Rail Baltica

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Rail Baltica Global Project
Corridor Synergies Study

Final Report

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TABLE OF CONTENT

List of Tables

List of Figures

List of Acronyms and Abbreviations

Acronyms and Abbreviations	Explanation
ATS	Autotransformers centres
BASF	International Chemistry and Industrial Company
BEV	Battery Electric Vehicle
BIM	Building Information Modelling
CAPEX	Capital Expenditures
CBA	Cost-Benefit-Analysis
CCAM	Cooperative Connected and Automated Mobility
CCS	Combined Charging System
CEF	Connecting Europe Facility
CF	Cohesion Fund
CINEA	European Climate, Infrastructure and Environment Executive Agency
CT	Transformation Centre
CX	Customer experience
DAS	Distributed Antenna System
DESI	Digital Economy and Society Index
DSO	Distribution System Operator
EDzL	Eiropas Dzelzceļa līnijas SIA. Latvian national implementing body
EEAG	Guidelines on State Aid for environmental protection and energy
EFSI	European Fund for Strategic Investment
EIB	European Investment Bank
ERDF	European Regional Development Fund
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EU	European Union
FCEV	Fuel Cell Electric Vehicle
FCH	Fuel Cells and Hydrogen Joint Undertaking
FO	Fibre Optic
FOAS	Fibre Optic Acoustic Sensing
FRMCS	Future Railway Mobile Communication System
FTIA	Finnish Transport Infrastructure Agency
FTTH	fibre-to-the-home
FTTx	Fibre to the x
GBER	General Block Exemption Regulation
GDP	Gross domestic product
gNB	radio base station in 5G NR networks (Next generation Node B)
GNI	gross national income
GSM-R	Global System for Mobile Communications–Railway
HaDEA	European Health and Digital Executive Agency
HSR	High Speed Rail
HV	High Voltage
IEC	International Electrotechnical Commission
IFIs	International financial institutions

IM	Infrastructure Manager
IoT	Internet of Things
IPCEI	Important Projects of Common European Interest
ISO	International Organization for Standardization
ITS	Intelligent Transport Systems
KPI	Key Performance Indicator
LGI	Lietuvos geležinkeliai JSC. Lithuanian national implementing body
LRT	Light rail transit
MFF	Multiannual Financial Framework
MNO	Mobile Network Operator
MV	medium voltage
NUTS	Nomenclature of Territorial Units for Statistics (divided into 3 levels)
OCS	Overhead Catenary System
ODFs	Specific optical distribution frames
OHL	Overhead Line
OPEX	Operating Expenses
PP	paralleling post
PV	Photovoltaic cell
RAN	Radio Access Network
RB	Rail Baltica
RBE / RB Estonia	Rail Baltic Estonia OÜ. Estonian national implementing body
RBGP	Rail Baltica Global Project
RB HSR	Rail Baltica High Speed Railway
RBR	RB Rail AS joint venture
RIS	River Information Services
RIX	Riga airport
RRF	Recovery and Resilience Facility
RRP	Resilience and Recovery plans
SEA	Strategic of Environmental Assessment
SESAR	Single European Sky ATM Research
SFC	Static Frequency Converter
SLA	Service Level Agreement
SME	Small and Medium Enterprise
TFEU	Treaty on the Functioning of the European Union
TfNSW	Transport for New South Wales
TKG	German Telecommunications Act
TSO	Transmission System Operator
TSS	Traction Sub-Station
UIC	International Union of Railways
V2N	Vehicle-to-network
V2X	Vehicle-to-everything
VMO	Virtual Mobile Operators
VTMIS	Vessel Traffic Monitoring and Information Systems
WP	Work Package

1 INTRODUCTION

The objective of this report is to analyse and provide policy recommendations for maximising the benefits for the Rail Baltica corridor. The study shall draw extensively on European and global best practice cases for the optimisation of commercial and synergy opportunities in such a corridor, as well as emerging opportunities stemming from innovation and digitalisation.

The study provides guidance and recommendations for the value maximisation of the RBGP from the "**Dig Once" perspective**, in order to calibrate precisely the necessary infrastructural design elements, future functionalities, and related developments, to assess and promote the potential future business cases for various services/offerings, as well as provide insights to national governments on opportunities to **co-synchronise relevant infrastructure developments** with the delivery of Rail Baltica. This study is to be based on current designs, guidelines and timelines and focus on areas which will not cause significant issues with respect to the Global Project timeline or existing designs.

The Synergies study final report is organized **according to the following structure**:

- **1. Introduction:** which includes an overview of the project, the scope of the study, and the proposed methodology.
- **2. Review of areas identified in the context of the Rail Baltica Design Guidelines to demonstrate where proposed areas / activities could be implemented without significant changes and other identified areas should be assessed in terms of their potential impact.** This chapter reviews different areas of the design guidelines to demonstrate where proposed synergetic actions could be implemented without significant changes with impact on RBGP project timeline or costs.
- **3. Applicability of key recommendations and the synthesis of International best practice and opportunities with respect to the critical analysis of the synergy components of the Connecting Europe Facility (CEF) and other national and European development programmes and of the impact of State Aid and other rules for synergistic opportunities and the review of areas identified in the context of the Rail Baltica Design Guidelines to demonstrate where proposed areas / activities could be implemented without significant changes and other identified areas should be assessed in terms of their potential impact**: This chapter summarises the applicability of key recommendations and the synthesis of WP2, the review and assessment of opportunities and best practices and lessons learned in the field of synergistic opportunities, with respect to WP3.1, the critical analysis of the synergy components of the Connecting Europe Facility and other national and European development programmes, as well as of the impact of State Aid and other rules for synergistic/catalytic opportunities, and WP3.2, the review of areas identified in the context of the Rail Baltica Design Guidelines for demonstrating where proposed areas/activities could be captured without significant change in terms of impact on project timeline or costs.

The Synergies Study Final Report also contains the following **three annex documents**:

- **Annex 1:** International Best Practices and Opportunities

- **Annex 2:** Critical analysis of the synergy components of the Connecting Europe Facility (CEF) and other national and European development programmes and of the impact of State Aid and other rules for synergistic opportunities
- **Annex 3**: Background Information

1.1 OVERVIEW

Rail Baltica is a greenfield rail transport infrastructure project with the goal to integrate the Baltic States in the European rail network. As part of the EU's North-Sea Baltic TEN-T corridor, Rail Baltica will eliminate the North-South railway axis' missing link, ensuring full integration of Estonia, Latvia and Lithuania into the Single European Railway Area[1] (SERA). Apart from the railway connection between the three Baltic states, the project includes the connection with Poland as well as, indirectly, Finland.

Figure 1: Rail Baltica services Schematic map

Source: www.railbaltica.org

Rail Baltica Global Project delivery is expected to act as a catalyst for sustainable economic development in the Baltic region, through a greenfield UIC-gauge, double-track, 25kV AC electrified, ERTMS-equipped, mixed-traffic railway line and related infrastructure, which will enhance market accessibility and trade competitiveness.

[1] Directive 2012/34/EU of the European Parliament and of the Council of 21 November 2012 establishing a Single European Railway Area text with EEA relevance

Figure 2: Rail Baltic NUTS3 versus GDP Per Inhabitant Percentge_EU27_Average_with_RailwayLines

Source: Rail Baltica Global Project Synergies Study (2021)

However, Rail Baltica is not only about building a railway line. The infrastructure shall rather serve as an enabler for the emergence of a whole new economic corridor, that will provide a comfortable, safe and environmentally friendly alternative for passenger mobility, enhancing regional integration and connectivity.

Furthermore, Rail Baltica, as an EU transport flagship project, has **innovation and digitalisation as its key strategic enablers, alongside with de-carbonisation and cross-border connectivity**. The new railway infrastructure and its future commercialisation shall serve as a platform for digitalisation and innovation within the new paradigm of seamless intermodal connectivity, supply chain transparency and service integration.

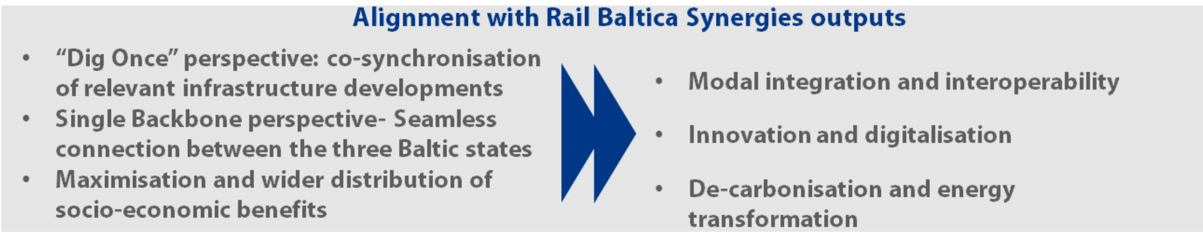
1.2 SCOPE OF THE RAIL BALTICA SYNERGIES STUDY

The primary objective of the study is to provide guidance and policy recommendations for the maximisation of the value of the Rail Baltica (RB) global project from the **"Dig Once" perspective**, in order to be able to calibrate precisely the necessary infrastructural design elements, future functionalities and related developments, and to assess the potential future business cases for various services/offerings.

