to a sense of well-being and community cohesion.

Increased utilization of public transportation will **encourage physical activity**. Residents may choose to walk or bike to and from train stations, promoting an active lifestyle. This not only leads to improved physical health but also reduces the risk of chronic diseases, enhancing overall well-being.

15.7.5 Safety and Security

Rail Baltica Phase 1, as a transformative infrastructure project, promises to **address multiple urban challenges**, notably enhancing commuter safety, promoting community engagement in public spaces, and elevating women's safety in urban contexts.

Historically underserved communities may face safety concerns, especially during nighttime or in poorly lit areas. Well-lit and meticulously maintained stations are at the heart of the design of Rail Baltica Phase 1. Coupled with the presence of security personnel and surveillance systems, these measures are set to instill a heightened sense of safety among commuters.

Further, the development will **connect communities to safe shared public spaces** such as parks, recreational areas, and cultural venues. This connectivity encourages residents to access and enjoy these spaces, contributing to their overall well-being and psychological safety. Safer public spaces promote community cohesion and reduce social isolation.

Drawing parallels from studies focusing on the **impact of metro stations on women's feeling of safety** (Pogonyi, 2019) it's anticipated that Rail Baltica Phase 1 will significantly enhance safety for women. Infrastructure projects that spur increased pedestrian activity have an inherent crime-deterring effect; a notion supported by Twinam (2017) through the "eyes on the street" concept.

A persisting challenge **is the necessity to improve "last mile" connectivity in marginalized communities.** Addressing this issue holds the potential to unlock a wide array of benefits, including enhanced job access, improved healthcare, and greater educational opportunities.

15.8 Environmental sustainability

Rail Baltica Phase 1 is expected to play a key role in supporting energy security and accelerating the transition to renewable energy sources, in alignment with the European Union's goal to reach net zero by 2050. This strategic shift, aligning with the objective **of replacing fossil fuels with renewables of Rail Baltica Phase 1**, promises to reduce external energy dependencies, **stimulate investment** in renewable technologies, align with sustainability objectives and **limit the number of short-haul flights** in the region. The following chapter quantifies the impact on the environment of RB Phase 1 by analyzing both the emissions replaced via its service and the induced investment it generates in the region.

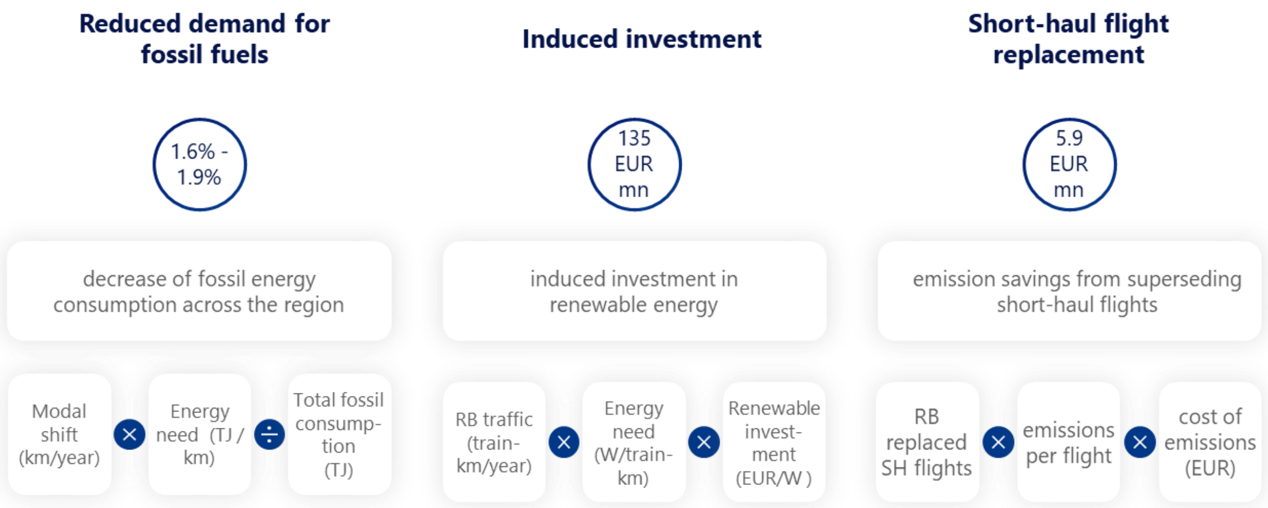


Figure 223: Environmental sustainability chapter overview

15.8.1 Reduced Demand for Fossil Fuels

The commitment of RB Phase 1 to renewable-generated power supply would enable the **reduction of demand for fossil fuels in the transport ecosystem of the Baltics**. The three countries, on average, consumed 305 577 TJ of energy from fossil sources between 2010 and 2021, primarily imported from third countries[122]. By reducing this dependency through a modal shift from combustion engine vehicles, RB Phase 1 would contribute to energy independence, a key target of the European Union, ultimately enhancing energy security within the region. Fossil fuel consumption is estimated to decrease between 1.6% and 1.9% compared to the historical average

[122]Consultant team analysis based on (World Energy Statistics and Balances, 2020a)) for Estonia, (2020c) for Latvia and (2020b) for Lithuania.

consumption observed between 2010 and 2021. To realize these benefits, the analysis assumes that a reduction in energy demand would lead to diminished fossil fuel consumption.

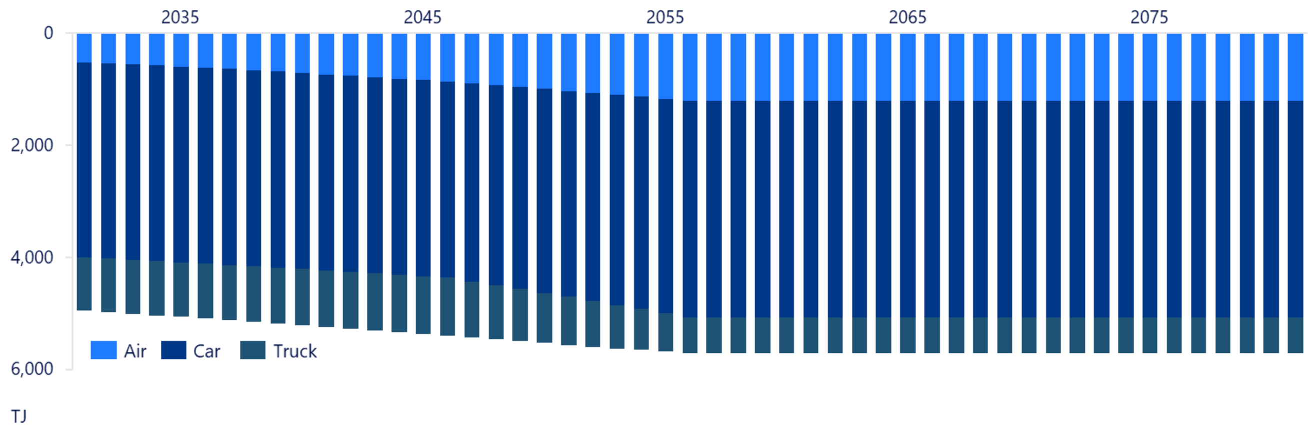


Figure 224: Annual projected fossil fuel consumption savings from modal shift to rail

15.8.2 Induced Investment in Renewables

The commitment of Rail Baltica Phase 1 to being exclusively powered by renewable energy sources is expected to **stimulate local investments in renewable technologies.** This not only aligns with environmental objectives but also sets the stage for increased utilization of renewables in the energy mix, ensuring a more sustainable and secure energy future. As Rail Baltica Phase 1 will be entirely powered by renewable energy sources, consuming an estimated 144 k MWh energy annually[123], an induced investment in renewable energy generation is anticipated in the region.

Because of its considerable untapped potential, offshore wind energy is assumed to be the main future source of renewable energy for RB Phase 1. This is further supported by the Baltic Declaration for offshore Wind Energy, a signed declaration from Poland, Germany, Denmark, Sweden, Finland, Estonia, Latvia, Lithuania and the EU (Baltic Declaration for Offshore Wind Energy, 2022). Using the average capacity factor[124] of offshore wind installations, which stood at 48.87% between 2010 and 2018 (Anna Sobotka, 2019), the required installed capacity is estimated at 33.7 MW.

Based on information available for the 12 largest operating wind power plants in the North Sea, the cost per MW of offshore wind power capacity installation is assumed to be EUR 4 mn (ESFC Investment Group). The increased

---

[123] Consultant team analysis. Applying linear proportion of train-km and energy consumption based on the 2018 operational plan, RB estimates to use EUR 11.5 mn worth of energy. On the average projected industrial market price between 2030 and 2050, converting to approximately 144 k MWh, assumed to be covered by offshore wind power. Considering the capacity factor of offshore wind, an estimated 33.7 MW additional installed capacity is required to meet this annual demand. (Anna Sobotka, 2019). Assuming EUR 4 mn per MW investment necessary (ESFC Investment Group), an estimated EUR 135.1 mn is achieved.

[124] The capacity factor is a measure of a power plant's actual output over a period of time, expressed as a percentage of its potential output if it were operating at full capacity continuously.

demand for renewables may therefore contribute, among other factors, to an **estimated induced investment for offshore wind energy** of EUR 135.1 mn for the Rail Baltica project.

The drive of Rail Baltica Phase 1 towards **achieving a net-zero transport ecosystem by 2050** holds economic significance. By helping the renewable energy sector reach economies of scale, it promotes an economically sustainable shift towards renewable power in transportation, further enhancing the region's energy security. Furthermore, achieving cost efficiencies through economies of scale has shown to foster innovation and thus lead to growth (Stern, 2021).

15.8.3 Short-Haul Flight Replacement

Rail Baltica Phase 1 has the potential to make the Baltic region a **global leader in reducing short-haul flights** along its High-Speed Rail network. Through flight number limitations or bans as per in the case of France, this initiative is expected to yield emission **savings valued at EUR 5.9 mn annually**, considering a full replacement of flights feasible where train services below 2.5 hrs travel time are offered. Further, the reduction of intra-Baltic flights would also benefit air carriers given the negative profitability of short-haul feeder flights replaced by Rail Baltica Phase 1.[125]

Route	Annual flights	Emissions saved (EUR)
RIX - TLL	3,016	5,867,930

Figure 225: Impacted air O/Ds, yearly flights, and emission savings[126]

It is important to note that indirect and induced impacts, although not classified as direct project benefits in the ECBA, include the potential implications on energy independence. Given the complex geopolitical and economic context of the development, it is strongly **recommended that funding applications consider energy security as a key and integral benefit**, acknowledging its significance within the broader scope of the transformative impact of RB Phase 1.

[125] Source: airline expert analysis

[126] Calculation based considering Airbus A220 capacity and 80% average utilization rate. The emissions saved consider both GHG emissions and noise pollution.

15.9 Corridor Synergies

This chapter details the corridor synergies Rail Baltica (RB) is positioned to **unlock corridor through "Dig once" benefits**. This strategy enables the deployment of innovative technologies along its lines, offering services that might not be financially viable as standalone business units. The key synergetic corridor projects RB Phase 1 can benefit from include telecommunications and digital infrastructure, as well as local transport connections.[127]

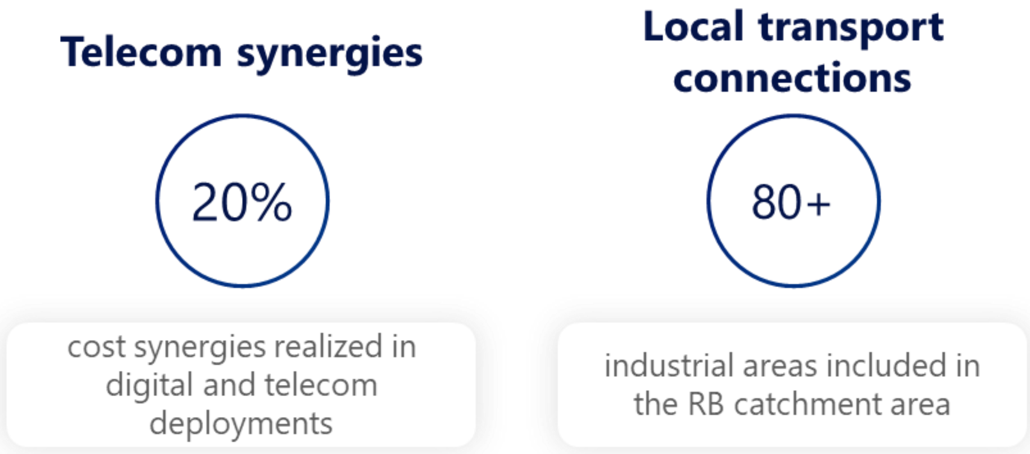


Figure 226: Corridor synergies chapter overview

15.9.1 Telecom Synergies

Several **crucial assumptions** underpin this strategy. Firstly, it assumes the technical and financial feasibility of deploying energy, telecommunications, and transport systems in tandem. Successful implementation also relies on investments and efficient collaboration from system providers. Additionally, the analysis acknowledges the potential for maintenance costs to increase over the long term, contingent on the lifecycle of adjacent systems.

The involvement of Rail Baltica Phase 1 in setting conditions for service providers to **access dark fiber optic and 5G mobile infrastructure** marks a pivotal development. It extends beyond mere transportation, potentially revitalizing rural and regional areas within the European Union. This initiative would foster cross-border telecommunications infrastructure development, strengthening the interconnectedness and performance of European fiber optic networks. In doing so, it would elevate service quality, ensuring that the benefits of enhanced telecommunications extend to a wider audience. **Digital and telecom deployments have the potential to realize 20% cost reduction, due to synergies** with the development of Rail Baltica Phase 1 corridor, making its construction financially feasible (Christina Biedny, 2021).

15.9.2 Local Transport Connections

RB's emphasis on improving **local transport connections** is supported by the construction of regional railway branches. These branches are designed to facilitate accessibility for industrial, defense, and logistics areas, encouraging further investment in synergistic transport infrastructure. This would enable a further shift away from road transport thus benefiting RB Phase 1 with increased rail freight traffic. The catchment area identified for RB

---

[127] Source: Rail Baltica Corridor Synergies Study

Phase 1 encompasses **over 80 industrial areas** of the Baltic region with a direct overlap with the main urban centers. By fostering improved connectivity, RB aims to catalyze economic development and regional growth.