Additionally, the study provides insights to national governments and EU on opportunities to co-synchronise relevant infrastructure developments with the delivery of Rail Baltica through a **single backbone perspective**, in other words, the study will assess the value of a seamless connection approach to infrastructure developments (i.e., digital networks, energy, etc.) between the three Baltic states.

The study shall extensively draw on European and global best practices for the **maximisation of and wider distribution of socio-economic benefits** in such a corridor, as well as emerging opportunities stemming from innovation and digitalisation.

Figure 3: Alignment with Rail Baltica Synergies Outputs



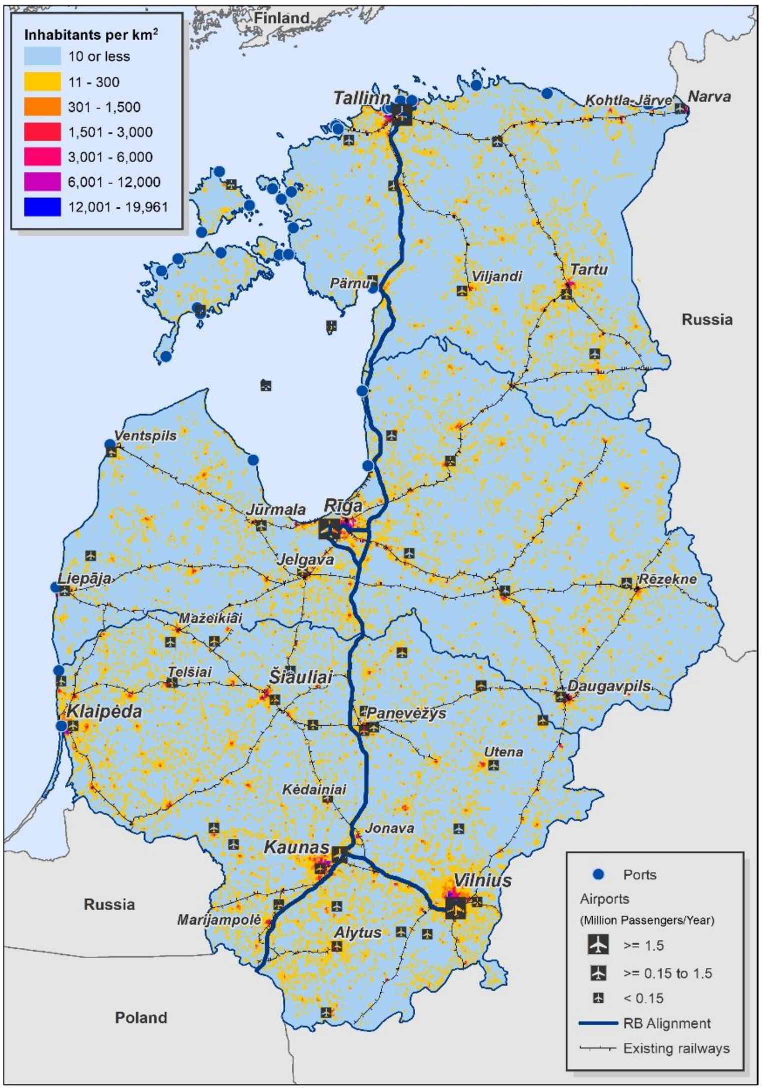
Source: Rail Baltica Global Project Synergies Study (2021)

1.2.1 "DIG ONCE" APPROACH

In a greenfield project, such as Rail Baltica, systems can be designed with modern approaches, using more sustainable solutions, in order to help reduce the lifecycle cost of the infrastructure and operations, as well as strengthen the long-term business case.

The development of Rail Baltica, one of Europe's flagship infrastructure initiatives, can provide connectivity and support a range of other projects, aligned with EU initiatives and funding requirements, in order to co-synchronise relevant infrastructure developments with new business opportunities that can serve all Rail Baltica stakeholders (end users, EU taxpayers, the EU and other institutional partners, suppliers, and the citizens of the Baltic states, both urban and rural, as well as indirectly the population of Finland and Poland).

Figure 4: Transport Network (Airports and Railway) and Inhabitants per km^2 in the Rail Baltica Wider Economic Corridor



Source: Rail Baltica Global Project Synergies Study (2021) based on RBR Grid_Baltics_1k_Statistic_data_Total_Population.shp and Rail Baltica alignment from Rail Baltica Web GIS. The joint construction, development and delivery of very high-capacity digital networks, boosting the digitalisation of transport and energy networks, benefits taxpayers and ultimately the utilities' rate payers by reducing the costs of the Rail Baltica Global Project corridor public open access facilities.

1.2.2 SINGLE BACKBONE PERSPECTIVE

As a major EU flagship initiative, Rail Baltica will emerge as an exemplary platform for an efficient functioning of the Single European Railway Area, featuring full interoperability, streamlined cross-border infrastructure management and fair and equal access to infrastructure without barriers, distorted competition or conflicts of interest.

The Rail Baltica project and its railway infrastructure delivery is the key for enabling a "single backbone perspective", an efficient and competitive market cooperation and integration that can create added value regarding the following aspects:

- Improved collaboration and communication between countries concerning strategic assets such as energy and digital networks, preventing from future cross-country hindrances
- Increased use of standardised or modular technologies, which can diminish waste, increase efficiency, and reduce labour and material costs.
- Economies of scale: cost and resource savings in operations and maintenance
- Holistic approach for project stakeholders concerning planning, design, funding, and delivery of the synergy opportunities
- Alignment for other forward-looking commercialisation efforts: edge computing and cloud services, telecommunication wayleaves, e-commerce etc.

1.2.3 MAXIMISATION AND WIDER DISTRIBUTION OF SOCIO-ECONOMIC BENEFITS

As many mega-projects have demonstrated, the true extent of the socio-economic impact of these transformations is difficult to predict.

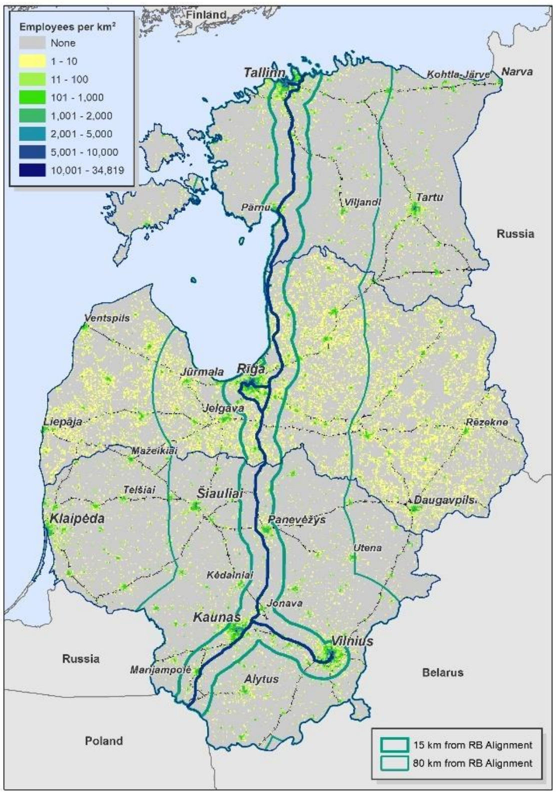
Figure 5: Benefits of Rail Baltica High-speed Railway Project Investment (Direct, Inducted and Wider Impact)

Source: Rail Baltica Global Cost-Benefit Analysis (CBA) - 2017

It is also clear that strategic planning, together with innovation and digitalisation, can help maximise long-term socio-economic benefits, employability and, importantly, ensure their broader and equitable distribution.

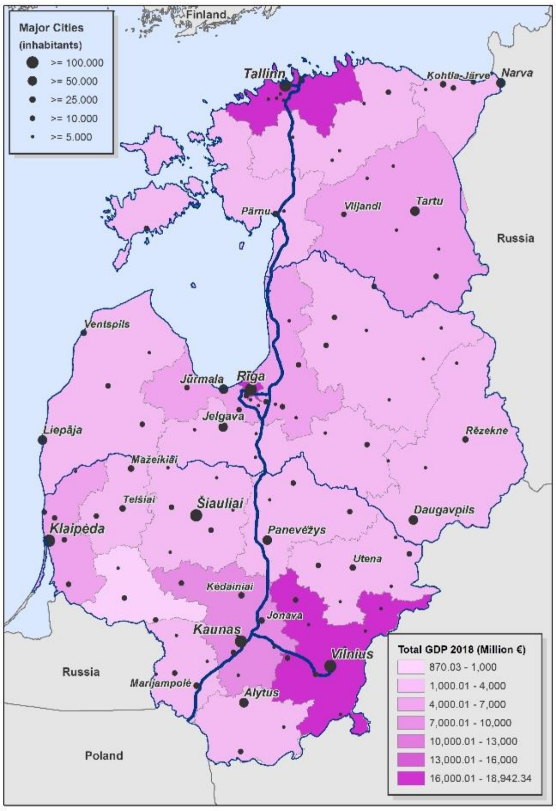
As a greenfield infrastructure development, Rail Baltica has a unique opportunity to enable seamless and multimodal freight and passenger mobility in the region, promoting rural connectivity and fostering collaboration with, among others, small and medium enterprises (SMEs), start-ups, universities, and industrial partners, thus, making mobility accessible to everyone.

Figure 6: Connectivity to Rail Baltica HSR from Employees' Workplaces in the Rail Baltica Wider Economic Corridor (15 km – 80 km)



Source: Rail Baltica Global Project Synergies Study (2021) based on RBR Grid_Baltics_1k_Statistic_data_Employees_Workplaces.shp and RB alignment from RB Web GIS

Figure 7: Total GDP by NUTS3 in Rail Baltica Countries

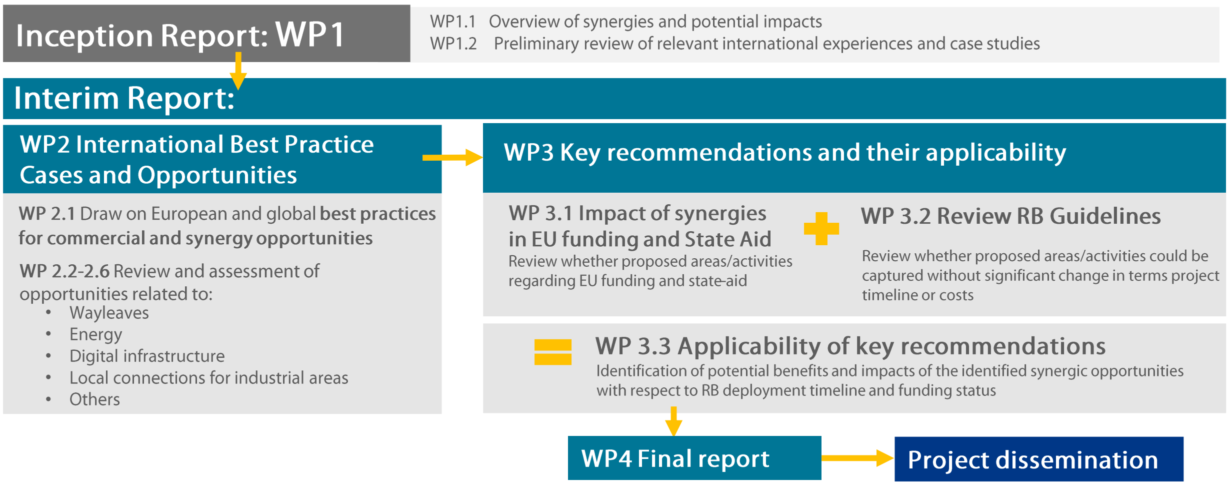


Source: Rail Baltica Global Project Synergies Study (2021) based on Rail Baltica alignment from Rail Baltica Web GIS, GISCO – Eurostat and Eurogeographics data

1.3 METHODOLOGY

The project is structured in work packages representing the main deliverables.

Figure 8: Methodology for the Synergies Study



Source: Rail Baltica Global Project Synergies Study (2022)

The development of Rail Baltica, as one of Europe's flagship infrastructure initiatives, can help deliver connectivity and support a range of other projects, aligned with EU initiatives and funding requirements, in order to co-synchronise relevant infrastructure developments with new business opportunities that can serve all Rail Baltica stakeholders, including the general population of the Baltic states.

The results of this study provide guidance and recommendations for the maximisation of the value of the Rail Baltica global project from the "Dig Once" perspective, to be able to calibrate more precisely the necessary infrastructural design elements, future functionalities and related developments, assess the potential future business cases for various services/offerings, as well as provide insights to national governments.

All new investment opportunities would have to take into account the transport infrastructure requirements regarding safety and security, as well as specific requirements or its possible connection to industrial and defence areas taking into account the previous Rail Baltica studies, spatial planning and preliminary designs and the local urban development plans, in order to establish a coordinated dialog between railway managers, local and regional authorities, investors, transport providers and users.

The implementation of these synergetic actions will involve complex work as it should address evolving standards in specific areas of railway activity which should involve the coordination and contribution of specialists from the Rail Baltica Global Project coordinator (RBR, which is also an implementing body in key areas), and Rail Baltica project national implementing bodies (Rail Baltic Estonia OÜ (RBE Estonia), Eiropas Dzelzceļa līnijas SIA (Latvia), Rail Baltica statyba UAB and Lietuvos geležinkeliai JSC, LTG Infra, (Lithuania) and the final beneficiaries of the Rail Baltica HSR (the three Member States represented by the ministries responsible for transport: – Estonia's Ministry of Economic Affairs and Communications, Latvia's Ministry of Transport and Lithuania's Ministry of Transport and Communications).

2 REVIEW OF AREAS OF THE RAIL BALTICA DESIGN GUIDELINES TO DEMONSTRATE WHERE PROPOSED SYNERGETIC ACTIONS PERTAINING TO ANOTHER SECTOR COULD BE CAPTURED WITHOUT SIGNIFICANT CHANGE IN THE RAIL BALTICA GLOBAL PROJECT WORK PROGRAMME

In a greenfield project, such as Rail Baltica, systems can be designed with a modern approach, using more sustainable solutions, and other similar approaches to help reduce the lifecycle cost of the infrastructure and operations, as well as strengthen the long-term business case.

In this chapter, 2, areas of the design guidelines are reviewed, to demonstrate where proposed synergetic actions could be implemented without significant changes with impact on RB GP project timeline or costs.

Actions contributing simultaneously to the achievement of one or more CEF objectives of at least two sectors, as provided for in Table 1: Synergetic Actions Contributing Simultaneously to the Achievement of One or More CEF Objectives of at Least Two Sectors, shall be implemented through work programmes addressing at least two sectors. Therefore, the CEF should allow, within each sector, the possibility to consider as eligible some synergetic elements pertaining to another sector, where such an approach improves the socio-economic benefit of the investment. Synergies between sectors will be incentivised through the award criteria for the selection of actions[2], as well as through increased co-financing[3].

Table 1: Synergetic Actions Contributing Simultaneously to the Achievement of One or More CEF Objectives of at Least Two Sectors

Sector	Actions
Transport Sector	(i) contribute to the development of projects of common interest relating to efficient, interconnected and multimodal networks and infrastructure for smart, interoperable, sustainable, inclusive, accessible, safe and secure mobility in accordance with the objectives of Regulation (EU) No 1315/2013 (ii) adapt parts of the TEN-T for the dual use of the transport infrastructure with a view to improving both civilian and military mobility
Energy Sector	(i) contribute to the development of projects of common interest relating to further integration of an efficient and competitive internal energy market, interoperability of networks across borders and sectors, facilitating de-carbonisation of the economy, promoting energy efficiency and ensuring security of supply (ii) facilitate cross-border cooperation in the area of energy, including renewable energy
Digital Sector	contribute to the development of projects of common interest relating to the deployment of and access to safe and secure very high-capacity networks, including 5G systems, and to the increased resilience and capacity of digital backbone networks on Union territories by linking them to neighbouring territories, as well as to the digitalisation of transport and energy networks.

Source: Based on Regulation (EU) 2021/1153 establishes the Connecting Europe Facility

[2] Art 14. 1.e of Regulation 2021/1153 of the European Parliament and of the Council

[3] Art 15. 5 of Regulation 2021/1153 of the European Parliament and of the Council

As commented in Annex 2, Synergy components of CEF and other development programmes and of the impact of state aid and other rules, an important objective of the CEF is to deliver increased synergies and complementarity between the transport, energy and digital sectors, thus enhancing the effectiveness of Union actions and enabling the costs of implementation to be minimised.

The proposed areas that could be implemented without significant change in terms of impact on project timeline or CAPEX are:

1. Telecommunication wayleaves
2. Deployment of a cross-border 5G mobile network (Neutral Host approach)
3. Deployment of a cross-border fibre optic backbone transport network (Neutral Host approach)
4. Implementation of smart stations and installation of smart stations digital infrastructure and provision of smart services.
5. Deployment of edge computing infrastructure
6. Information network and digital infrastructure funding programmes
7. Installation of renewable energy generation sources. PV modules and mini wind turbines
8. Utilisation of the energy subsystem (mainly traction substations) to transfer renewable electrical energy to the electrical grid
9. Development of battery electrical vehicle charging infrastructure (BEV)
10. Development of fuel cell electrical vehicle infrastructure (FCEV)
11. Construction of local connections in order to facilitate accessibility for relevant industrial, defence and/or logistics areas

2.1 TELECOMMUNICATION WAYLEAVES

Firstly, it shall be noted that Rail Baltica Design Guidelines do not include concepts such as “rights of way” / “wayleaves” or analogous since same are not engineering matters but rather a country regulatory and legal framework issue. Likewise, to seek legal advice before entering into any sort of agreement on this regard is highly recommended given the complexity and the potential long-term impact this may have. In any case, it is recalled what is indicated in section 3.1.2.4 of this report with respect to the European Commission Directive of December 2012 in which revised guidelines were adopted to achieve the ambitious goals of the EU Digital Agenda, such as **reinforcement of open access**, in which the consumers should benefit from a **truly open network where competition is ensured**.