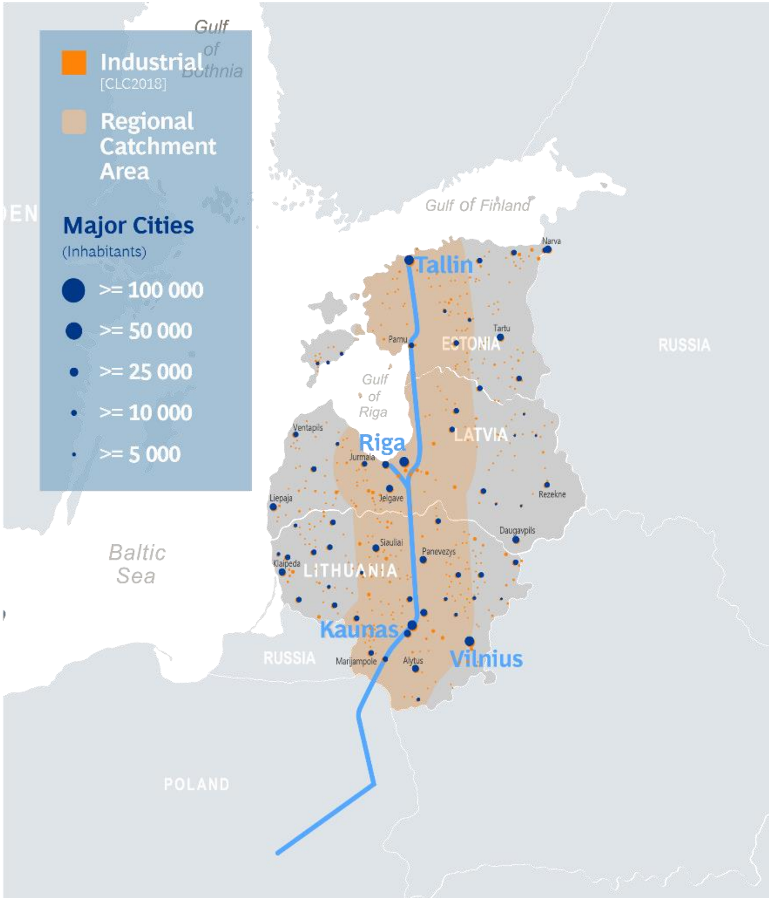


Figure 227: Location of industrial areas in proximity of the RB Phase 1 network[128]

However, the **primary challenge lies in efficiently collaborating** with energy, telecom, and transport providers to streamline the construction of adjacent infrastructure, ensuring that the "Dig once" strategy realizes its full potential. In summary, RB's potential transcends traditional transportation infrastructure, offering substantial synergies and economic benefits through strategic deployments. Recognizing these benefits and efficient collaboration with system providers are key to fully realizing the transformative potential of the "Dig once" strategy within the project.

In the context of **funding applications**, it's important to recognize that while indirect and induced impacts are typically not considered direct benefits in the CBA, the substantial size of RB Phase 1 and potential synergies with adjacent systems warrant a more comprehensive evaluation, as the realization of otherwise unfunded public projects will provide true socio-economic benefits.

[128] Consultant team elaboration on Rail Baltica Global Project Corridor Synergies Study (2021)

15.10 WEI Conclusions and Recommendations

This wider economic analysis estimates the forecasted **indirect and induced socio-economic benefits in addition to the ENPV**, extending the standard CBA framework proposed by EU guidelines to capture context-specific benefits in a more comprehensive manner.

In this context, the analysis underscores the significance of **impacts beyond the direct users of the infrastructure across several dimensions**. In particular, the analysis focuses on quantifiable economic advantages, including stimulation of GDP growth, alongside qualitative enhancements such as increased access for traditionally marginalized communities. Additionally, Rail Baltica Phase 1 holds significant consequences for military logistics and supply chain efficiency in the Baltic region, as well as corridor synergies and environmental sustainability.

Rail Baltica Phase 1 is expected to boost GDP of the Baltic region by 0.5-0.7% in additional yearly growth, or EUR 16.5-23.0 bn in the operational phase until 2105, composed of direct, indirect and indirect impact components. This increase is partially captured by the ECBA (direct impacts with an influence on GDP amount for EUR 2.5 bn), with EUR 14.0-20.5 bn additional GDP growth realized through indirect and induced effects.

Rail Baltica Phase 1 could **significantly impact the military mobility strategy of the Baltic states** by enhancing capacity and integrating with the 1435 mm gauge network. Designed for dual-use, both civilian and military, the infrastructure of Rail Baltica Phase 1 and rolling stock are equipped to meet military transport needs. Specifically, its capacity to facilitate the transport of military units, coupled with the reduction in loading and unloading durations in cross-border operations, positions Rail Baltica Phase 1 as a critical asset in military logistics, in both peacetime operations and potential armed conflicts.

Rail Baltica Phase 1 is expected to **streamline integration into global supply chains**, enhancing the movement of goods, fostering economic growth, and aligning with EU transport objectives. It represents a significant investment in the TEN-T network, notably contributing to the Baltic-Adriatic and Baltic-North Sea corridors. This expansion is anticipated to boost freight capacity along the Asia-EU land corridor, attracting foreign investment and broadening access to goods and services. The project also plays a critical role in supporting trade flows affected by the Ukraine conflict, particularly addressing transport bottlenecks and Polish logistical constraints. Additionally, Rail Baltica can support Ukraine's reconstruction efforts, especially given the country's reliance on rail infrastructure. The introduction of more reliable and expedited transport services is expected to benefit e-commerce sectors by enabling faster delivery options.

Rail Baltica Phase 1 is set to **enhance social equity by improving transportation access** for marginalized groups. Regional services are projected to benefit around 268,570 low-income individuals, offering them affordable options for commuting and personal travel. Furthermore, approximately 47,000 passengers with reduced mobility, who currently face barriers in accessing public transport, are expected to gain from high-quality rail services. The improved accessibility to educational institutions provided by Rail Baltica Phase 1 could enable an additional estimated 90-110 students to pursue university studies each year.

The project also promises environmental and safety benefits for communities currently reliant on cars, through reduced pollution and accidents. In addition, Rail Baltica Phase 1 is likely to bolster women's safety during travel, fostering their social inclusion and participation in the workforce, as evidenced by studies on metro systems.

From an energy perspective, Rail Baltica is anticipated to **bolster energy security in the Baltic states** by encouraging a shift from fossil fuels to renewables in transportation. This shift is expected to cut fossil fuel consumption between 1.6% to 1.9% and stimulate a EUR 135.1 mn investment in renewable energy, driven by the railway's reliance on green energy. Additionally, by offering an alternative to short-haul flights, Rail Baltica Phase

1 could yield EUR 5.9 mn in emission savings, contributing to the Baltics' goal of achieving net-zero emissions in transport by 2050.

Finally, Rail Baltica Phase 1 is poised to catalyze **corridor synergies, leveraging "Dig once" benefits** through the integration of innovative technologies along its route. This approach could unlock up to 20% in deployment cost savings by providing shared infrastructure for services like dark fiber optic and 5G mobile networks. Furthermore, the project is expected to trigger investments in adjacent transport infrastructure, enhancing both cost and revenue synergies.

Ultimately, the assessment finds that wider economic impacts are key benefits of infrastructure projects, especially in regions with moderate economic performance which is also the case with RB. The results imply that even in the case of a project with net positive direct economic and financial impact, a more comprehensive assessment of costs and benefits can provide a more detailed understanding of its true societal impact. In this context, **the study recommends the consideration of wider economic impacts in funding application processes** to account for context-specific benefits of infrastructure investments.

16 Appendix

16.1 Risk Mapping

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
General	Regulatory	1	Changes in legislation and regulatory requirements	1	3	Low	The establishment of legal monitoring for legislative and other regulatory changes is advised. A transparent change-management process is suggested, where implications of potential changes are fully assessed and considered by governing bodies before acceptance. This approach aims to ensure that all regulatory alterations are constantly evaluated to maintain compliance and project stability. Ministries, being end shareholders, to be also considered in mitigation.
General	Operational	2	Challenges in procurement documentation for the construction	3	4	High	Development of a clear and comprehensive procurement guideline, involvement of legal experts, and strict documentation standards to minimize procurement-related challenges.
General	Operational	3	RB ICT system vulnerability	2	5	High	Implementation of a comprehensive cybersecurity framework to safeguard against potential ICT system vulnerabilities. Conducting regular vulnerability assessments and penetration testing to identify and rectify security weaknesses. Establishment of a robust patch management process to ensure timely updates and mitigations against known vulnerabilities. Adoption of multi-factor authentication and encryption technologies to enhance system security. Engagement with cybersecurity experts to ensure continuous monitoring and swift response to any security incidents. Development of a cybersecurity awareness training program to educate staff on best practices and the latest threats. Establishment of incident response and disaster recovery plans to ensure resilience and rapid recovery in the event of a security breach.

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
General	Operational	4	Suboptimal project management and communication	3	3	Moderate	Project management team with clear responsibilities. Establishment of a project management software to ensure effective oversight and communication throughout the project. Implementation of a clear communication strategy detailing channels, frequency, and responsibilities to ensure accurate and timely information exchange among project teams and stakeholders. Establishment of regular project update meetings and reporting mechanisms to keep all parties informed and engaged. Adoption of collaborative tools and platforms to facilitate seamless communication and document sharing. Training on effective communication skills and conflict resolution to foster a positive communication culture. Engagement with communication experts to assess and improve the existing communication processes.
General	Operational	5	Health and Safety (H&S) standard not implemented on time and at sufficient quality	1	5	Low	Implementation of a detailed Health and Safety (H&S) plan outlining the standards, timelines, and responsibilities to ensure on-time delivery with requisite quality. Engagement of H&S experts for guidance and assessment of the H&S plan and its implementation. Establishment of a robust monitoring and evaluation system to track and ensure adherence to H&S standards and timelines. Conducting regular H&S training and awareness sessions to foster a culture of safety and quality among the project team and contractors.
General	Financial	6	Lack of funding leading to delays or stoppages (from non-EU sources)	4	4	Very High	To address high funding risk, it is necessary to plan in advance and prepare funding estimations for the entire length of the project. The strategic spending approach should be tailored by the project team based on these estimations, with options to adjust non-critical path spending to

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
							meet forecasted expectations. In case of potential funding reduction, align delivery strategy and spending plans with funding authorities to allow for discrete, affordable delivery stages, ensuring continued progress and value delivery.
General	Financial	7	Inflation and economic instability	4	2	Moderate	An analysis of economic conditions and the inclusion of inflation contingencies in the project budget are suggested to buffer against economic instability impacts. This analysis could extend to other investment programs under the same governance body and, where feasible, coordination with other relevant governing bodies may be beneficial to navigate artificial supply chain rate inflation due to constrained supply scenarios. In cases where demand exceeds supply, a coordinated market strategy among governing bodies may be advisable to optimize or expand market capacity.
General	Financial	8	Allocation of financial responsibilities and benefits among project partners	2	1	Low	Open and upfront communication. Clear resource allocation agreement (contract and international laws) and regular review of allocations.
General	Financial	9	Interest rates	2	3	Moderate	Monitor interest rate trends and incorporation of interest rate sensitivity analysis into financial planning. Frontload funding agreements and consider hedging.
General	Financial	10	Reduced EU funding	3	5	Very High	Engagement in continuous dialogue with EU authorities to secure commitments and explore alternative financing options to compensate for any potential reductions in EU funding.
General	Financial	11	Ukraine's reconstruction could divert infrastructure funds from RB,	3	3	Moderate	Develop a comprehensive financing strategy that factors in potential risks and alternative funding sources, given the chance of fund diversion.

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
			potentially reducing the available financing for RB projects				Additionally, consider lobbying for extra funding due to proximity to Russia.
General	Strategic	12	Organization and Governance – Lack of organization and governance with sufficient autonomy, transparency, and/or efficiency in decision making	4	4	Very High	A clear organizational and decision-making structure with defined responsibilities is advised to be in operation. The organizational design should evolve to reflect the project's progression, recognizing that leadership themes and scaling may transition across different organizational segments as the project progresses. This adaptive organizational approach aims to ensure alignment with the project's evolving demands and stages.
General	Strategic	13	Unclear Operational Vision	3	3	Moderate	Early discussions concerning the operating set-up are advised. These discussions and related decisions should aim to clarify operating principles, operations, and maintenance regimes, sufficiently to inform whole life cost optimization by managing trade-offs between capital expenditures (CAPEX) and operational expenditures (OPEX).
General	Strategic	14	Information security not synchronized among project parties	3	4	High	Implementation of a unified Information Security (InfoSec) framework for all project parties. Establishment of a centralized information security management system to ensure synchronization and compliance. Conducting regular information security alignment meetings with all project parties. Utilization of secure and standardized communication and data sharing platforms. Development of a collaborative incident response plan to address any information security breaches promptly.
General	Strategic	15	Changes to the project scope	3	4	High	Implementation of a change control process with defined approval protocols

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
							(and boards) to evaluate and manage any proposed changes to the project scope, ensuring alignment with project objectives.
General	Strategic	16	No clear emergency and crisis management plan	2	3	Moderate	Development of a comprehensive emergency and crisis management plan outlining protocols and responsibilities. Conducting regular training and simulation exercises for readiness. Establishment of a dedicated emergency response team. Utilization of emergency notification systems for timely communication. Periodic review and updating of the emergency and crisis management plan. Ensuring availability of necessary resources and equipment for effective response.
General	Strategic	17	Lack of document management and control	3	4	High	Implementation of a robust document management and control system to ensure accuracy and timeliness of information. Clarifying responsible and chain of related decision makers with an escalation route. Utilization of document management software to automate version control, ensuring that all project parties access the most current documents. Establishment of clear guidelines for document review, update, and approval to maintain document relevance and accuracy. Conducting regular training to ensure adherence to document management protocols. Periodic audits to identify and rectify outdated information. Establishing a notification mechanism to alert relevant parties of document updates, ensuring everyone stays informed of the latest information.
General	Strategic	18	Environmental concerns of the society	1	2	Low	Further comprehensive environmental impact assessments are advised, along with engagement with relevant stakeholders to address and mitigate environmental issues. It is essential to ensure that any environmental-related project requirements are identified and integrated into the project scope. This