That said, this section will include some **general interest content** to be considered in relation to some key concepts such as rights of way wayleaves, how services (such as optical fibre) may be articulated in the railway network, and some references on infrastructure managers based on European regulations, with the purpose of making a preliminary sketch of how all these concepts are coordinated mainly in Europe. It must be taken into consideration that the following considerations do not constitute an exhaustive study but rather a mere approach to how some key concepts are treated in accordance with general international practice.

It must be taken into consideration that the following considerations do not constitute a regulatory or a legal study but rather an approach to how some key concepts are treated in accordance with general international practice.

Traditionally and based on general international practice, a “wayleave” is an agreement between the owner or land user (the grantor) and a third party (the grantee, typically a utility company) permitting the grantee **to access** privately-owned land to carry out works (such as cabling installation or other equipment) **in return for compensation**. For instance, an electrical wayleave agreement is often an annually renewed right of use for apparatus over or under private land for which payment is made. Therefore, there are restrictions on third party access to the railway corridor.

There are jurisdictions whose regulations require the **railway administrator** to be the one who holds the ownership of the assets where the railway is framed for security reasons mainly and be the ones who **grant access to third-party providers** (such as telecom providers) offering them the infrastructure **in conditions of reliability, availability, maintenance and safety**. This is the current Spanish business model in which ADIF **rents** out space or facilitates the **use** of certain optical fibre as the owner of the infrastructure and not allowing, for instance, third parties to lay cable in its ducts (Case Study W.1).

The usual practice in this context is to grant access to service providers if the traffic or the railway management itself is not compromised. This would be consistent with European regulations which aims to guarantee **open access**. Although market conditions differ from one country to another, in a context of free competition, regulation regarding this matter is limited.

Based on the foregoing, dark optic fibre additional-auxiliary service may be embedded in the sphere of lease agreements or right-of-way/use for its installation and maintenance. Thus, Rail Baltica as a Global Project could set out the general conditions for services providers to access dark fibre optic as well as 5G mobile infrastructure (additional services and ancillary service facilities as referred to in point 2 and 2 of Annex II of Directive 2021/34/EU.

In this "open access" context, in reference to how services can be provided, dark optic fibre additional-auxiliary service may be embedded in the sphere of lease agreements. Thus, Rail Baltica as a Global Project could set out the general conditions for services providers to access dark fibre optic as well as 5G mobile infrastructure (additional services and ancillary service facilities as referred to in point 2 and 4 of Annex II of Directive 2021/34/EU.

Additionally, *“Private involvement in communication networks is huge. It is therefore very important* ***to allow access to the infrastructure in an open and competitive market****, and not to disturb this competition*[4]*”.* In this respect it is important to mention the **Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018***, which establishes a harmonised framework for the regulation of*

[4] Page 38 ECORYS Nederland BV (NL), COWI (DK) and ECN (NL) (2006) Synergies between Trans-European Network. https://ec.europa.eu/ten/transport/legislation/doc/2006_08_report_ten_synergies_en.pdf

electronic communications networks, electronic communications services, associated facilities and associated services, and certain aspects of terminal equipment. It lays down tasks of national regulatory authorities and, where applicable, of other competent authorities, and establishes a set of procedures to ensure the harmonised application of the regulatory framework throughout the Union"

"It should be recognised that the communications sector is in general a commercially viable market. ***Public interventions should therefore be directed at stimulating to open communications networks previously dedicated*** *(e.g., to rail, road, electricity)* ***to wider communication uses****.* ***This can also include the option to bring in private (commercial) partner to operate the communication part***[5]".

On the other hand, and in relation to how some countries treat the "rights of way":

- **Germany:** "*under the German Telecommunications Act (TKG), the operators of public telecommunications networks are entitled to use thoroughfares (public roads, paths, squares, bridges and waterways) for* ***deploying telecommunications lines free of charge****. On application,* ***this free use is authorised*** *by the Federal Network Agency for Electricity, Gas, Telecommunications, Post and* ***Railways****.* ***The application must designate the area for assigning right of use****. The deployment of telecommunications lines also requires the consent of the agency in charge of road construction, for example the local urban or municipal authority and possibly others, such as the office for the protection of architectural monuments.* ***The powers of the municipality are confined to technical matters, such as cable laying depth, safety and ease of traffic flow***".

- **Netherlands:** *"The legal requirements in the Netherlands do not make a distinction between rights of way for the last mile or other parts of the network.* ***Rights of way are granted by law to anyone who wants to install, maintain or remove a public electronic communications network****. Before installing a network, any installer* ***needs administrative approval*** *of the municipality with respect to the timing of the construction, the specific location and the way the works will be carried out, including safety measures taken. The municipality cannot refuse a licence"*

- **New Zealand:** *"Public entities other than municipalities have no jurisdiction for granting public ROW, but public* ***entities responsible for national highway and rail infrastructure have jurisdiction over rights of way with respect to the national highway and rail corridors****".*

- **Spain:** *"the Spanish Constitution states limitations to regional and local administrations in the development of their own regulations. Article 148.1.3 of the constitution provides that Regional Communities may have jurisdiction for land distribution, town planning and dwelling-related issues and, through Article 148.1.9, they may have jurisdiction for environmental management issues. Furthermore,* ***Article 149.1.21 provides that the State has exclusive jurisdiction for telecommunications****. The pertinent legislation for the regulation of the rights of way is provided for*

[5] Page 10 ECORYS Nederland BV (NL), COWI (DK) and ECN (NL) (2006) Synergies between Trans-European Network. https://ec.europa.eu/ten/transport/legislation/doc/2006_08_report_ten_synergies_en.pdf

in General Spanish Act 32/2003, of 3 November, on telecommunications; in Royal Decree 424/2005, of 15 April, wherein the regulations on the conditions for the supply of electronic communications services, universal service and user protection are approved; and in Royal Decree 1066/2001, of 28 September, wherein the regulations providing the conditions of radio electric public domain protection, restrictions to radio electric emissions and health protection measures against radio electric emissions are approved. Regardless of the above, regional and local administrations are also drafting their own regulations, mainly related to the environmental and town-planning issues for which they are responsible"

Based on the foregoing, **it is of utmost importance for all operators to know beforehand which are the applicable laws**, which entity with jurisdiction grants public rights of way and which entity is responsible for settling disputes. In many countries, authorisation to use public lands may also be subject to other legislation which aims at meeting other objectives, such as environmental protection or the preservation of historic sites etc.[6]"

Therefore, it can be affirmed that the general practice seems to indicate that it is common that the railway manager holds the ownership of the railway line and is the one who decides and grants the service providers access permits (for example via the bidding process or contract) so they can provide their services within the railway line owned by the Member State.

It is clear that technology advances by leaps and bounds, causing many situations in which the law is positioned behind of what is happening. This situation is one of the reasons why it is reasonable for a single public managing body and owner to analyse and determine what has to be transformed, in any case.

An example of this could be the case of Ireland, where "*a number of telecom companies have approached the rail operator Iarnród Éireann seeking to use its communications lines to develop their own networks. It is understood that at least one of them indicated that it would be willing to pay over €1 million for access to the State rail company's fibre optic network, which would be capable of carrying broadband signals".* The rail operator responded, *"We will consider any proposal, but at this point we do need to assess what our existing needs are and what they will be in the future, particularly in light of Transport 21 (the government's transport plan) which allows for expansion of rail services*[7]".

The railway operator is the one responsible for the asset where the railway is framed for conditions of reliability, availability, maintenance and safety and be the one who grant accessibility to third-party providers (such as telecom providers) for example via the bidding process of contract or lease agreements.

This would be consistent with European CEF Digital regulations which aims to guarantee open access.

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[6] Page 15 OECD (2008), "Public Rights of Way for Fibre Deployment to the Home", OECD Digital Economy Papers, No. 143, OECD Publishing, Paris, https://doi.org/10.1787/230502835656

[7] https://www.irishtimes.com/business/telcos-approach-irish-rail-over-network-development-1.1006746

2.2 INFORMATION NETWORKS AND DIGITAL INFRASTRUCTURE

European policy states that the achievement of the EU Digital Single Market relies on the available digital connectivity infrastructure. The digitalisation of Union industry and the modernisation of sectors like transport, energy, healthcare and public administration depend on universal access to reliable, affordable, high and very high-capacity networks.