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
							integration allows for effective tracking and allocation for design and implementation through either i) project team action or ii) inclusion in the supply chain contractor scope of work, facilitating a structured approach to environmental compliance and management throughout the project.
General	Strategic	19	Inconsistent quality and non-compliant process across RB	4	5	Very High	Implementation of a standardized quality management system (QMS) across RB to ensure consistent quality and compliant processes. Hiring of quality management professional(s). Establishment of clear quality and compliance standards, guidelines, and protocols to be followed by all project parties. Conducting regular quality audits and process assessments to identify and rectify inconsistencies and noncompliance. Utilization of quality management software to automate quality control processes, ensuring real-time monitoring and compliance. Training and awareness programs to educate all project parties on the importance of adhering to quality and compliance standards. Establishment of a corrective action process to address any identified quality or compliance issues promptly.
General	Strategic	20	Delayed decision making	4	4	Very High	Establishment of an optimized and well-functioning organizational structure including a group of key decision-makers, clear decision-making protocols, assignment of clear responsibilities for key decisions, and definition of deadlines. Implementation of a group with final negotiating and decision-making power.
General	Strategic	21	Stakeholder satisfaction issues	3	2	Moderate	Open and transparent communication with stakeholders, complemented by active stakeholder management and regular feedback, is advised. Additionally, the development of a stakeholder management plan is recommended, capturing the concerns

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
							and materiality of each stakeholder. The plan should outline the management approach through e.g., a RASCI-type (Responsible, Accountable, Supporting, Consulted, Informed) consultation, ensuring transparency, provision of information, and decision-making input.
General	Strategic	22	Lack of knowledge management during fluctuations of workforce	3	3	Moderate	Documentation of project knowledge and briefing of new leadership according to the project scope.
General	Political	23	Changes of political environment (local)	2	3	Moderate	Development of a political risk management strategy to monitor and respond to local political changes. Maintenance of open communication channels with local political stakeholders to address concerns, foster support, and ensure a collaborative approach towards project objectives amidst political changes.
General	Geopolitical	24	Geopolitical conflicts in the region causing disruptions e.g., Russian/EU tension impacting the project.	2	4	Moderate	Close monitoring of the situation and preparation of actions if required.
General	Geopolitical	25	Geopolitical conflicts in the region affecting the railway's and construction teams safety and stability	1	3	Low	Implementation of a comprehensive security plan to protect construction teams amidst potential geopolitical conflicts. Establishment of a security coordination center related to H&S to monitor geopolitical developments. Conducting regular security briefings and training for construction teams. Coordination with local law enforcement and security agencies for enhanced security measures. Development of an evacuation and emergency response plan for prompt action on security incidents. Utilization of secure transportation and housing

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
							arrangements for construction teams. Regular review and updating of the security plan to reflect changing geopolitical dynamics.
General	Geopolitical	26	Changes in regional alliances and geopolitical dynamics affecting project cooperation	1	3	Low	Establishment of a diversified network of partners and stakeholders to reduce dependency on any single regional alliance. Maintaining open communication channels with all project stakeholders to address concerns and build trust amidst changing geopolitical landscapes. Fostering strong relationships with key stakeholders and regional entities to ensure continued support and cooperation for the project, regardless of geopolitical shifts.
General	Geopolitical	27	Changes in regional alliances and geopolitical dynamics affecting operational cooperation	1	4	Low	Regular assessment of geopolitical developments.
Design	Regulatory	28	Regulatory compliance differences between the countries	3	4	High	A comprehensive regulatory analysis is suggested, with engagement from relevant authorities across all three Baltic countries to ensure project compliance. An alignment exercise among the three governing bodies and adherence to International Railway Construction Standards could contribute to normalizing a consistent end-to-end standards specification for RB, except in instances where unique demands necessitate variances or concessions. Establish a tri-country corridor team to recommend legislative changes, harmonize policies, and initiate lobbying as necessary.
Design	Regulatory	29	Delays in obtaining necessary permits and approvals	4	2	Moderate	Early initiation of the permitting process and maintaining open communication with authorities is advised to expedite approvals. Setting up dependency roadmaps and contingency plans could

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
							also be beneficial for potential delays. Early engagement with regulatory bodies and transparency in development progress are also recommended to foster an environment for timely approvals and to address any potential challenges promptly.
Design	Regulatory	30	Compliance challenges with evolving environmental and sustainability regulations	2	2	Low	Implementation of environmental management systems and their regular update following changing regulations; collaboration with environmental agencies.
Design	Regulatory	31	Rail design guidelines are of poor quality	1	4	Low	Independent review to validate and potentially enhance the design guidelines, ensuring they meet industry standards and best practices.
Design	Operational	32	Differences in local operating standards and practices	4	2	Moderate	Establishment of a cross-functional committee with the necessary authority delegated to address differences in operating standards. Development of a harmonized set of operating standards and practices for consistency across the project. Engagement with operational experts for standardization. Conducting regular training to ensure adherence to harmonized standards. Implementation of a monitoring and audit system to rectify deviations. Facilitation of open communication for continuous improvement of operating standards. Maintenance of a repository for easy and mandatory access and reference to the agreed-upon standards and practices.
Design	Operational	33	Land acquisition issues and delays	2	3	Moderate	Early initiation of land acquisition processes, engagement with local authorities and communities, setup of clear escalation routes, and the establishment of contingency plans are advised to address potential land acquisition issues and delays. This should encompass understanding legislative requirements to permit i) an efficient purchasing or procurement

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
							process for each parcel of land, and ii) a basis for land pricing that aims to avoid cost escalation or market inflation when the acquisition process starts.
Design	Technical	34	Unforeseen geological and environmental challenges and soil conditions	1	3	Low	Conducting geological and environmental assessments, implementation of appropriate engineering solutions and mitigate challenges related to the project's location and environment.
Design	Technical	35	Delays due to technical difficulties or design changes	4	3	High	Conducting regular technical assessments, creating dependency roadmaps, collecting alternative operational partners, engaging prospective 'Plan B' partners now for quicker involvement if issues arise later, relationship building and streamlining the change management process to minimize delays caused by technical difficulties or design changes.
Constructio n	Regulatory	36	Regulatory compliance differences between the countries	3	3	Moderate	A comprehensive regulatory analysis is suggested, with engagement from relevant authorities across all three Baltic countries to ensure project compliance. An alignment exercise among the three governing bodies and adherence to International Railway Construction Standards could contribute to normalizing a consistent end-to-end standards specification for RB, except in instances where unique demands necessitate variances or concessions.
Constructio n	Regulatory	37	Delays in obtaining necessary permits and approvals	2	2	Low	Early initiation of the permitting process and maintaining open communication with authorities is advised to expedite approvals. Contingency plans for potential delays could be beneficial. Early engagement with regulatory bodies and transparency in development progress are also suggested to foster an environment for timely approvals and to address any potential challenges promptly.

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
Construction	Regulatory	38	Necessary construction permits not obtained	1	2	Low	Initiation of the permitting process in advance, open communication with regulatory bodies.
Construction	Regulatory	39	Changes in regulations or standards during the project	1	2	Low	Establishing legal monitoring for legislative and other regulatory changes. Set-up of a transparent change-management process, where implications of potential changes are fully assessed and considered by governing bodies before acceptance, is suggested.
Construction	Regulatory	40	Import/export restrictions/disruptions	3	4	High	Monitoring of trade regulations, establishment of alternative supply sources.
Construction	Operational	41	Security of infrastructure	2	5	High	Implementation of a robust security strategy encompassing physical measures such as fencing, lighting, and surveillance systems. Engagement with local law enforcement and community stakeholders for a collaborative approach to infrastructure security. Establishment of a rapid response and repair protocol to address incidents of theft or vandalism promptly. Employment of security personnel and conduction of regular security audits to enhance infrastructure protection and minimize associated risks throughout the project lifecycle. Creation of comprehensive handbook for IBs and subcontractors to lower risks. Identifying leaders responsible for security management, and related decision-making hierarchies and escalation routes.
Construction	Operational	42	Rejection of transition from construction to operational phase	2	4	Moderate	Communication with approval bodies and setting of clear deadlines for necessary approvals. Implementation of a tracking system for monitoring of construction tasks.
Construction	Operational	43	Delays of transition from	2	4	Moderate	Communication with approval bodies and setting of clear deadlines for

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
			construction to operational phase				necessary approvals. Implementation of a tracking system for monitoring of construction tasks.
Construction	Operational	44	Disruptions due to unforeseen weather conditions or natural disasters	1	4	Low	Development of a comprehensive disaster response plan, and implementing of weather monitoring systems to minimize disruptions.
Construction	Operational	45	Insufficient contractor capacities throughout the project	3	5	Very High	Implementation of a rigorous contractor selection and evaluation process to ensure chosen contractors have the necessary capacities and resources. Establishment of clear contract terms and SLAs outlining performance expectations, timelines, and capacity requirements. Conducting regular contractor performance reviews to identify and address capacity issues early. Development of a contingency plan to manage potential contractor capacity shortfalls, including identifying alternative contractors or additional resources. Engagement with contractors to encourage capacity building and continuous improvement. Utilization of a centralized project management system to monitor contractor performance and capacity in real time.
Construction	Operational	46	Safety incidents leading to legal liabilities and reputation damage	2	4	Moderate	Establishment of safety protocols, regular safety trainings, and a robust incident reporting and response system to prevent safety incidents and minimize legal liabilities.
Construction	Operational	47	Construction delay	5	4	Very High	To mitigate construction delays in RB, key strategies include robust planning with realistic timelines and buffers, comprehensive risk assessment, effective contractor management, and rigorous progress monitoring. Continuous communication with stakeholders and well-developed contingency plans for known risks are essential. Flexibility in resource allocation is also crucial to adapt to changing needs and avoid bottlenecks,

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
							collectively enhancing project resilience and ensuring efficient completion. Finally, maintaining an effective governance structure, activist project management and delivery rhythm with clear decision-making allocation, escalation routes and authority delegated for coordination are important for keeping the delivery roadmap.
Construction	Financial	48	Significant cost overruns and budget deviations during construction	3	4	High	Implementation of stringent cost monitoring and project management controls, complemented by regular budget reviews, is advised. Additionally, active risk management is suggested to maintain continuous scanning of potential threats and to identify risk management actions in response to such risks. It is also advised to implement key response strategies (avoidance, management, ignoring, or mitigation). Establish a dedicated oversight team with decision-making authority.
Construction	Financial	49	Underestimated testing costs	1	1	Low	A comprehensive estimation of testing cost, accounting for potential contingencies, unforeseen complexities, and regulatory requirements, is advised to prevent underestimation of testing cost. Additionally, defining a Testing and Commissioning Strategy from the start is recommended. Planning this from the start ensures a proper understanding of the full scope of work, making time and cost plans more representative and potentially reducing risks associated with testing and commissioning.
Construction	Financial	50	Poor or late delivery from contractors	4	3	High	Implementation of strict contractor performance and quality monitoring, enforcement of clear contract terms and deadlines. Setup of early warning systems and management controlling.

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
Constructio n	Strategic	51	Misalignment of construction milestones	2	3	Moderate	Development of a detailed project schedule with well-defined milestones, interdependencies, regular progress reviews, and establishment of clear communication channels to ensure alignment of construction milestones among all project stakeholders. Potentially utilizing a dynamic project management software allowing for e.g., dynamic interdependencies and decisions tracking.
Constructio n	Strategic	52	Construction site interface risk	3	5	Very High	Implementation of a detailed site interface management plan to coordinate between different contractors and project teams. Establishment of clear guidelines for site access, communication, and coordination. Utilization of a centralized coordination platform. Conducting regular coordination meetings to address interface issues. Development of a risk assessment and mitigation strategy for potential interface risks. Engagement with construction management experts for guidance on site interface management. Implementation of a feedback mechanism to capture lessons learned and improve site interface management practices.
Constructio n	Technical	53	Design flaws and engineering errors	1	4	Low	Implementation of design reviews, engagement with experts, and the establishment of a quality assurance program are advised to identify and rectify design flaws and engineering errors early in the project. Additionally, the engineering governance process should encompass cross-disciplinary design reviews at key intervals to ensure alignment across each engineering stream as well as conformance with requirements, deliverability, constructability, and value for money objectives.

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
Construction	Technical	54	Archeological findings	3	2	Moderate	Strategic planning early on to discern the potential impacts on the critical path is advised, which may lead to considering earlier implementation of certain activities.
Construction	Technical	55	Unforeseen geological and environmental challenges and soil conditions	2	4	Moderate	Conduction of thorough geological and environmental surveys, employment of experienced geotechnical experts, and preparation of contingency plans in place to address unforeseen challenges.
Construction	Technical	56	Defects found during testing	2	1	Low	The implementation of a comprehensive quality control and inspection program during construction is advised. An overarching Technical and Quality Assurance Framework is suggested, defining the approval and certification process for each element of the project delivered scope, ensuring compliance with project requirements and standards.
Operation	Regulatory	57	Change of operation regulations and safety standards	2	2	Low	Close monitoring of evolving regulations and standards and implementation of regular safety audits.
Operation	Regulatory	58	Legal issues from changes in cross-border taxation or tariffs	2	3	Moderate	Close monitoring of legislative changes, and proactive adjustment of financial strategies and contracts to address any legal issues arising from changes in cross-border taxation or tariffs. Establish a cross-border team with decision-making power.
Operation	Operational	59	Issues with maintenance (provider)	2	3	Moderate	Implementation of stringent maintenance service level agreements, regular evaluation of provider performance.
Operation	Operational	60	Inadequate workforce training and skill gaps	3	2	Moderate	Establishment of workforce training programs, conduction of regular skills assessments, and hiring skilled workers to address and bridge skill gaps.
Operation	Operational	61	Potential accidents	2	4	Moderate	Design of an environmental management plan outlining general

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
			involving hazardous goods transport on railway network				principles. Additionally, on a secondary level, precise guidelines and procedures should be established, creating a framework for both preventive measures and reactive strategies in case of an incident. Establishment of robust disaster management practices.
Operation	Operational	62	Shortage of labor	4	3	High	Establishment of a strategic labor contingency plan, including cross-training and workforce development, to address potential labor shortages. Advocacy and educational activities to secure future labor supply.
Operation	Operational	63	Coordination challenges among countries for maintenance	4	3	High	Implementation of cross-border management model standards and collaboration frameworks, and a maintenance coordination team with the necessary decision-making power, and the utilization of modern technology for real-time information sharing to address coordination challenges among countries.
Operation	Financial	64	Underestimated operating costs	2	3	Moderate	Comprehensive and ongoing cost assessments, establishment of financial reserves for unexpected expenses, and implementation of cost control measures to prevent underestimation of operating costs and maintain financial stability.
Operation	Financial	65	Lower OPEX coverage	2	3	Moderate	Optimization of operational efficiencies, exploration of cost-sharing partnerships (subsidies), and implementation of resource allocation adjustments.
Operation	Financial	66	Demand or supply shocks increasing the costs of renewable energy, insufficient supply of renewable energy	2	2	Low	Diversifying energy sources to include a mix of renewable options like solar, wind, hydro, geothermal, and biomass, thereby reducing dependency on any single source. Direct investment in renewable energy infrastructure could provide more control over energy supply and stabilize costs over the long term. Additionally, financial hedging strategies could also be used to guard against significant price swings.