Digital connectivity has become one of the decisive factors in closing economic, social and territorial divides, supporting the modernisation of local economies and underpinning the diversification of economic activities. The scope of the intervention in the area of digital connectivity infrastructure should be adjusted to reflect its increasing importance for the economy and for society at large.

Low connected territories throughout the Union represent bottlenecks and unexploited potential for the Digital Single Market. In most rural and remote areas, high-quality internet connectivity can play an essential role in preventing digital divide, isolation, and depopulation by reducing the costs of delivery of both goods and services and in partially compensating for remoteness. High-quality internet connectivity is necessary for new economic opportunities, such as precision farming or the development of a bio-economy in rural areas.

The synergic actions proposed will contribute to providing all households in the RB GP economic corridor, whether rural or urban, with very high-capacity fixed or wireless connectivity, focusing on those deployments in respect of which, a degree of market failure is observed that can be addressed using low intensity grants.

It is expected that the synergies of actions supported will be maximised, taking into account the level of concentration of socio-economic drivers in the Baltic area. Moreover, the RB GP backbone fibre optic will aim to achieve comprehensive coverage of households and economic corridor territory.

The deployment of this backbone information network, including connecting cross border European territories to submarine cables is needed to provide necessary redundancy for such vital infrastructure, to increase the capacity and resilience of the Union's digital networks and to contribute to territorial cohesion.

The synergic opportunity is fully aligned with EU funding objectives. On 9 March 2021, the Commission adopted the Communication "The 2030 Digital Compass: the European way for the Digital Decade" ('Digital Compass Communication'). This includes addressing vulnerabilities and dependencies as well as accelerating investment. The Communication proposed to agree on a set of digital principles, to launch rapidly important multi-country projects, and to prepare a legislative proposal setting out a robust governance through a monitoring and cooperation mechanism with Member States, to ensure progress – the Policy Programme "Path to the Digital Decade ('Policy Programme')".

Under the Multiannual Financial Framework, the MFF, the digital strand of CEF is worth €2.07 billion (in current prices) and will fund connectivity projects in the period 2021-2027. Actions foreseen under CEF Digital include:

- developing and making available very high-capacity networks, including 5G systems, across Europe
- supporting increased security, resilience and capacity of the digital backbone networks in the EU
- boosting the digitalisation of transport and energy networks

CEF Digital will fund projects that contribute to the deployment of 5G infrastructure along cross-border corridors. Cross-border connectivity will ensure the continuity of 5G services across borders and in important industry cases. This includes connected and automated mobility, automated manufacturing operations and more. The investments will be dedicated to motorways, ports, railways and in-land waterways to enable innovative services for passenger and freight transport.

CEF Digital will fund projects that deploy 5G connectivity for smart communities, for example schools, hospitals and community centres to improve access to online services and digital skills.

2.2.1 DEPLOYMENT OF A 5G MOBILE CROSS-BORDER NETWORK: NEUTRAL HOST

2.2.1.1 Synergy Scope

The synergistic measure consists of deploying a 5G network along the railway line, installed and operated by a Neutral Host, and providing advanced 5G services along the corridor.

The 5G mobile network should support advanced high bandwidth 5G services, so it needs to be deployed at mid (2.1-2.6 GHz, 3.3-4.2 GHz) and, if possible, high (e.g., 26 GHz and 40 GHz) spectrum bands.

The high bandwidth 5G mobile network should complement the FRMCS Network supporting ERTMS (ETCS and operational voice communication) at the corridor which is already included in the Rail Baltica Design Guidelines, both 5G networks being totally independent and isolated from each other.

This high bandwidth 5G mobile network can provide the next services for rail:

- Performance communication services and other operation-related applications.
- Business communication services and applications: advanced voice, data and video services. Connectivity for customer services.

Without this 5G mobile network, implemented at mid/high spectrum bands, the provision of advanced services requiring high bandwidth will not be possible. The implementation of some of the 5G advanced services included in performance and business applications, such as video on-demand, will require rolling out this additional 5G network, offering mid and high spectrum radio coverage all along the corridor.

As mid/high frequency radio waves have a shorter physical range, high bandwidth 5G network geographic cells will be smaller than FRMCS network cells, which are based on low frequencies.

As to provide the corridor railway line with full coverage with 5G NR nodes radiating at mid/high spectrum bands, and consequently being able to support advanced high-speed and high bandwidth services, a great number of nodes (sites) will have to be deployed in comparison to the FRMCS network, making the deployment of this high bandwidth 5G network very costly.

In order to cover the important investment that the roll-out of such 5G network implies, it is recommended to share the cost with all the communication and non-communication entities interested in its deployment, reducing costs and increasing efficiency, the business model suggested being a Neutral Host solution.

Under the Neutral Host model, a third neutral party shall roll out a "neutral" shared advanced high bandwidth 5G network and shall offer private and public communication services to all the MNOs and other non-communication entities that could need 5G network services.

The Neutral Host model can be beneficial for all involved stakeholders:

- The neutral third party acting as a Neutral Host will invest in installing and operating the advanced 5G network, obtaining incomes and revenues from the provision of 5G services.
- MNOs will experience a significant cost reduction, mainly due to the reduced need for both investments and operating activities like maintenance.
- Non-communication entities requiring 5G network coverage will receive the required advanced 5G services, without needing to deploy a private communication network, which is not part of its ordinary operational business, and therefore they are able to focus on customers' needs and on the provision of services based on 5G to the Baltic society. A 5G mobile network could support 5G coverage adjacent to the railway line, in rural and less populated areas where main operators and carriers have less incentive for improving connectivity, consequently helping with the 5G introduction in market-failure areas and collaborating with the society digitalisation.

The neutral third-party acting as 5G Neutral Host will use the infrastructure and 5G network to provide communication services on its own and to offer infrastructure and logical networks (network slices) to other operators and non-communication entities. As a result, Virtual Mobile Network Operators (VMNO) and non-communication entities can extend their services in areas not covered with own resources.

Through "Network Slicing" supported by 5G, the Neutral Host will be able to provide the following services:

- network slices, consisting of virtualised resources in RAN, creating an independent end-to-end logical network, capable of providing a negotiated service level agreement (SLA)
- edge and core network services
- extension of 5G coverage for operators or any other parties willing to deploy their services in specific area

<u>Customers</u>

The potential customers for the 5G network, deployed and operated by the Neutral Host, are at least following entities:

- **Mobile network operators**: This 5G network deployed along the Rail Baltica corridor will pass through areas where typically 3-4 MNOs will be interested in having overlapping networks, which results in huge potential for optimisation of future infrastructure deployment with network sharing.
- **Administrators and operators of roads and highways in the proximity of the Baltic corridor**: The implementation of a CCAM system or another kind of 5G supported services, depends on a 100% complete and densified 5G mobile coverage of the road. Deployment of 5G networks along the high-speed roads at the transport corridor, is a key factor.
- **Industrial players:** Companies and enterprises in areas near the corridor, adopting new technologies within the framework of the Smart Factories and Industry 4.0, might require installing and managing their own private and local 5G network. This private 5G networks can be a virtual private network provided by the 5G network managed by the Neutral Host.
- **Municipalities and local governments** in the proximity of the Baltic corridor, which are interested in supporting the implementation of advanced 5G based services in cities or towns, forming part of the smart city ecosystem, could demand a 5G network to be deployed locally in order to provide the advanced services.

- **Logistic areas, technology parks, university campuses, ports, mining, construction sites, commercial areas, venues and other entities** demanding the implementation of private 5G local networks for the provision of 5G specific applications and advanced services needed by the entities.
- **The Rail Baltica railway administrator** itself can be a customer of this advanced high bandwidth 5G Network, making use of it for the provision of performance and business communication high bandwidth 5G services.

For serving the different 5G customers, the Neutral Host 5G network could implement different network slices, offering specific 5G resources tailored for each particular customer and use case. Each network slice will create a virtual 5G network that can be software managed by the customer.

Each 5G network customer will negotiate with the Neutral Host provider the Quality of Service (QoS) and Service Level Agreement (SLAs) required.

Network slices of different customers shall be properly separated for security reasons.

Neutral Host 5G Network Coverage

A Neutral Host 5G Network implemented along the Rail Baltica corridor would provide 5G coverage in a band around the corridor railway line. The width of the 5G coverage band will depend on the deployed spectrum bands, being the lower the frequency, the bigger the coverage range reached.

Towers built with low spectrum radio bands can offer service within 15-20 km radii, with 5G service that ranges in speed from 30 to 250 megabits per second (Mbps).

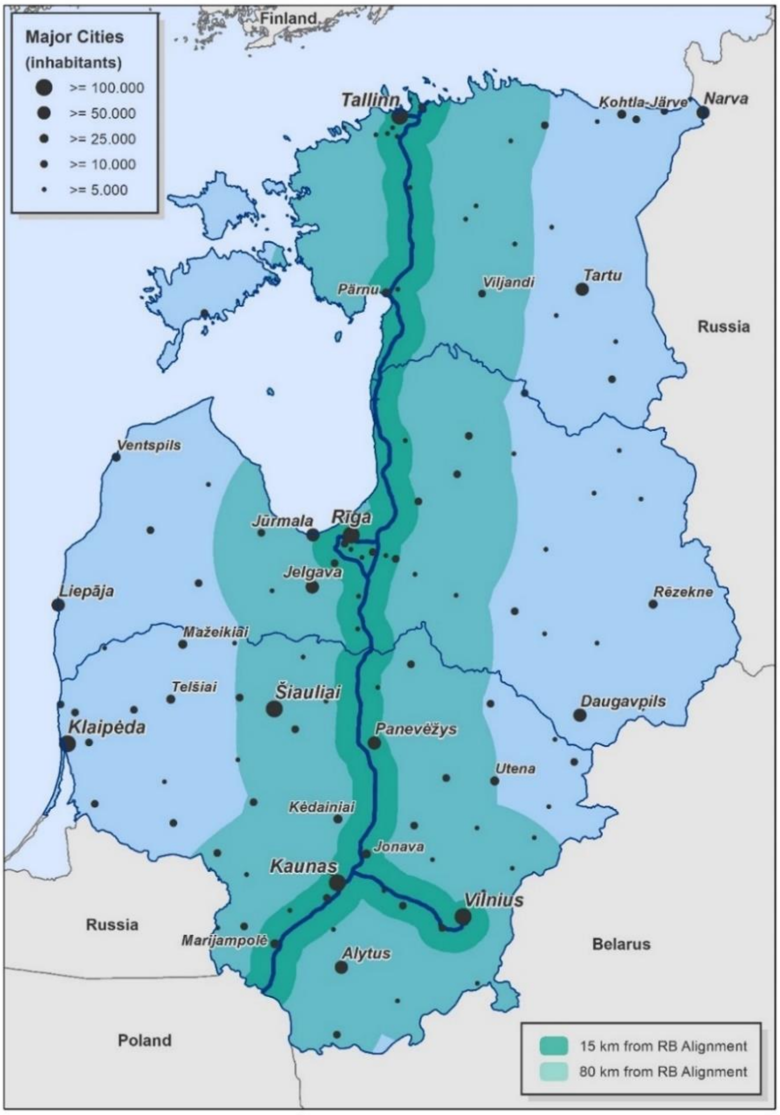
Towers built with mid band radios can offer service within several-kilometres radii, with 5G services currently ranging from 100 to 900 Mbps.

Finally, a high band tower covers a 1,5 kilometres or lower radius, while delivering speeds from 1 to 3 Gbps.

Taking into consideration the location of cities and towns around the railway corridor and the population concentrated in the urban nucleus, with a 5G network deployed along the Rail Baltica railway corridor it is possible to reach the following population:

Distance (km)	Total Population (hab.)
5	1,948,986
10	2,616,285
15	2,758,620

Figure 9: Location of Major Cities Near Rail Baltica Network



Source: Rail Baltica Web GIS, Rail Baltica alignment from Rail Baltica Web GIS, GISCO – Eurostat and Eurogeographics data

The total population of the three countries being about 6,200 million people, depending on the source, a 5G network built along the railway corridor could reach directly about 44% of the total population.

Additionally, Neutral Host could improve 5G coverage in additional areas surrounding the corridor, building 5G network branches connected to the main network. This way would be possible to increase 5G coverage in rural and less populated, collaborating with the society digitalisation.

2.2.1.2 Review of Areas of the Rail Baltica Design Guidelines

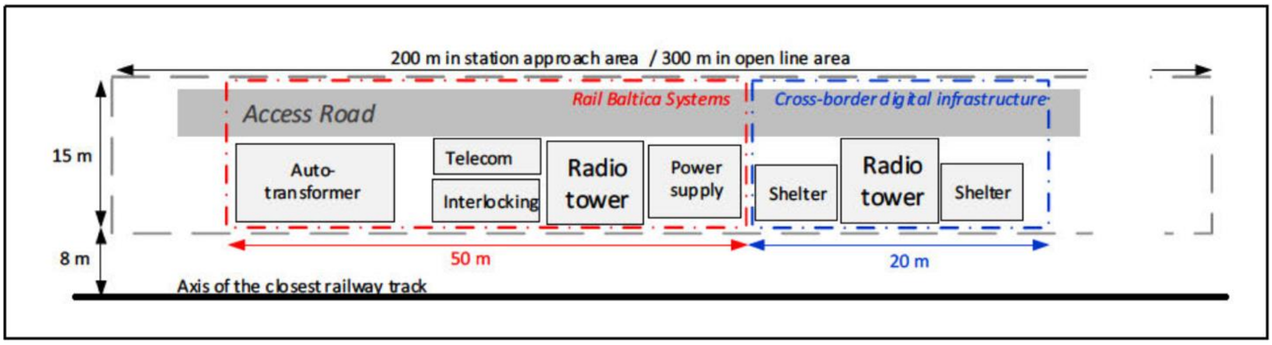
The design parameters for the 5G network along the railway line, installed and operated by a Neutral Host would be constrained by the layout of Rail Baltica network. Compatibility with telecommunication systems and with system equipment locations is required.

The design and installation of a 5G mobile network should follow the **Rail Baltica Design Guidelines**, particularly the following ones:

- General Requirements

At **Rail Baltica Design Guidelines** *"General Requirements" Section 14* system equipment locations are included in the specification, as well as the details of the land plot reservation areas reserved for the installation of system equipment:

Figure 10: Land Plot Reservation Area at System Equipment Location



Source: RB Design Guidelines "General Requirements" Section 14

At the land plot reservation area there exist a part destined for cross-border digital infrastructure, where there is space reserved for the deployment of the next equipment:

- telecommunication equipment cabinets
- optional radio tower

These facilities can be used for the installation of the Neutral Host 5G network equipment and infrastructure. By installing Neutral Host equipment and infrastructure in this location physical separation between the railway systems and the Neutral Host system is achieved.

The design guideline requirements for the land plot area already requires an independent and specific fenced area for the non-railway equipment, so the Neutral Host could access to this area without needing to pass through railway facilities.

The optional tower at the land plot reservation area could be used for installing the Neutral Host 5G antennas.

2.2.1.3 Impact on Project Timeline

The design and construction of a **Neutral Host 5G network along the railway line could be carried out parallel** to the construction of the Rail Baltica FRMCS network with**out impact on Rail Baltica timeline**.

Anyway, the implementation of a 5G mobile network capable of providing advanced services require a great number of NR nodes to be deployed.

As for the timeline of a Neutral Host 5G network, the following phases could be considered:

- **Preparatory phase**: it would comprise feasibility studies (including analysis of funding sources), radio planning and 5G network concept design, with an estimated term of 12 months.
- **Design phase**: it would include the detailed design of the Neutral Host 5G network, the detailed implementation plan of the action, administrative permits and licences, and the application for European/national funding, lasting around 12-18 months.
- **Construction phase**: depending on the complexity of works, the construction and commissioning of the 5G network would take 18 - 36 months.

Therefore, and taking into account that some phases could overlap, the total duration for the implementation of a **Neutral Host 5G network along the railway line** would amount 48 - 60 months.

2.2.1.4 Impact on Cost

The implementation of a 5G mobile network capable of providing advanced services requires a great number of NR nodes to be deployed, which is very costly. The final costs will depend on the number of sites deployed according to the radio frequency plan. Regarding the costs of a 5G mobile network, an average cost of 0,05-0,2 M€/km can be considered for the construction and installation of railway telecommunication sub-systems depending on the number of sites finally deployed.

Despite the previously mentioned average costs, the Neutral Host model will help to share this cost with other stakeholders interested in the deployment of the 5G mobile network.

2.2.1.5 Funding Programmes

This specific output is developed for all the information network and digital infrastructure paragraphs in section *3.2.2.5 Information Network and Digital Infrastructure Funding Programmes*. The content can be found there, which is the same for all information networks and digital infrastructure synergy proposals.

2.2.2 DEPLOYMENT OF A FIBRE OPTIC BACKBONE TRANSPORT CROSS-BORDER NETWORK: NEUTRAL HOST

2.2.2.1 Synergy Scope

The synergistic measure consists of deploying a **fixed backbone transport network** based on **fibre optic** technology along the railway line, installed and operated by a Neutral Host, and providing broadband access and transport communication services along the corridor.

Deployment of an optical transport network helps to create a managed optical backbone transport network along the Baltic corridor suitable for other non-rail uses. This network could be used for offering telecommunication transport and access services in areas along the line and at its proximity.

The fixed backbone transport network should support high-capacity broadband communication services and would increase the corridor total communication network capacity, offering bandwidth for non-rail uses.

This FO backbone transport network should complement the fibre optic network required for the railway corridor operation, already included in the Rail Baltica Design Guidelines, these two FO networks being totally independent from each other.