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
							Moreover, adopting energy-efficient technologies and practices would lower overall energy consumption, offering a buffer against supply shocks. Collaborating with governments and regulatory bodies could foster a supportive environment for renewable energy stability and growth. Finally, while aiming for 100% renewable energy, RB should also develop a strategy for flexible energy sourcing. This includes having agreements or plans in place to source energy from alternative (non-renewable) sources in case of shortfalls in renewable energy availability.
Operation	Strategic	67	Competition from other forms of transport	3	2	Moderate	Enhancing the rail system's value proposition by improving reliability, and connectivity, while also developing marketing strategies to promote its unique advantages and to attract passengers and freight shippers.
Operation	Strategic	68	Competition with existing railway network	1	3	Low	Differentiation of services through better value proposition, modernization, improved efficiency, and enhanced customer experience.
Operation	Strategic	69	Lack of interest from railway undertakings to operate	4	4	Very High	Offering of incentives or tailored agreements to attract RUs and foster competition within the railway system. Early market testing and incentive scheme development.
Operation	Strategic	70	Misalignment of long-term operational goals and strategies among countries	3	5	Very High	Establishment of shared long-term operational goals and strategies, and creating a governance framework to ensure consistent collaboration.
Operation	Strategic	71	Evolving market demands and customer preferences	3	4	High	Monitoring evolving market demands and customer preferences through market research and customer feedback mechanisms.
Operation	Technical	72	Capacity constraints of	2	4	Moderate	Earlier expansion to double track lines on the most congested routes.

Project's phase	Risk category	#	Risk description	Probability (1-5, low to high)	Potential impact (1-5, low to high)	Aggregate risk level	Potential mitigation methods
			the single-track network of RB Phase 1				Implementing real-time demand monitoring to adjust service levels dynamically. Increasing the capacity of rolling stock to accommodate more passengers.
Operation	Technical	73	Significant defects during operation, service disruptions due to accidents, natural disasters, or infrastructure failures	1	5	Low	Establishment of regular maintenance. Implementation of quick response teams to solve operational issues. Development of a disruption tracking system in addition to a robust disaster recovery and business continuity plan, investment in redundancy and backup systems, and execution of regular emergency response drills to minimize service disruptions.
Operation	Technical	74	Difficulty in sourcing spare parts and maintenance materials	2	4	Moderate	Establishment of a strategic spare parts inventory and forecasting, diversification of suppliers, and a network of reliable sources to ensure the availability of spare parts and maintenance materials.
Operation	Political	75	Political interference or lobbying from interest groups affecting project decisions	2	2	Low	Engagement with legal and political advisors to navigate political landscapes and ensuring compliance with all regulatory and ethical guidelines.
Operation	Geopolitical	76	Trade restrictions or embargoes affecting the flow of goods and services across borders	2	4	Moderate	Close monitoring of international geopolitics, trade policies and implementation of diversified supply chains and establishment of contingency plans.

16.2 Detailed Macroeconomic Overview

For easier readability of the main analysis, additional drivers behind trends like population decline, GDP growth and war in Ukraine are not mentioned in those sections. These key underlying drivers will be detailed in the following pages as per the following figure.

16.2.1 Population Decline in the Baltics

Demographic decline is primarily attributed to factors visible in figure below. The first graph in top-left shows that even though **fertility rate** is expected to rise in all three Baltic countries, it **will still be well below 2.1**, i.e., the value needed to ensure natural population growth. Second graph on the left shows that there will be no drastic changes in mortality and in 2080 all three Baltic countries will have a **mortality rate of approximately 21 deaths per 1000** people. Another contributing factor to population decline is a slight **negative net migration** which can be seen on the graph in bottom left. The allure of better living standards, higher wages, and broader career prospects in neighboring countries often entices the younger and working-age population from the Baltics to emigrate. The population decline is further intensified by the aging demographic. Graphs on the right in figure below confirm that all three Baltic countries will experience an increase in life expectancy over the next 60 years with **expected median age of 53 years in 2080**.

Figure 228: Data explaining population decline (UN, 2023)[129]

[129] Forecast from 2024 onwards.

16.2.2 GDP Growth

Charts presented in the figure below summarize important indicators of country's economic health including GDP PPP, foreign direct investment, public debt to GDP ratio and Gini index.

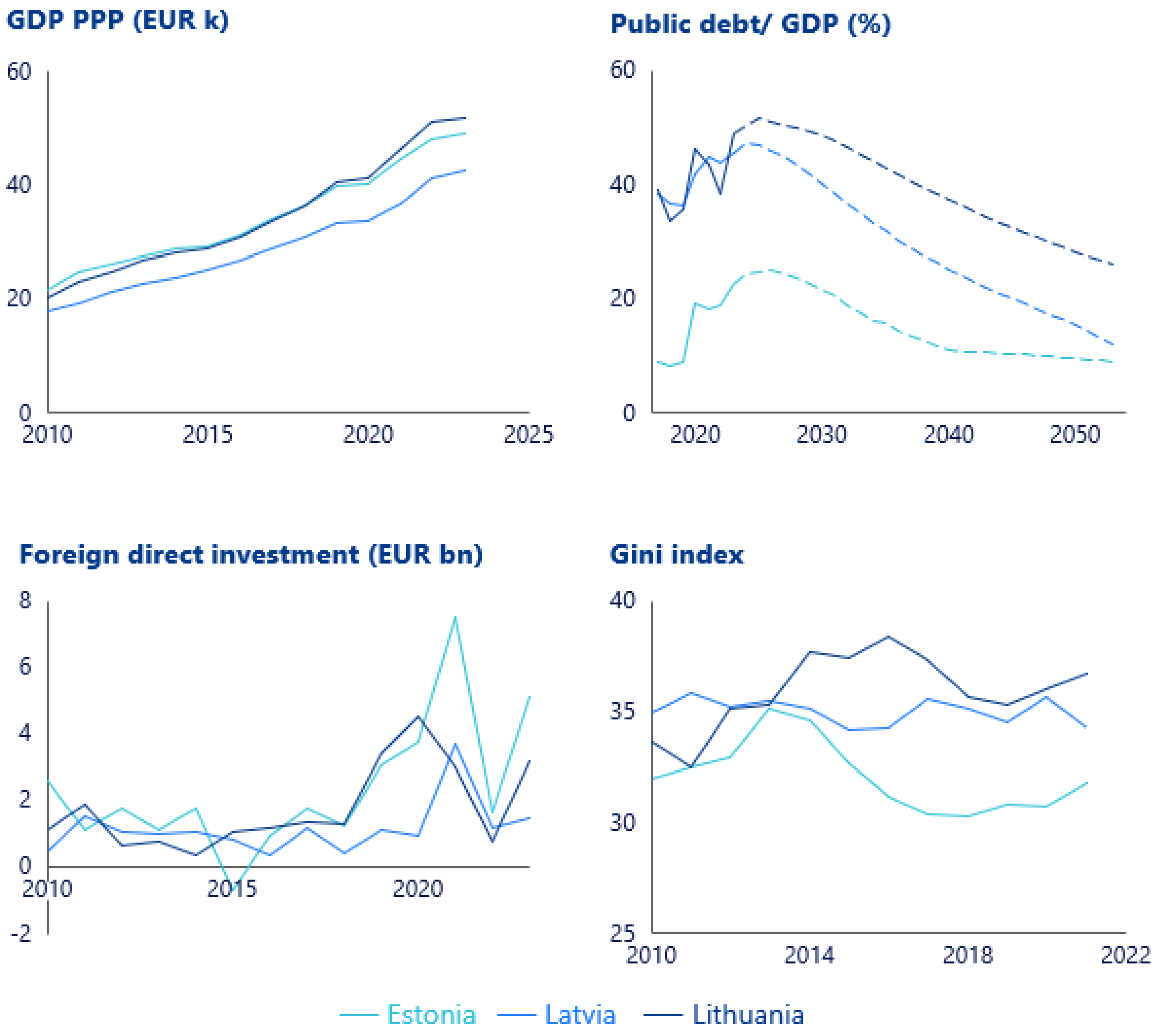


Figure 229: Economical landscape in the Baltics (World Bank, 2023; S&P Capital IQ, 2023b)[130]

GDP PPP is a measure of the total value of all final goods and services produced in a country each year, adjusted for the relative cost of living in that country. The first graph in the figure above shows that all three Baltic countries have had a significant increase in this metric since 2010 which means that the living standard has improved. From 2010 to 2023, **Estonia experienced a GDP PPP growth at a CAGR of 6.5%, Latvia 7% and Lithuania 7.6%**.

On the bottom left chart in the figure above it is visible that from **2010 to 2023**, **Estonia** has received a total of **$32.7 bn** of foreign direct investment at a **CAGR of 5.4%** which indicates that foreign investments are increasing. In the same period **Latvia** has received a total of **$16.3 bn** at a **CAGR of 9.3%** which indicates the foreign

[130] The data shown in figure is not available through S&P, thus World Bank data was used. World Bank data is assumed to be aligned to S&P as S&P's data on GDP for Estonia, Latvia and Lithuania was the same. Forecast from 2023 onwards.

investment is increasing at a high rate. Similar to Estonia, **Lithuania** has received a total of **$24.5 bn** at a **CAGR of 8.5%**.

All countries have a public **debt to GDP ratio below the Maastricht criteria** (60%) which is an indicator of good fiscal health. Despite the expected increase in the short term, all countries are expected to experience an even bigger decrease in this metric until 2053 (see figure above). Therefore, it comes as no surprise that **Estonia, Latvia, and Lithuania have credit ratings of A+, A and A** respectively.

Another important aspect of every economy is income inequality. Gini index in the figure above shows that from 2010 to 2021 **Estonia and Latvia** has seen a **decrease in income inequality**. On the other hand, in the same time frame **Lithuania** has seen a **slight increase** in inequality. All three Baltic states indicate a larger than EU average Gini index (29.6). Lithuania (36.7) being the largest, closely followed by Latvia (34.3) and Estonia (31.8).

Analyzing **lending interest rates** unveils that the region has a relatively high cost of borrowing, which may influence the funding of infrastructure projects and increase financing costs if it persists. One indicator potentially affecting funding is the **corporate borrowing rate**.

Due to the macro-economic environment, the **corporate borrowing rate** forecasted by the end of 2023 is higher for all countries compared to previous years. By the **end of 2023**, **Estonia's** corporate borrowing rate is estimated to reach **16.8%,** while **Latvia** and **Lithuania** are bound to have rates of **6.7%** and **6.1%** respectively. (Oxford Economics, 2023)

Historically, when analyzing the period between years **2016 and 2023**, the CAGR by which the corporate borrowing rate increased in Europe has been of **16.8%.** The European Central Bank's tighter monetary policy has elevated loan interest rates, causing them to rise uniformly across the Eurozone, now 2-3 percentage points higher than last year, with the aim of restricting generally high inflation. **Lithuania**'s corporate borrowing rate has a **CAGR** of **14.8%** (Oxford Economics, 2023)**, Estonia** of **30.5%** (Oxford Economics, 2023), and finally **Latvia** of **14.2%** (Oxford Economics, 2023). When comparing the Baltic region's CAGRs with the European average, it is noticed that Estonia exhibits a significantly higher growth rate that its counterparts. Previously, Estonian entities benefited from low rates through floating-rate loans tied to Euribor. However, the increased rates are swiftly impacting the cost of servicing earlier loans. While banks retain strong lending capacity, the economic outlook and higher risks have led to slight tightening in lending standards, marginally narrowing the pool of eligible borrowers (Eesti Pank, 2023).

However, the outlook for the future period between **2024 and 2029** is more positive, as all three Baltic countries are projected to have **negative borrowing rate CAGRs**. **Lithuania**'s CAGR is forecasted to be **-4.3%,** and **Lithuania**'s **-5%** (Oxford Economics, 2023), which is **in line with the average CAGR of -3%** estimated for the

European continent in the same period. Estonia may have a **negative CAGR** of **1.4%.** Both the historic outlook and the future forecast can be seen in the figure below.

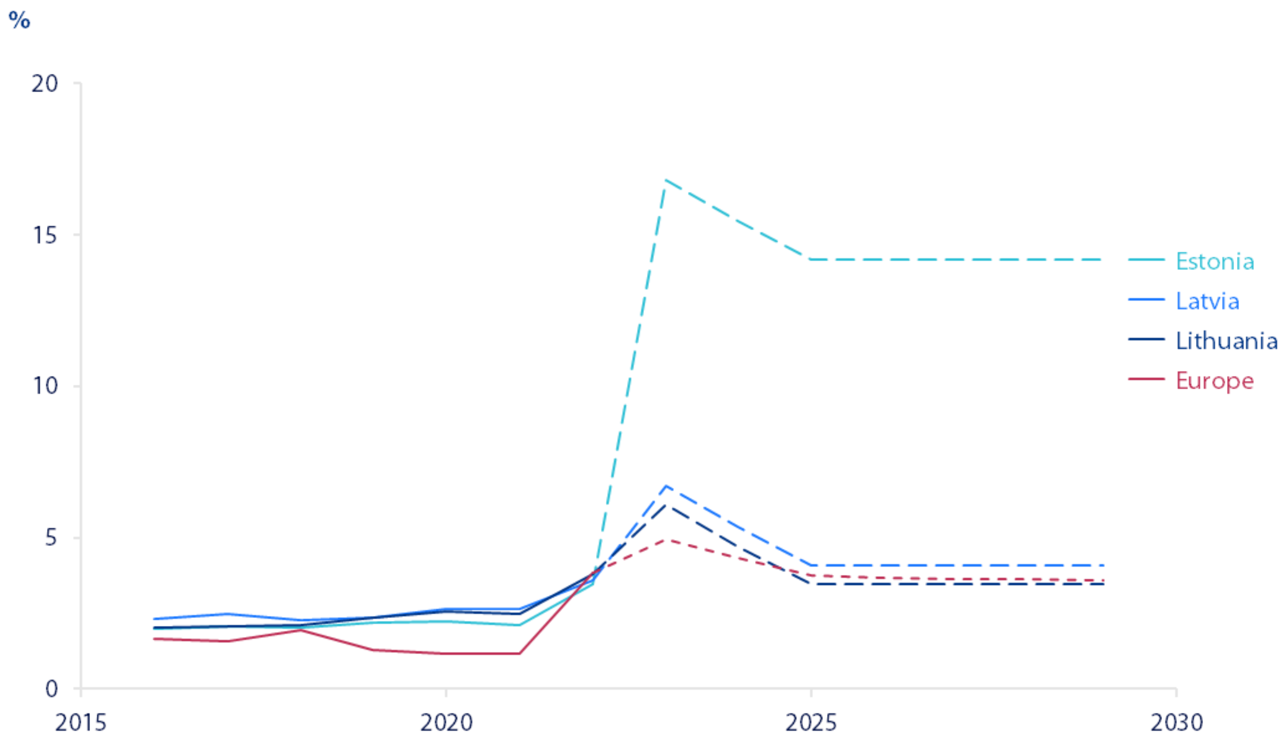


Figure 230: Corporate borrowing rate in Europe and the Baltic states (European Central Bank\Haver Analytics, 2022; Oxford Economics, 2022)[131]

16.2.3 Effects of the War in Ukraine

This section aims to provide an in-depth view about the effects that the war in Ukraine on the trade landscape in the Baltics. The effects discussed below are the emergence of **alternative trade routes**, the **disruptions associated with trade activities**, the **increasing electricity prices**, and, finally, the change of the **population and the labor market composition**.

Alternative Trade Routes

Alternative trade routes are emerging in adaptation to the war in Ukraine and trade sanctions imposed on Russia and Belarus. Global and Baltic economies are exploring new and rediscovering old ways to continue trade with East Asia. The **war in Ukraine disrupted overland trade paths**, specifically the Northern Corridor passing through Russian and Belarusian territories, thereby **revitalizing the Middle Corridor**. The sanctions imposed on Russia and Belarus have complicated cargo transportation between Europe and China through these nations, leading to a growing interest in the Middle Corridor. This initiative connects Turkey to China via a network spanning Georgia, Azerbaijan, the Caspian Sea, and multiple routes into Central Asia (see next figure).

---

[131] Forecast from 2023 onwards.

The **Middle Corridor witnessed a surge in cargo traffic and attracted investments from both European and Asian stakeholders**, resulting in significant cargo volume increase in early 2022 – approximately 3.2 mn tons of cargo were transported via this route, marking a substantial growth from the 350,000 tons recorded in 2020 (Foreign Policy Research Institute, 2023). This positive impact comes on top of the traffic increase fueled by the pandemic, when the shift in trade routes favored the shorter length of the Middle Corridor connecting the East and the West.

Recent **collaborative efforts by transit countries** to enhance infrastructure and coordination, coupled with the geopolitical ramifications of the Ukraine conflict, have further enhanced the appeal of the Middle Corridor. While the Middle Corridor is gaining traction, the growth in volumes has not entirely offset the decline in volumes on the Northern Corridor. This is partly attributable to the rising popularity of ocean routes, driven by decreasing ocean rates and the surge in China-Russia trade volumes following the sanctions.

However, the **European Union (EU) has become increasingly interested** in its use, driven by disruptions in global supply chains and the EU's need for alternative routes following Russia's invasion of Ukraine. The EU recognizes the significance of alternative routes connecting Asia and Europe and is open to investing in such projects. For example, the European Bank for Reconstruction and Development has announced plans to invest over USD 100 mn in Kazakhstan railways.

Overall, **the implications of the increasing popularity of the Middle Corridor and the decreasing popularity of the Northern Corridor for RB are mixed**. RB could lose some of its traffic related to the Middle Corridor, but it could also become more important as a transit route between Russia and Europe. The ultimate impact of these trends on RB will depend on a number of factors, including the future development of the Middle Corridor and the Northern Corridor. Moreover, RB could serve as a conduit for Ukraine to retain access to Baltic ports.

Additionally, in the event of a prolonged war in Ukraine, the development of infrastructure in the Baltic region, including RB, could become **crucial in expanding grain export capacity** as explained in earlier chapters**.** As traditional Black Sea routes face disruptions, the Baltic ports offer a viable alternative, especially as Polish ports approach full capacity. This shift would significantly enhance the Baltic region's role in maintaining critical global grain supply chains during geopolitical crises.

Trade Disruption

The second effect of the war in Ukraine are **trade disruptions**. Baltics have historically been the most exposed countries in Europe to the Russian economy (Fleck, 2022). The three Baltic states are among the 12 countries most exposed to Russian trade, Lithuania being the fourth and Estonia the sixth on the list below.

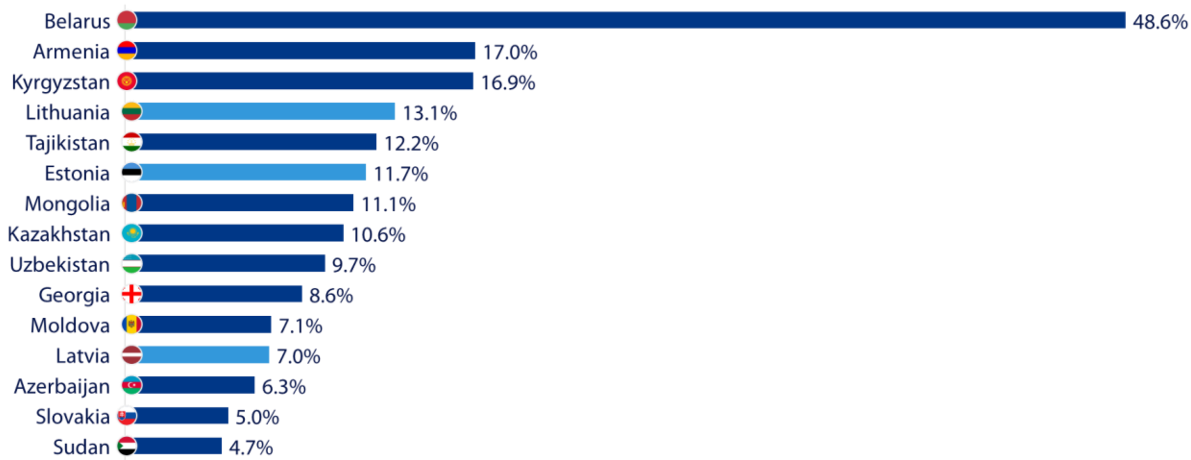


Figure 231: Countries where international trade with Russia equals the highest share of GDP in 2020 (Fleck, 2022)

Despite the tensions with Russia, the **region witnessed a 25% uptick in overall trade when comparing the period before the war** (from March 2021 to February 2022) **to the period after the onset of the war and the imposition of sanctions on Russia** (from March 2022 to February 2023). This indicates a resilient trade landscape in the region.

A close examination of recent and anticipated trade activities in Estonia, Latvia, and Lithuania helps to gauge the potential impact on the RB project. Assuming that the military conflict does not escalate further, current projections suggest that the disruptions caused by the war might not significantly hinder the project in the long run. This notion is supported by the trade forecast, which outlines the progression of trade from 2005 and estimates trends up until 2040.

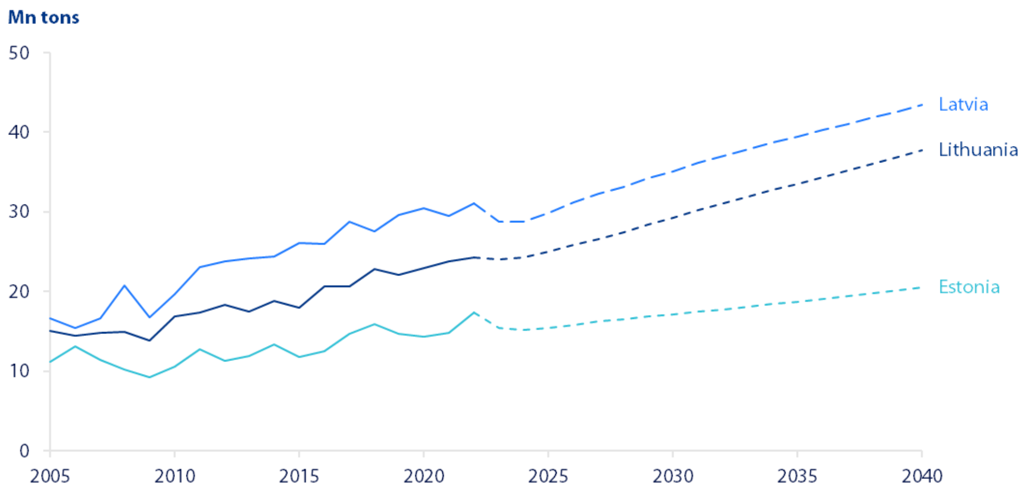


Figure 232: Trade evolution between years 2005 and 2040, including forecast from 2023 onwards (S&P Capital IQ, 2023b)

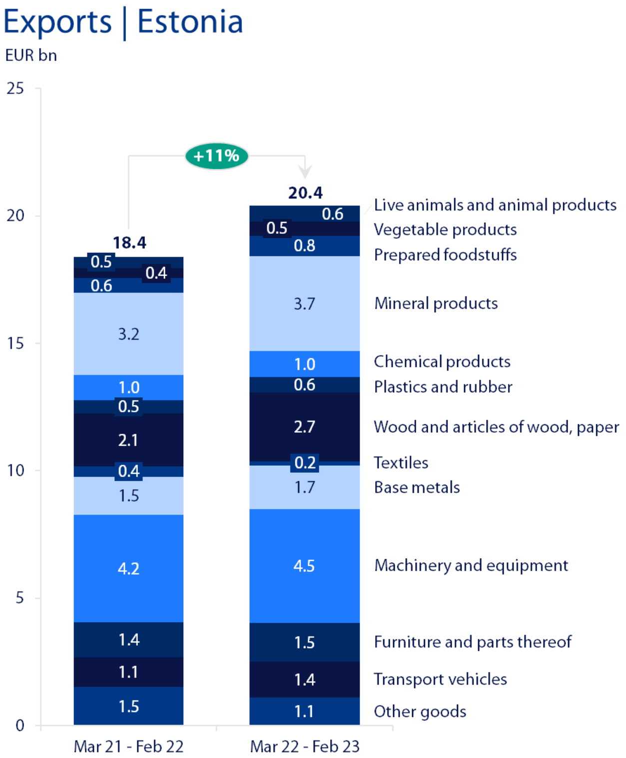
To grasp the scenario fully, it is necessary to delve into each country's individual trade dynamics, specifically focusing on the trade composition and primary trade partners, including an analysis of trade relations with Russia and Ukraine in the wake of the ongoing conflict. Due to lack of country level pass-through trade data availability, the focus is on exports and imports that constitute the majority of trade; thus, are appropriate proxies of greater trade dynamics.

Estonia

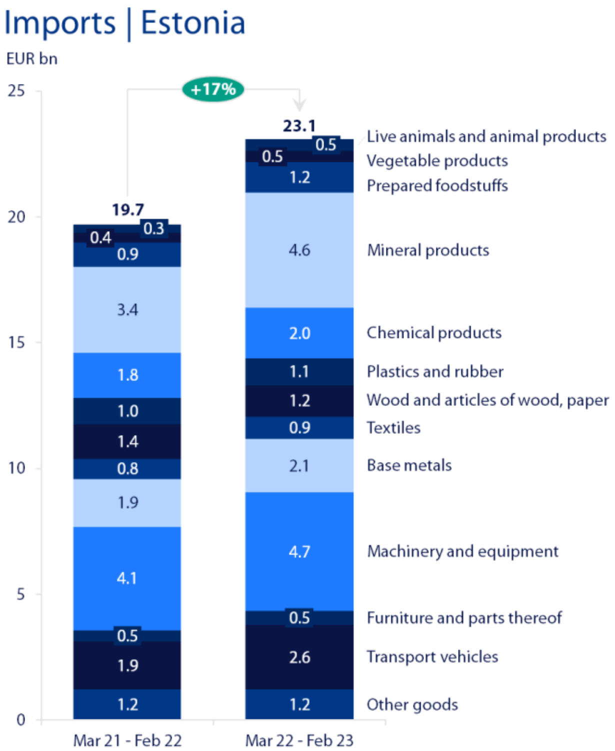
Starting with Estonia, the data illustrates a notable **increase in trade activities**, seen in the figures below[132]. **Exports** surged by **11%**, and **imports** witnessed a **17%** growth. Considering the countries where Estonia exports the most, there has been a significant 50% increase with Latvia, generally attributable to the geographical proximity and possibly shared market characteristics between the two states. Out of the state's main import partners, Finland experienced a 42% growth – Estonia and Finland share a long-standing and significant economic relationship, which is supported by a series of economic agreements that span a wide array of areas, encompassing

[132] This chart includes rounded figures where applicable for Estonia's trade mix (presented for all trade partners) and top trade partners between March 2022 and February 2023. Specific attention has been given to highlight data for Ukraine and Russia.

economic cooperation, aid, the avoidance of double taxation, aviation, as well as reciprocal customs and road transport, collectively laying a strong foundation for their trade partnership (Embassy of Estonia - Helsinki, 2023).



Export destination	Mar 21 – Feb 22	Mar 22 – Feb 23	Change
Finland	2.8	3.1	14%
Latvia	2.0	3.0	50%
Sweden	1.7	2.0	17%
Lithuania	1.1	1.3	21%
Germany	1.2	1.2	1%
USA	1.7	1.1	-36%
Netherlands	1.2	0.8	-34%
Russia	0.8	0.8	-3%
Denmark	0.6	0.6	7%
Poland	0.6	0.6	6%
Ukraine	0.1	0.2	41%



Import origin	Mar 21 – Feb 22	Mar 22 – Feb 23	Change
Finland	3.0	4.2	42%
Germany	2.1	2.5	22%
Latvia	1.8	2.5	37%
Lithuania	1.9	2.5	30%
Sweden	1.5	1.7	18%
Poland	1.3	1.7	29%
Russia	2.3	1.4	-37%
Netherlands	0.8	1.1	36%
China	0.8	0.9	21%
Italy	0.5	0.6	23%
Ukraine	0.1	0.1	110%

Figure 233: Trade in Estonia (Statistics Estonia, 2023)

Regarding **trade composition**, **machinery and equipment**, along with **mineral products**, remained the dominant goods traded, experiencing a surge in both imports and exports during this period. This growth is propelled by Estonia's rich repository of natural resources like oil shale, sand, and gravel, fostering a thriving industrial sector (Ministry of Climate Estonia, 2023). The nation's sound economic strategies have also played a pivotal role in this progression, fueling rapid growth in technology, and manufacturing sectors, primarily focusing on the international markets (Workman, 2022). Furthermore, being a member of the European Union facilitates Estonia's access to expansive markets, fostering collaborative trade relations and negotiations with other EU nations (Montonen, 2019). Consequently, these aspects have potentially cushioned the adverse effects of the Russian conflict on Estonia's trade dynamics.