This high-capacity fixed backbone transport network can be applied for providing the next services:

- Transmission of voice, data, and video services: Digitalisation implies a growing bandwidth in all the data networks demanding more transmission resources on the backbone network. HD video surveillance, Wi-Fi connections, and wireless transmission services are becoming increasingly important to railway and non-railway systems.
- Backbone connectivity for transport networks of communication operators and internet providers.
- Fibre optical backhaul, mid-haul and front-haul connection to mobile access networks.

The proposed backbone transport network shall be based on fibre optic technology, the transport nodes connected through fibre optical cores, providing ultra-high bandwidth, long distance transmission, immunity to electromagnetic interference and low latencies.

The fibre optic cables required for the implementation of the fixed backbone transport network would be provided by the railway administrator, which would oversee the installation, operation and management of the FO cables (also including the cable ducts). The railway administrator would lease the use of dark fibre optic to the third party operating the transport network, establishing a clear limit between the railway facilities and the transport network operator facilities, through specific optical distribution frames (ODFs), avoiding any kind of interference of the transport network operator in the railway infrastructure.

Regarding the technology supported by the fixed backbone transport network, it should support high bandwidths of at least 40 GbE and 100 GbE per wavelength over the same fibre optic core. Using DWDM technology, the backbone transport network would be able to transmit multiple wavelengths per fibre optic core, increasing immensely the transmission capacity of the network.

In order to finance the important investment that the deployment of such FO backbone transport network implies, it is recommended to share the cost with a similar business model to the one suggested for the 5G mobile network operation, a business model based on a Neutral Host solution.

In the framework of the Neutral Host model, a third neutral party shall install and operate a “neutral” FO backbone transport network and shall offer private and public high-band transport communication services, to all the communication operators and other non-communication entities interested in data transmission services.

The same as the Neutral Host providing the 5G services, the Neutral Host model can be beneficial for all the involved stakeholders:

- The third-neutral-party acting as a Neutral Host will invest in installing the FO transport nodes and operating the fixed backbone transport network, obtaining incomes and revenues from the provision of transmission services.
- Communication operators and internet providers will experience a significant cost reduction, mainly due to the reduced need for both investments and operating activities like maintenance.
- Customers requiring fixed connectivity will receive the required transmission services.
- Baltic society: A broadband backbone transport network could support introduction of broadband access in areas surrounding the railway line, especially in rural and less populated areas where main operators and carriers have less incentive for improving connectivity, consequently helping with the broadband access introduction in market-failure areas and collaborating with the society digitalisation.

Being the Neutral Host model proposed for the management of the FO backbone transport network, in the same way the Neutral Host model is proposed for the 5G network management, it could be more efficient having a single third-party perform both functions.

<u>Customers</u>

The potential customers for the FO backbone transport network operated by the Neutral Host are at least following entities:

- Mobile network operators: The FO backbone transport network deployed along the Rail Baltica corridor will go all along the three Baltic countries, creating a strong potential for facilitating a connected MNO infrastructure all over the three countries.
- Communication operators and internet providers interested in long distance high-band transmission connections.

- Industrial actors: Companies and enterprises in the proximity of the corridor, adopting new technologies, could require high broadband links between different offices and factories located in geographically separated areas.
- Local communication operators interested in providing broadband access in areas surrounding the railway line, such as small cities, towns, rural areas, industrial and business areas.
- Municipalities and local governments in the proximity of the Baltic corridor interested in supporting the implementation of fixed broadband access services in cities or towns, forming part of the smart city ecosystem or supporting the digitalisation of the area.
- The Rail Baltica railway administration itself can be a user of this high bandwidth backbone transport network, transmitting non-critical high-band demanding services through the network.

The following could be a further use case of the FO backbone transport network:

Fibre optic transport network nodes can be a perfect interface for interconnection with non-railway access communication networks. Transport nodes could be easily installed on Rail Baltica sites (each 5-20 km) for offering access services to third parties which can offer communication access (e.g., metro Ethernet, PON, etc.) to small villages, residential or industrial areas, etc. and support last mile access surrounding the railway line.

This solution can be of advantage in rural and less populated areas where main operators and carriers have less incentive for improving connectivity and therefore it would help with broadband access introduction in market-failure areas.

2.2.2.2 Review of Areas of the Rail Baltica Design Guidelines

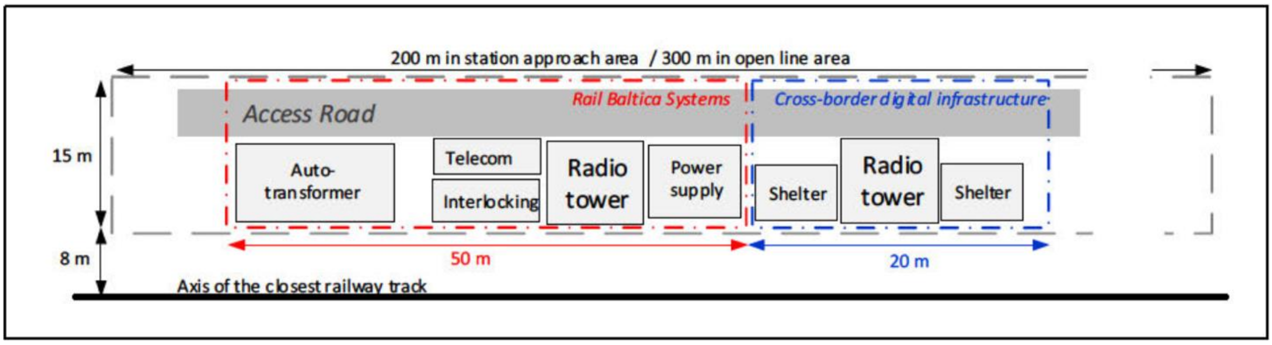
The design parameters for the deployment of a **fixed backbone transport network based on fibre optic** technology along the railway line, installed and operated by a Neutral Host would be constrained by the layout of Rail Baltica network. Compatibility with telecommunication systems and with system equipment locations is required.

The design and installation of a 5G mobile network should follow the **Rail Baltica Design Guidelines**, particularly the following ones:

- General Requirements.

In the **Rail Baltica Design Guidelines** ***"****General Requirements" Section 14. System Equipment Locations* the specification and the details of the land plot reservation areas reserved for the installation of system equipment are included:

Figure 11: Land Plot Reservation Area at System Equipment Locations



Source: Rail Baltica Design Guidelines "General Requirements" Section 14

In the land plot reservation area there is a part destined for cross-border digital infrastructure, where there is space reserved for the deployment of the future equipment:

- Telecommunication Equipment Cabinets.

These facilities can be used for the installation of the Neutral Host FO backbone transport network equipment and infrastructure. Installing the Neutral Host equipment and infrastructure in this area, ensures that physical separation between railway systems and Neutral Host systems is achieved.

The design guidelines requirements for the land plot area already requires an independent and specific fenced area for the non-railway equipment, so the Neutral Host could access to this area without needing to pass through railway facilities.

The dark fibre optical cables required for connecting the backbone transport network should be leased between the rail administrator and the Neutral Host. A clear limit between the railway facilities infrastructure and the Neutral Host infrastructure should be established, through specific Optical Distribution Frames (ODFs), installed in the cross-border digital infrastructure of the land plot area, avoiding any kind of interference of the transport network operator in the railway FO infrastructure.

2.2.2.3 Impact on Project Timeline

The design and construction of a **fixed backbone transport network based on fibre optic could be carried out in parallel** to the construction of the Rail Baltica fibre optic network with **no impact on Rail Baltica timeline**.

Anyway, the implementation of a backbone transport network capable of providing telecommunication transport services require a great number of transport nodes to be deployed.

Regarding the timeline of the design and construction of a fixed backbone transport cross-border network based on fibre optic, the following phases could be considered:

- **Preparatory phase**: comprises feasibility studies (including analysis of funding sources), and a network concept design with an estimated term of 12 months.
- **Design phase**: includes the detailed design of the "Neutral Host" backbone transport network, the detailed implementation, the plan of action, administrative permits and licences as well as the application for European/national funding, lasting around 12 months.
- **Construction phase**: depending on the complexity of works, the cable duct construction, cable laying, installation and commissioning of the transport network nodes would take 18 - 36 months.

Therefore, and considering that some phases could overlap, the total duration for the implementation of a **fixed backbone transport network along the railway line** would amount to 48 - 60 months.

2.2.2.4 Impact on Cost

The implementation of a fixed backbone transport network based on fibre optic requires transport nodes to be deployed and fibre optic cables to be leased to the railway administrator, being as a result a costly operation.

Despite of the previous average costs, the Neutral Host model will help to share this cost with other stakeholders interested in the deployment of the FO backbone transport network.

2.2.2.5 Funding Programmes

This specific output is developed for all the information network and digital infrastructure paragraphs in section *3.2.2.5 Information Network and Digital Infrastructure Funding Programmes*. The content can be found there, as it is the same for all information networks and digital infrastructure synergies proposals.