Analyzing Estonia's **trade partners**, a significant **positive shift in trade relations with Ukraine** is observed. **Exports** soared by **41%**, and **imports** more than doubled, registering a **110%** growth. This development is largely due to Estonia's increased imports of wood and wood-related products from Ukraine, a strategic shift initiated after halting wood imports from Russia following sanctions. This strategic realignment, which began in July 2022, has not only diversified the source of wood imports but also resulted in a trade surplus in the wood sector in 2022 (Post Times, 2023).

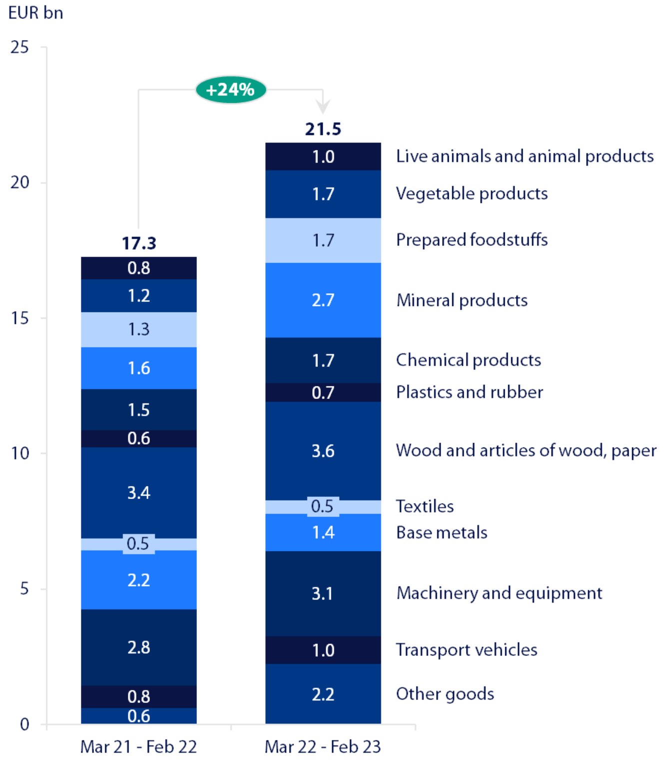
Latvia

In **Latvia**, the trade sector has also observed an expansion, with **exports** rising by **24%** and **imports** by **30%** during the defined period presented in the charts below[133]. Latvia has seen increasing exports to Nordic countries, in particular Finland (117%) and Sweden (33%). Latvia and these Nordic countries have strong economic ties, with all three states undergoing active efforts in the previous years to enhance economic activity through various investments and cooperation (Cabinet of Ministers - Republic of Latvia, 2023). Latvia has seen the highest increase in import activity with neighboring countries Lithuania and Estonia (89% and 52% growth respectively), as all three

[133] This chart includes rounded figures where applicable for Latvia's trade mix (presented for all trade partners) and top trade partners between March 2022 and February 2023. Specific attention has been given to highlight data for Ukraine and Russia.

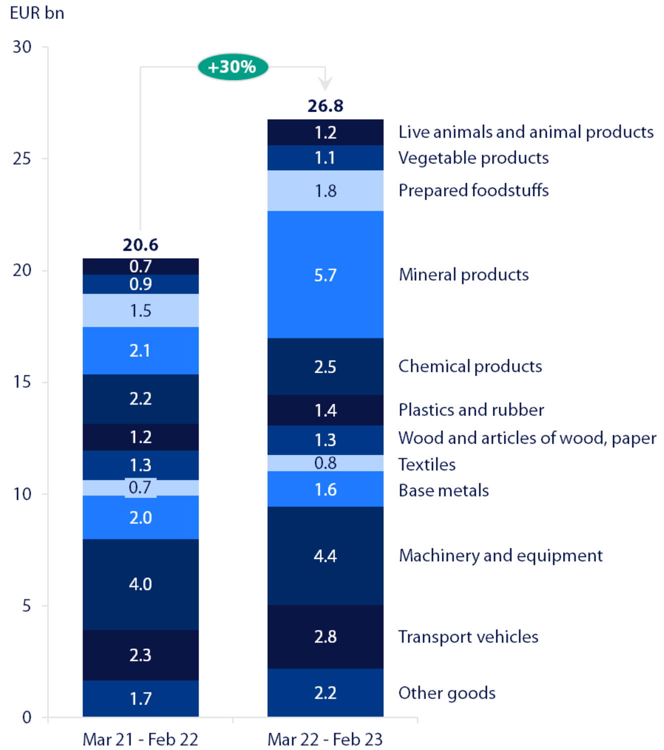
states have similar economic structures, aligned EU-wide trade-specific policies and enhanced connectivity for the streamlined transport of goods.

Exports | Latvia



Export destination	Mar 21 – Feb 22	Mar 22 – Feb 23	Change
Lithuania	3.1	3.9	27%
Estonia	1.9	2.5	31%
United Kingdom	1.3	1.1	-12%
Germany	1.3	1.5	16%
Russia	1.2	1.2	2%
Sweden	0.9	1.3	33%
Poland	0.7	0.8	0%
Denmark	0.7	0.9	17%
Netherlands	0.6	0.7	29%
Finland	0.5	1.1	117%
Ukraine	0.3	0.5	112%

Imports | Latvia



Import origin	Mar 21 – Feb 22	Mar 22 – Feb 23	Change
Lithuania	3.5	6.7	89%
Estonia	1.8	2.7	52%
Germany	2.1	2.6	22%
Poland	2.0	2.6	30%
Russia	2.0	1.6	-17%
Netherlands	0.8	1.1	31%
China	0.9	1.0	5%
Finland	0.7	0.9	26%
Italy	0.6	0.8	25%
Sweden	0.6	0.8	24%
Ukraine	0.2	0.3	20%

Figure 234: Trade in Latvia (Central Statistical Bureau of Latvia, 2023)

The **trade composition** has also seen a striking growth in the mineral products sector. While Latvia's main export commodities include wood, wood products, and charcoal, a significant portion of exports in 2022 also consisted of mineral fuels, mineral oils, and products of their distillation. These were primarily exported to Lithuania, Finland, and Estonia (LSM, 2023a). Between the selected timeframes, the value of mineral products in exports rose by approximatively 70% (from EUR 1.6 bn to EUR 2.7 bn) (Central Statistical Bureau of Latvia, 2023). One underlying reason for this can be found in the government policies and regulations – the Latvian government has implemented proactive policies and regulations to ensure the sustainable development of mineral resources, and of trade activities associated with them (International Trade Council, 2022).

For **trade partners**, Latvia's exports with Russia have registered a very small growth rate of just 2%, while with Ukraine they more than doubled, rising by 112%. The effect of the trade sanctions has been offset by the continued trade of chemical products between Russia and Lithuania, which is reflected in the 2% increase. Latvia's chemical exports, especially pharmaceuticals, to Russia rose as they are not subject to EU sanctions - the chemicals category grew by EUR ~0.2 bn amid the ongoing political tensions (reaching EUR ~1.7 bn from EUR ~1.5 bn) (Central Statistical Bureau of Latvia, 2023). The 20% rise in imports from Ukraine was mainly driven by products of the chemical and allied industries, while the 17% decrease in imports from Russia, considered one of the 10 main trade partners of Latvia, is significantly affected by declining trade of mineral products.

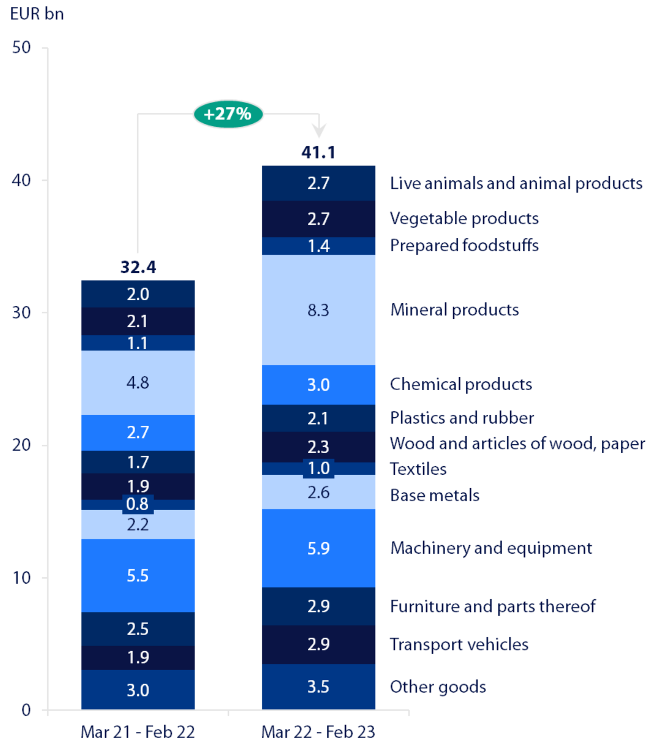
Lithuania

Finally, the Lithuanian trade landscape experienced positive developments in both **exports** and **imports**, which are marked by a **27%** and **35%** increase respectively, as depicted in the upcoming figures[134] (Official Statistics Lithuania, 2023). Lithuania's export partners which depict the highest growth are Latvia and Estonia, due to aforementioned reasons such as geographical proximity, regional economic cooperation and similar policies. However, a striking 75% increase in imports is seen with Sweden, mainly attributable to both countries being

[134] This chart includes rounded figures where applicable for Lithuania's trade mix (presented for all trade partners) and top trade partners between March 2022 and February 2023. Specific attention has been given to highlight data for Ukraine and Russia.

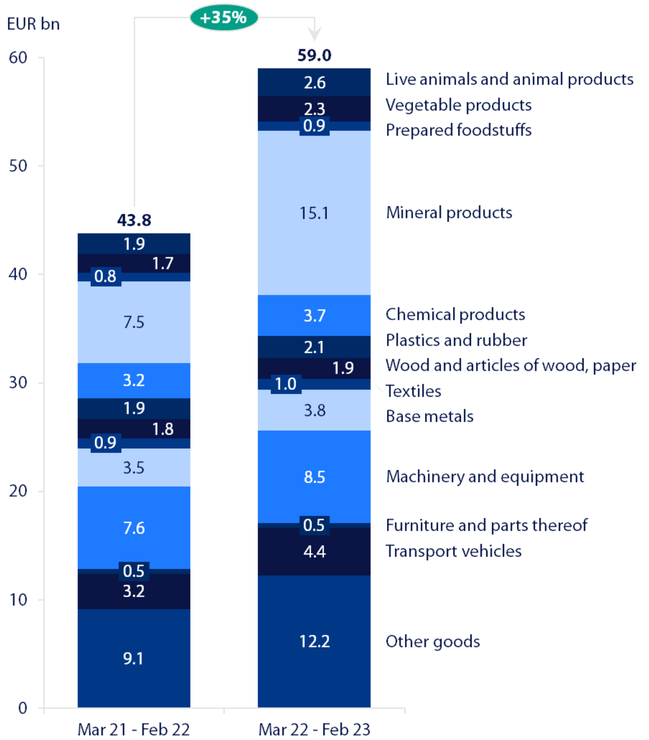
members of the EU and benefitting from easier trade due to common regulatory frameworks and diminished trade barriers.

Exports | Lithuania



Export destination	Mar 21 – Feb 22	Mar 22 – Feb 23	Change
Latvia	3.3	5.8	74%
Poland	3.0	4.1	36%
Germany	3.0	3.5	16%
Russia	3.8	2.6	-33%
Estonia	1.8	2.5	40%
Netherlands	1.8	2.5	37%
Sweden	1.6	1.8	16%
United Kingdom	1.4	1.5	9%
Ukraine	1.3	1.2	-8%
France	0.9	1.0	16%
Denmark	0.9	1.0	12%

Imports | Lithuania



Import origin	Mar 21 – Feb 22	Mar 22 – Feb 23	Change
Poland	4.7	6.3	34%
Germany	5.0	6.3	25%
Latvia	3.3	4.2	28%
Sweden	1.6	2.8	75%
Netherlands	2.0	2.4	20%
Italy	1.8	1.9	9%
Estonia	1.4	1.7	25%
Russia	5.2	1.6	-70%
France	1.2	1.4	15%
Finland	1.1	1.2	13%
Ukraine	0.5	0.5	-2%

Figure 235: Trade in Lithuania (Official Statistics Lithuania, 2023)

In terms of the **trade mix**, between the years until end of February 2022 and February 2023, Lithuania's export and import of mineral products experienced a pronounced increase due to a confluence of factors. The **27% growth in exports** is propelled by a strong global market for crude oil and other commodities, alongside Lithuania's adaptability to the COVID-19 pandemic and geopolitical challenges. This resilience led to a significant increase in exports, particularly in the chemicals and oil industries, highlighting a robust demand in specific subcategories like petroleum gases and electrical energy.

The significant decrease in trade between Lithuania and Russia, one of its primary **trade partners**, is primarily due to geopolitical developments and economic sanctions related to Russia's invasion of Ukraine. The **70% drop in imports** is fueled by Lithuania's decision to halt imports of oil, gas, and electricity from Russia, in line with EU sanctions. This marked a shift in its economic relations and foreign policy, making this change impactful given Russia's role as a major trading partner, with much of the trade being transit trade (OECD, 2022). Additionally, this reduction in trade aligns with Lithuania's strategy to diversify its economy, lessen reliance on Russian energy, and more closely align with the EU's economic and political frameworks. However, unlike the other states, Lithuania exhibited negative growth in trade with Ukraine, primarily due to Ukraine's halted agri-food exports caused by the conflict (European Central Bank, 2022).

The war in Ukraine seems to have had a limited impact on the overall trade landscape of the Baltics. While the trade with Russia has generally decreased or experienced very slow growth, trade with Ukraine has picked up. However, activity with the Baltic states' main partners has in principle increased, and this scenario points to an escalation in the volume of goods traded, supported by the S&P forecasts, therefore potentially elevating the demand for railway freight services in the region.

Population and Labor Market

As of November 2023, the Baltic states are **hosting 73,627 Ukrainian citizens**, accounting for **about 1% of their total population**. Among the 58,468 individuals aged 15 to 74, there is a gender distribution of 55% women and 45% men. By October 2023, there are 21,361 persons aged 20-64 receiving temporary protection, with about 54% of them employed. A breakdown of their occupational distribution is shown in the following figure, revealing that 29% are **unskilled workers**. (Statistics Estonia and Estonian Ministry of Economic Affairs and Communications, 2023)

Figure 236: Occupations of 15-74-year-old citizens of Ukraine (Statistics Estonia and Estonian Ministry of Economic Affairs and Communications, 2023)

A comprehensive 2022 study by RAKE, the University of Tartu's Center for Social Science Applied Research and Think Tank Praxis found that 63% of the Ukrainian war refugees plan to return to Ukraine within three years. Only 25% of war refugees saw themselves in Estonia after three years.

Ultimately, the analysis of the geopolitical landscape and the effects of the war in Ukraine indicates that the **long-term disruptions impacting RB's viability are relatively contained**. Moreover, there exists potential for RB to enhance the flexibility of trade corridors, such as those from Ukraine, adapting to changing geopolitical circumstances.

17 Bibliography

airBaltic. (2022). *Sustainability and annual report 2022*. Retrieved from https://www.airbaltic.com/sustainability/report/2022/airBaltic_Sustainability_Annual_Report.pdf

American Journal of Transportation. (2022). *Ukraine grain exporters carve out new route via Baltic Sea*. Retrieved from https://www.ajot.com/news/ukraine-grain-exporters-carve-out-new-route-via-baltic-sea#:~:text=Ukrainian%20grain%20shippers%20have%20carved,and%20raising%20worries%20over%20hunger

Anna Sobotka, K. C. (2019). *Analysis of offshore wind farm located on Baltic Sea*. Retrieved from https://www.researchgate.net/publication/337964562_Analysis_of_offshore_wind_farm_located_on_Baltic_Sea

Baltic Declaration for Offshore Wind Energy. (2022). Retrieved from IEA: https://www.iea.org/policies/12652-baltic-declaration-for-offshore-wind-energy

Biernikowicz, W. (2021). Rail Transport in NATO's Logistics System: The Case of Poland. *European Research Studies Journal, Volume XXIV, Special Issue 1*, 748-761. Retrieved from https://ersj.eu/journal/2071

Bird, K. (2019). Addressing Spatial Poverty Traps.

Blanquart, C. K. (2017). The Local Economic Impacts of High-Speed Railways: Theories and Facts. *Eur. Transp. Res. Rev.* Retrieved from https://etrr.springeropen.com/articles/10.1007/s12544-017-0233-0

Boston Consulting Group. (2022). *Riding the Rails to Sustainability.*

Brinckerhoff, P. (1996). *Transit and Urban Form, TCRP Report 16.* Washington DC: Transportation Research Board.

Bureau van Dijk. (2023). Retrieved from https://www.bvdinfo.com/en-gb/

Cabinet of Ministers - Republic of Latvia. (2023). *E. Siliņa: Closer cooperation with Finland to contribute to new investment and enhanced security in Latvia*. Retrieved from https://www.mk.gov.lv/en: https://www.mk.gov.lv/en/article/e-silina-closer-cooperation-finland-contribute-new-investment-and-enhanced-security-latvia

Campa, J. L.-L. (2016). High Speed Rail Effects on Tourism: Spanish Empirical Evidence Derived from China's Modelling Experience. *Journal of Transport Geography, Volume 57*, 44-54. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7127499/

Carbon Pricing Leadership Coalition. (2023). *What is carbon pricing?* Retrieved from https://www.carbonpricingleadership.org/what

Cartmell, J. (2018). *Economic Impacts of new or improved rail lines.* UK Government, Department for Transport, Rail. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/939962/economic-impacts-of-new-or-improved-rail-lines-executive-summary.pdf

Catalano, G., & Pancotti, C. (2022). Estimations of SDR in selected countries. *CSIL – Centre for Industrial Studies (Milan, Italy) and University of Milan*.

Central Statistical Bureau of Latvia. (2023). *Foreign Trade of Goods*. Retrieved from https://eksports.csb.gov.lv/en/years/landing: https://eksports.csb.gov.lv/en/years/products/import/2023

Chang Ma, K. T. (2023). The Impact of Opening a High-Speed Railway on Urban Innovation: A Comparative Perspective of Traditional Innovation and Green Innovation.

Christina Biedny, B. W. (2021). *Do 'Dig Once' and Permitting Policies Improve Fiber Availability?* Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3895985

Claire, L. (2017). Does the High Speed Rail (TGV) infrastructure boost corporate competitiveness?

Daniel F Heuermann, J. F. (2019). The effect of infrastructure on worker mobility: evidence from high-speed rail expansion in Germany.

DB Netze AG. (2021). *The Track Access Charges 2022 of DB Netz AG*. Retrieved from https://fahrweg.dbnetze.com/resource/blob/9728804/912151ca28a0ca82e68ebdd0ede31c3d/broschuere_tps_2022_engl-data.pdf

Disabled people in Latvia face high risk of poverty and social exclusion. (2022). *ENG.LSM.lv*. Retrieved from https://eng.lsm.lv/article/society/society/disabled-people-in-latvia-face-high-risk-of-poverty-and-social-exclusion.a485685/

Du, X. Z. (2022). How Does New Infrastructure Investment Affect Economic Growth Quality? Empirical Evidence from China. *Sustainability, Volume 14, Issue 6*, 3511. Retrieved from https://www.mdpi.com/2071-1050/14/6/3511

Eesti Pank. (2023). *Monetary policy impacts the Estonian economy more than it does in the euro area on average*. Retrieved from https://www.eestipank.ee/en/press/monetary-policy-impacts-estonian-economy-more-it-does-euro-area-average-22092020

Embassy of Estonia - Helsinki. (2023). *Economic Relations - Estonia*. Retrieved from https://helsinki.mfa.ee/en/: https://helsinki.mfa.ee/en/estonia-and-finland/economic-relations/

ESFC Investment Group. (n.d.). Offshore wind farms in the North Sea: projects construction cost and financing.

Euractiv. (2023). *EU Commission: Ukraine grain exports through Poland far below capacity*. Retrieved from https://www.euractiv.com/section/agriculture-food/news/eu-commission-ukraine-grain-exports-through-poland-far-below-capacity/

European Central Bank. (2022). *Trade flows with Russia since the start of its invasion of Ukraine*. Retrieved from https://www.ecb.europa.eu/home/html/index.en.html: https://www.ecb.europa.eu/pub/economic-bulletin/focus/2022/html/ecb.ebbox202205_01~9a64e27f6f.en.html

European Commission. (2002). COMMISSION DECISION of 30 May 2002 concerning the technical specification for interoperability relating to the rolling stock subsystem of the trans-European high-speed rail system referred to in Article 6(1) of Directive 96/48/EC. *Official Journal of the European Communities*.

European Commission. (2014). *Guide to Cost-Benefit Analysis of Investment Projects.*

European Commission. (2016). *Fourth railway package of 2016*. Retrieved from https://transport.ec.europa.eu/transport-modes/rail/railway-packages/fourth-railway-package-2016_en

European Commission. (2019a). *Handbook on the external costs of transport*. Retrieved from https://data.europa.eu/doi/10.2832/51388

European Commission. (2019b). *Rail Market Monitoring (RMMS)*. Retrieved from https://transport.ec.europa.eu/transport-modes/rail/market/rail-market-monitoring-rmms_en

European Commission. (2019c). *The European Green Deal*. Retrieved from https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF

European Commission. (2021a). *Economic Appraisal Vademecum 2021-2027*. European Comission. Retrieved from https://ec.europa.eu/regional_policy/sources/guides/vademecum_2127/vademecum_2127_en.pdf

European Commission. (2021b). *European Semester 2020-2021 country fiche on disability equality - Latvia*.

European Commission. (2022). CINEA Guide on economic appraisal for CEF-T transport projects.

European Commission. (2023a). Retrieved from https://www.consilium.europa.eu/en/press/press-releases/2023/10/09/refueleu-aviation-initiative-council-adopts-new-law-to-decarbonise-the-aviation-sector/

European Commission. (2023b). Retrieved from https://ec.europa.eu/european-social-fund-plus/en/news/estonia-partnership-agreement-adopted-2021-27#:~:text=Estonia%20will%20receive%20%E2%82%AC3,Estonia%2C%20which%20was%20adopted%20today

European Commission. (2023c). Retrieved from https://ec.europa.eu/regional_policy/en/newsroom/news/2022/10/21-10-2022-eu-cohesion-policy-eur4-6-billion-for-latvia-to-support-a-green-and-fair-economy-and-society-in-2021-2027#:~:text=EU%20Cohesion%20Policy%3A%20%E2%82%AC4,territorial%20cohesion%2C%20a

European Commission. (2023d). Retrieved from https://ec.europa.eu/european-social-fund-plus/en/news/commission-adopts-partnership-agreement-lithuania#:~:text=English%20with%20Lithuania%2C%20laying%20down,the%20green%20and%20digital%20transition

European Commission. (2023e). Retrieved from https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility/country-pages/estonias-recovery-and-resilience-plan_en#:~:text=%E2%82%AC953%20m,entirely%20financed%20by%20RRF%20grants

European Commission. (2023f). Retrieved from https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility/country-pages/latvias-recovery-and-resilience-plan_en#:~:text=%E2%82%AC1%2C826%20m,by%20RRF%20grants%20and%20loans

European Commission. (2023g). Retrieved from https://www.consilium.europa.eu/en/press/press-releases/2023/07/25/fueleu-maritime-initiative-council-adopts-new-law-to-decarbonise-the-maritime-sector/

European Commission. (2023h). *The Habitats Directive*. Retrieved from https://environment.ec.europa.eu/topics/nature-and-biodiversity/habitats-directive_en#tools

European Commission. (2023i). *Questions and Answers: New measures to better manage and coordinate European rail traffic*. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/qanda_23_3769

European Commission. (2023j). *Competition Policy*. Retrieved from https://competition-policy.ec.europa.eu/sectors/transport-tourism/rail-transport_en#:~:text=Member%20States%20are%20allowed%20to,more%20polluting%20competing%20transport%20mode

European Commission Directorate General for Mobility and Transport. (2022). Retrieved from https://transport.ec.europa.eu/document/download/2d70cfc9-9d7b-4d61-a108-dc28f3917069_en?filename=pb2022-section23.xlsx

European Council. (2022). Retrieved from https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en

European Council. (2023). *Fit for 55*. Retrieved from https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

European Environment Agency. (2023a). *Fossil fuel subsidies*. Retrieved from https://www.eea.europa.eu/en/analysis/indicators/fossil-fuel-subsidies

European Investment Bank. (2023a). The Economic Appraisal of Investment Projects at the EIB.

European Investment Bank. (2023b). *EIB Project Carbon Footprint Methodologies.* Retrieved from https://www.eib.org/attachments/lucalli/eib_project_carbon_footprint_methodologies_2023_en.pdf

European Parliament. (2014). DIRECTIVE 2014/52/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014. *Official Journal of the European Union* .

European Parliament. (2023a). *Deployment of alternative fuels infrastructure: Fit for 55 package*. Retrieved from https://www.europarl.europa.eu/thinktank/en/home: https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2021)698795

European Parliament. (2023b). *Lithuania's National Recovery and Resilience Plan: Latest state of play*. Retrieved from https://www.europarl.europa.eu/thinktank/en/home: https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2022)729283

European Parliament and Council of the European Union. (2002, 06 25). Directive 2002/49/EC of the European Parliament and of the Council. *Official Journal of the European Communities*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32002L0049

European Union. (2006). Regulation (EC) No 561/2006 of the European Parliament and of the Council of 15 March 2006. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02006R0561-20200820

European Union. (2007). Regulation (EC) No 1370/2007 of the European Parliament and of the Council of 23 October 2007. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2007:315:TOC

European Union. (2008). DIRECTIVE 2008/68/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL. *Official Journal of the European Union*.

European Union. (2012). DIRECTIVE 2012/34/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL. *Official Journal of the European Union*.

European Union. (2019). Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02014R1300-20230928

European Union Agency for Railways. (2023). *Telematics Applications for Passenger Service TSI*. Retrieved from https://www.era.europa.eu/domains/technical-specifications-interoperability/telematics-applications-passenger-service-tsi_en

Eurostat. (2021). Retrieved from https://ec.europa.eu/eurostat/databrowser/view/tgs00006/default/map?lang=en

Eurostat. (2023a). *Country level - gross weight of goods handled in all ports*. Retrieved from Eurostat: https://ec.europa.eu/eurostat/databrowser/view/mar_mg_aa_cwh/default/table

Eurostat. (2023b). *GDP per capita, consumption per capita and price level indices*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=GDP_per_capita,_consumption_per_capita_and_price_level_indices

Eurostat. (2024a). *Database*. Retrieved from Eurostat: https://ec.europa.eu/eurostat/databrowser/view/road_go_ta_tott__custom_13682363/default/table?lang=en

Eurostat. (2024b). Retrieved from https://ec.europa.eu/eurostat/databrowser/view/rail_go_total__custom_13682384/default/table?lang=en

Eurostat. (2024c). Retrieved from https://ec.europa.eu/eurostat/databrowser/view/tps00001/default/table?lang=en&category=t_demo.t_demo_pop

Fastmarkets.com. (2023). *Ukraine grain transit through Baltics only workable with preferential tariff*. Retrieved from https://www.fastmarkets.com/insights/ukraine-grain-transit-through-baltics-preferential-tariff/

Financial Times. (2022). Germany plans ‘permanent’ force in Lithuania to strengthen Nato’s eastern flan. Retrieved from https://www.ft.com/content/78f80ec0-6df8-4f8a-902d-f319afb9fe90

Fleck, A. (2022). *Countries that depend on Russia for trade*. Retrieved from Statista: https://www.statista.com/chart/27367/countries-most-dependent-on-russia-for-trade/

Foreign Policy Research Institute. (2023). *The Middle Corridor through Central Asia: Trade and Influence Ambitions*. Retrieved from https://www.fpri.org/article/2023/02/the-middle-corridor-through-central-asia-trade-and-influence-ambitions/#:~:text=As%20a%20result%2C%20cargo%20shipments,into%20the%20heart%20of%20Europe

German Federal Ministry for Digital and Transport. (2023). The trans-European transport network (TEN-T).

Germany plans ‘permanent’ force in Lithuania to strengthen Nato’s eastern flan. (2022). *Financial Times*. Retrieved from https://www.ft.com/content/78f80ec0-6df8-4f8a-902d-f319afb9fe90

GlobalData. (2023a). *Estonia Construction Market Size, Trend Analysis by Sector, Competitive Landscape and Forecast to 2027*. Retrieved from https://www.globaldata.com/store/report/estonia-construction-market-analysis/

GlobalData. (2023b). *Latvia Construction Market Size, Trend Analysis by Sector, Competitive Landscape and Forecast to 2027*. Retrieved from https://www.globaldata.com/store/report/latvia-construction-market-analysis/#:~:text=Latvia%20Construction%20Market%20Report%20Overview,%2C%20electricity%2C%20and%20housing%20projects.

GlobalData. (2023c). *Lithuania Construction Market Size, Trend Analysis by Sector, Competitive Landscape and Forecast to 2027*. Retrieved from https://www.globaldata.com/store/report/lithuania-construction-market-analysis/#:~:text=The%20construction%20market%20size%20in%20Lithuania%20was%20%249.4%20billion%20in%202022.

Goodman, A. (2013). *Walking, Cycling and Driving to Work in the English and Welsh 2011 Census: Trends, Socio-Economic Patterning and Relevance to Travel Behaviour in General*. PLOS ONE. Retrieved from https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0071790

Graham, D. J. (2019). *Quantifying Wider Economic Impacts of Agglomeration for Transport Appraisal: Existing Evidence and Future Directions*.

Grandsart, D. (2021, 01 04). *Punctuality report of European trains*. Retrieved from epf.eu: https://www.epf.eu/wp/10929-2/

GSCi. (2023). *https://www.ti-insight.com/*. Retrieved from https://www.ti-insight.com/product/gsci/

Guerra, E., Cervero, R., & Tischler, D. (2011). *Half-Mile Circle: Does It Best Represent Transit Station Catchments?* Berkeley: University of California.

Hiramatsu, T. (2018). *Job and Population Location Choices and Economic Scale as Effects of High Speed Rail: Simulation Analysis of Shinkansen in Kyushu, Japan*. Retrieved from https://ideas.repec.org/a/eee/retrec/v72y2018icp15-26.html

International Monetary Fund. (2023). Retrieved from https://www.imf.org/en/Publications/WEO/weo-database/2023/April

International Trade Council. (2022). *Mineral Resources in Latvia*. Retrieved from https://thetradecouncil.com/: https://thetradecouncil.com/mineral-resources-in-latvia/#:~:text=Latvia%27s%20modest%20mineral%20resources%20have,Published

IRG-Rail. (2022). *Tenth Annual Market Monitoring Report*. IRG-Rail.

Jensen, A. E. (2020). *Baltic Adriatic Fourth Work Plan of the European Coordinator*. Retrieved from https://transport.ec.europa.eu/system/files/2022-12/4th_workplan_bac.pdf

Jing Ma, C. L.-P. (2018). *A Multilevel Analysis of Perceived Noise Pollution, Geographic Contexts and Mental Health in Beijing*. Retrieved from https://pubmed.ncbi.nlm.nih.gov/30011780/

Kate Bird, K. H. (2010). *Spatial poverty traps*. Retrieved from http://cdn-odi-production.s3.amazonaws.com/media/documents/5514.pdf

Kerriou, A. (2022, 06 29). *The truck driver shortage has got worse in 2022*. Retrieved from Upply: https://market-insights.upply.com/en/the-truck-driver-shortage-has-got-worse-in-2022

Kosse, I. (2023). *Rebuilding Ukraine's Infrastructure after the War.* Retrieved from https://wiiw.ac.at/rebuilding-ukraine-s-infrastructure-after-the-war-dlp-6621.pdf

Latvijas dzelzceļš. (2022). *Annual Report for 2022*. Retrieved from https://www.ldz.lv/sites/default/files/LDZ_VAS%202022_annual_report_EN.pdf

Lewandowski, K. (2015). *New coefficients of rail transport usage.* International Journal of Engineering and Innovative Technology (IJEIT).

lrt.lt. (2023). *Ukraine grain export via Lithuania would be 'great opportunity', says FM*. Retrieved from https://www.lrt.lt/en/news-in-english/19/1965884/ukraine-grain-export-via-lithuania-would-be-great-opportunity-says-fm

LSM. (2023a). *Latvia's exports and imports reached record levels in 2022*. Retrieved from https://eng.lsm.lv/: https://eng.lsm.lv/article/economy/economy/latvias-exports-and-imports-reached-record-levels-in-2022.a496914/

LTG Link. (2023). *It's official: the train to Riga will start on 27 December*. Retrieved from https://ltglink.lt/en: https://ltglink.lt/en/important-notices/naujas-metinis-traukiniu-tvarkarastis-isigalios-jau-nuo-gruodzio-10-d#:~:text=The%20international%20trains%20will%20run,the%20use%20of%20its%20infrastructure

LTG Link. (n.d.). *LTG Link performance results*. Retrieved from LTG Link: https://ltglink.lt/en/ltg-link-performance-results

Lu Y., Y. S. (2022). *The Influence of High-Speed Rails on Urban Innovation and the Underlying Mechanism.*

Mark F. Cancian, S. M. (2023). *Strengthening Baltic Security: Next Steps for NATO.* CSIS. Retrieved from https://www.csis.org/analysis/strengthening-baltic-security-next-steps-nato

Mark Wardman, P. C. (2012). *European wide meta-analysis of values of travel time.* University of Leeds.

Ministry of Climate Estonia. (2023). *Mineral Resources*. Retrieved from https://kliimaministeerium.ee/en: https://kliimaministeerium.ee/en/water-forest-resources/mineral-resources

Montonen, V. (2019). *EU Trade Policy and Estonia: What are our Opportunities and Role?* Retrieved from https://icds.ee/en/: https://icds.ee/en/eu-trade-policy-and-estonia-what-are-our-opportunities-and-role/

National Audit Office of Lithuania. (2020). *SOCIAL INTEGRATION OF PERSONS WITH DISABILITIES.*

NATO's military presence in the east of the Alliance. (2023, 7 28). Retrieved from NATO: https://www.nato.int/cps/en/natohq/topics_136388.htm

Nguyen Ngoc Thach, A. M. (2021). *mpact of Super Heavy Load Vehicles on Transportation Infrastructure: Economic Aspects.* Retrieved from https://www.researchgate.net/publication/350746014_Impact_of_Super_Heavy_Load_Vehicles_on_Transportation_Infrastructure_Economic_Aspects

Nilsson, J.-E., Svensson, K., & Haraldsson, M. (2015). *Estimating the marginal costs of road wear.* Retrieved from https://trimis.ec.europa.eu/sites/default/files/project/documents/FULLTEXT.pdf

OAG. (2023). *Punctuality league 2023.* OAG Aviation Worldwide Ltd.

OECD. (2022). *OECD Economic Surveys: Lithuania.*

Official Statistics Lithuania. (2023). *Official Statistics Portal*. Retrieved from https://osp.stat.gov.lt/: https://osp.stat.gov.lt/statistiniu-rodikliu-analize?hash=f5d25926-8443-4414-8f47-553613454f3a#/

OU Xunmin, Y. Z. (2022). *The Development of High-Speed Rail in China.* Retrieved from https://transition-china.org/wp-content/uploads/2022/06/20220621_HSR-Study-English-Final.pdf

Oxford Economics. (2023). *Interest rate on loans to corporates*. Retrieved from Oxford Economics: https://data.oxfordeconomics.com/render-app

Pogonyi, C. G. (2019). *The Wider Economic Benefits of Transportation.* Imperial College.

Politico. (2023). *EU has no easy options to help Ukraine shift its grain*. Retrieved from https://www.politico.eu/article/eu-ukraine-russia-black-sea-grain-deal-food-security-war/

Post Times. (2023). *New supply countries quickly emerge after ban on import of Russian timber*. Retrieved from https://news.postimees.ee/: https://news.postimees.ee/7807994/new-supply-countries-quickly-emerge-after-ban-on-import-of-russian-timber

Rail Baltica. (2022). *Railway Infrastructure Access Policies Report.* Retrieved from https://www.railbaltica.org/wp-content/uploads/2022/06/Rail-Baltica-Railway-Infrastructure-Access-Policies-Study-Atkins-Final_Public.pdf

Rail Baltica TDM. (2024). *Rail Baltica Traffic Demand Model.*

Rail Target. (2023). *Estonian Elron orders 10 more trains from the Škoda Group*. Retrieved from https://www.railtarget.eu/: https://www.railtarget.eu/passenger/estonian-elron-orders-10-more-trains-from-the-skoda-group-4405.html

Railtech.com. (2023). Retrieved from https://www.railtech.com/infrastructure/2023/01/25/from-patchwork-to-true-european-high-speed-rail-network-the-costs-and-benefits/

Reuters. (2022). *Ukrainian grains still using Danube as gateway to Romanian Black Sea port*. Retrieved from https://www.reuters.com/markets/commodities/ukrainian-grains-still-using-danube-gateway-romanian-black-sea-port-2022-09-28/#:~:text=Ukraine%20continues%20to%20ship%20grain,remain%2C%20the%20deputy%20chief

Reuters. (2023). Latvia could begin Ukrainian grain exports in autumn - Latvian Railways.

Reuters. (2023). *Latvia could begin Ukrainian grain exports in autumn -Latvian Railways*. Retrieved from https://www.reuters.com/markets/commodities/latvia-could-begin-ukrainian-grain-exports-autumn-latvian-railways-2023-08-15/

RHG. (2023). Retrieved from https://rhg.com/research/sustainable-aviation-fuels/

Road Transport Administration of Latvia. (2023). Retrieved from https://www.atd.lv/lv/jaunumi/2023-gada-1-pusgad%C4%81-re%C4%A3ion%C4%81lajos-sabiedrisk%C4%81-transporta-mar%C5%A1rutos-p%C4%81rvad%C4%81ti-1957-miljoni

Rozenberga, M. (2018). *Rīga's Central Station in a wheelchair: poor accessibility, drunk helpers*. Retrieved from https://eng.lsm.lv/article/society/society/rigas-central-station-in-a-wheelchair-poor-accessibility-drunk-helpers.a301142/

S&P Capital IQ. (2023a). Retrieved from https://www.capitaliq.com/

S&P Capital IQ. (2023b). *S&P Capital IQ*. Retrieved from https://www.spglobal.com/marketintelligence/en/campaigns/sp-capital-iq-pro?cq_cmp=14495639714&cq_plac=&cq_net=g&cq_pos=&cq_plt=gp&utm_source=google&utm_medium=cpc&utm_campaign=CIQPro_Search_Google&utm_term=sp%20capital%20iq&utm_content=542966230023&_bt=54

Social Insurance Board of Estonia. (2022). *Statistics of disabled people by local governments* . Retrieved from https://www.sotsiaalkindlustusamet.ee/et/organisatsioon-kontaktid/statistika-ja-aruandlus#Puudega_inimesed_KOV

Song, Z. C. (2019). Public Transport Accessibility and Housing Value Uplift: Evidence from the Docklands Light Railway in London. *Case Studies on Transport Policy, Volume 7, Issue 3*, 607-616. Retrieved from https://discovery.ucl.ac.uk/id/eprint/10092578/

Statista. (2023). Retrieved from https://fr.statista.com/outlook/mmo/shared-mobility/shared-vehicles/flights/lithuania

Statistics Estonia. (2023). *Estonia*. Retrieved from https://data.stat.ee/profile/country/ee/: https://data.stat.ee/profile/country/ee/

Stern, N. (2021). Innovation, growth and the transition to net-zero emissions. *2021*.

Stiftung Wissenschaft und Politik. (2022). *Russia's War on Ukraine and the Rise of the Middle Corridor as a Third Vector of Eurasian Connectivity*. Retrieved from SWP Berlin.

Tax Foundation. (2023). Retrieved from https://taxfoundation.org/data/all/eu/carbon-taxes-in-europe-2023/

The bottlenecks on alternative routes to export Ukrainian grain. (2022, 7 26). *Hellenic Shipping News worldwide*. Retrieved from https://www.hellenicshippingnews.com/the-bottlenecks-on-alternative-routes-to-export-ukrainian-grain/

The Business Times. (2023). Retrieved from https://www.businesstimes.com.sg/international/global/airlines-will-hike-ticket-prices-pay-costly-sustainable-fuel-iata

UK Department of Transport. (2019). *TAG Unit A2-1 Wider Economic Impact Appraisal*. Department for Transportation. Retrieved from https://assets.publishing.service.gov.uk/media/5fc8b4bdd3bf7f7f52707867/tag-a2-1-wider-economic-impacts-appraisal.pdf

UN. (2023). *UN data*. Retrieved from http://data.un.org/

Upchurch, C. K. (2004). *Using GIS to generate mutually exclusive service areas linking travel on and off a network.* Journal of Transport Geography, no. 12, 23-33.

van den Engel, A. W. (2010). *Driving Restrictions for Heavy Goods Vehicles in the.*

Venables, A. J. (2016). *Incorporating Wider Economic Impacts within Cost-Benefit Appraisal.*

Venezia, E. (2023). Cost–Benefit Analysis in High-Speed Railway Projects: Appraisal of Methodological Approaches and an Initial Social Equity Evaluation, A Case Study.

Vitenbergs. (2023). First new electric trains to start running in Latvia by end-2023 - . *Baltic Times*. Retrieved from https://www.baltictimes.com/first_new_electric_trains_to_start_running_in_latvia_by_end-2023_-_vitenbergs/#:~:text=Skoda%20Vagonka's%20CEO%20Martin%20Bednar,by%20the%20end%20of%202023.

Wardman, M., & Lyons, G. (2015). The digital revolution and worthwhile use of travel time: implications for appraisal and forecasting. Retrieved from https://doi.org/10.1007/s11116-015-9587-0

Wheelchair Accessible Public Transportation in Tallinn, Estonia. (n.d.). Retrieved from Wheelchair Travel.org : https://wheelchairtravel.org/tallinn/public-transportation/

Workman, D. (2022). *Estonia's Top 10 Exports*. Retrieved from https://www.worldstopexports.com/: https://www.worldstopexports.com/estonias-top-10-exports/

World Bank. (2023). Retrieved from https://databank.worldbank.org/home.aspx

World Energy Statistics and Balances. (2020a). Retrieved from World Energy Statistics and Balances Estonia: https://www.iea.org/countries/estonia

World Energy Statistics and Balances. (2020b). Retrieved from World Energy Statistics and Balances Lithuania: https://www.iea.org/countries/lithuania

World Energy Statistics and Balances. (2020c). Retrieved from World Energy Statistics and Balances Latvia: https://www.iea.org/countries/latvia

Worldbank. (2023). Retrieved from https://databank.worldbank.org/home.aspx