2.2.3 IMPLEMENTATION OF SMART STATIONS. INSTALLATION OF SMART STATIONS DIGITAL INFRASTRUCTURE AND THE PROVISION OF SMART SERVICES

2.2.3.1 Synergy Scope

Introduction

The synergistic measure consists of developing "Smart Station" digital infrastructure and digital services at the Rail Baltica Railway corridor stations, implementing the systems and technologies required for the provision of smart services, and deepening in the digitalisation and connectivity of the corridor railway stations.

Digitalisation and connectivity are main pillars of the Smart Station concept, and they are a necessary for the implementation of smart mobility at the stations.

The digitalisation of the railway stations should consist of two main parts:

- Deploying of digital and telecommunication infrastructures consisting mainly of broadband backbone communication networks all over the railway station
- Implementation and provision of advanced digital services

Broadband Backbone Communication Networks

Deploying telecommunication infrastructure will require the installation of broadband backbone communication networks reaching all parts of the station. The station backbone communication networks will be the digital infrastructures through which the advanced digital services will be provided and must provide high broadband access and fulfil the necessary requirements of redundancy and reliability.

The backbone communication networks could consist of the next different telecommunication networks:

- fibre optic high-broadband network, connecting switches and optical distribution frames (ODFs) located at offices and other facilities along the station
- multi-access switching network with switches located all over the station allowing gigabit access
- Wi-Fi access network along the station available for clients and workers
- FTTx to shops at commercial areas and other facilities
- provision of MNO 5G coverage all over the station for providing internet and 5G services to station customers through their own mobile company

The telecommunication infrastructure shall support the implementation of advanced digital services, so the services can be provided through different access networks. For instance, wireless access services could be provided via Wi-Fi or via 5G.

5G Coverage

A key target when it comes to implementing smart services is improving the customer satisfaction and customer experience (CX). The provision of public 5G mobile network coverage within the station is an important factor. Public 5G operators can have some issues with providing 5G indoor coverage in closed spaces due to walls and solid building cores that can leave plenty of radio dead spots inside a building and, therefore reduced data connectivity and phone coverage.

The solution for the 5G indoor coverage issue is locating the radio mobile signal source inside the building. So, in order to provide public 5G coverage inside the railway station it would be necessary to allow all the public mobile operator to install multiple antennas inside the station, a very intrusive and inefficient solution.

A most efficient solution would be the installation of a neutral Distributed Antennas System (DAS) all along the station building, acting as a group of small cells reaching all the indoor areas and supporting the 5G services for the station users.

A DAS is a network of spatially separate antenna nodes connected to a common source via a transport system that provides wireless services within a geographical area or a building. DAS are usually deployed within large facilities such as stadiums or commercial venues.

It improves coverage, repeating the mobile radio signal of the serving mobile operators within the indoor space.

A possible business model for the installation and operation of a DAS system, is a Neutral Host solution. Under the Neutral Host model, a neutral third party could roll out a multi-standard/multi-frequency and multi-operator DAS system, since a single antenna can distribute the signal for several frequencies and several operators simultaneously.

Smart Digital Services

Digitalisation of the railway stations should also include the provision of advanced digital services (smart services).

Implementation of existing and new use cases based in the different telecommunication access networks deployed at the station (e.g., 5G, Wi-Fi, fixed broadband access, FTTH) are also a fundamental pillar of the smart station.

Digital infrastructure can be used for providing the next smart services at railway stations:

- travel information for passengers
- entertainment for passengers while waiting for their trains
- digital passenger access to the boarding area, easing the transition through the station areas
- AR (augmented reality) for guiding passengers through the station and for supporting maintenance works at the station
- security applications such as high-definition real time video surveillance, access control and intruder detection
- IoT maintenance and operation, providing the implementation of a SCADA system, controlling different devices and sensors distributed along the station such as, for instance, electromechanical installations
- gathering data related to passenger counts, ticketing, installation operation etc.
- Intuitive interactive terminals in stations providing information to passengers arriving in an unfamiliar building
- wireless data communication for station personnel, helping them in daily station operation.
- wireless internet for passengers, provided through the mobile network or through Wi-Fi
- other advanced digital services

2.2.3.2 Review of Areas of the Rail Baltica Design Guidelines

The design parameters for the deploying of smart station digital infrastructure and digital services at the Rail Baltica Railway corridor stations would be constrained by the layout of Rail Baltica network. Compatibility with stations and telecommunication systems in them is required.

The design and installation of the smart station digital infrastructure and services should follow the **Rail Baltica Design Guidelines**, particularly the following ones:

- Stations and Passenger Platforms

Rail Baltica Design Guidelines "stations and passenger platforms" do not include any section related to the digitalisation of station, so implementation of smart stations could lead to a small number of new requirements regarding this topic.

2.2.3.3 Impact on Project Timeline

The design and construction of a smart station digital infrastructure and services could be carried out in parallel to the construction of the Rail Baltica stations with no significant impact on Rail Baltica timeline.

Including the design of the smart station Infrastructure in the design phase, makes it possible to minimise the impact on the project duration as the design and deployment can be carried out simultaneously with the rest of the station installations.

It is estimated that the smart station infrastructure deployment would not have a big impact on the project timeline, as the deployment can be carried out simultaneously with the rest of the station installations.

2.2.3.4 Impact on Cost

The impact on the costs of smart station digital infrastructure implementation and services will depend mainly on the station design, but it will have a similar implementation cost the other installations at the railway station.

On the other hand, the implementation of smart stations can help to increase the incomes and revenues through the provision of new services.

2.2.3.5 Funding Programmes

This specific output is developed for all the information network and digital infrastructure paragraphs in section *3.2.2.5 Information Network and Digital Infrastructure Funding Programmes*. The content can be found there, which is the same for all information networks and digital infrastructure synergies proposals.

2.2.4 DEPLOYMENT OF EDGE COMPUTING INFRASTRUCTURE

2.2.4.1 Synergy Scope

Introduction

This synergistic measure consists of deploying edge computing infrastructure along the railway line, and offering edge computing services, acting as a Neutral Host which operates the edge data centre hardware or offers space for installing the data centre of third parties.

With the emergence of new technologies such as 5G, Internet of Things (IoT) or the "Smart City" services, networks are requested to provide new computing capacities. Edge computing data centre address this new information processing needs by being as close as possible to the user.

For the deployment of low latency 5G services, 5G networks have introduced edge computing data centres located at the same site that the new radio Centralised Unit (CU). Usually CU can be a better option ins terms of supporting all the DU connected to the CU. The provision of services requiring low latencies will require service applications running on edge data centres instead of on the cloud.

However it is not only 5G technology requires the Implementation of edge computing centres, but also the extension of other data services associated with concepts such as smart city, smart factory or industry 4.0.

This new generation of small "data centres" will bring production and consumption areas closer to the data needed for the growth of low-latency services.

An important constraint for the installation of edge computing nodes, is the existence of a fibre optic broadband access and transport network to give direct connectivity to these edge data centres. This particularity would be fulfilled clearly for edge computing equipment installed along the Rail Baltica railway corridor.

Neutral Host Model

A possible business model for the installation and operation of edge computing infrastructure, is a Neutral Host solution. Under the Neutral Host model, a neutral third party could install and operate the "data centres" and offer edge computing services to other communication or non-communication entities.

Different models can be offered, from the total implementation of the edge application on the data centre to the provision of an edge server where the customers could run their own applications.

2.2.4.2 Review of Areas of the Rail Baltica Design Guidelines

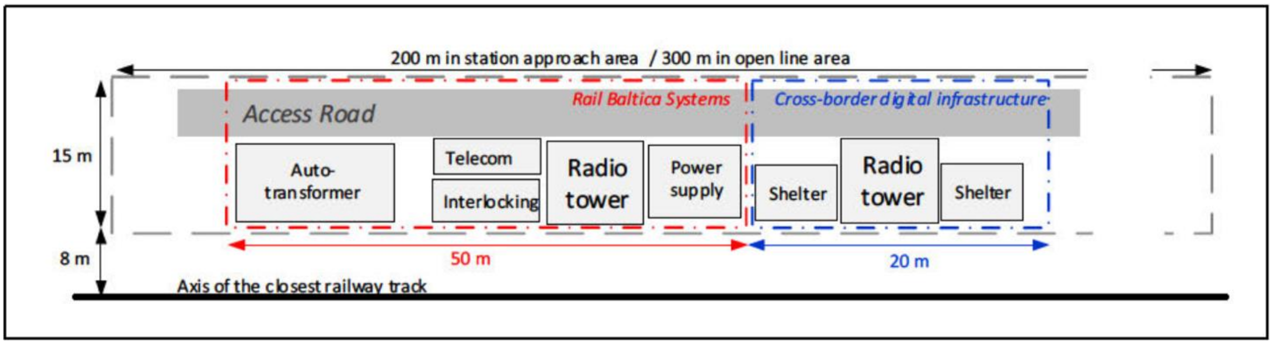
The design parameters for the deployment of edge computing infrastructure along the railway line, would be constrained by the layout of the Rail Baltica network. Compatibility with telecommunication systems and with system equipment locations is required.

The design and installation of edge computing centres should follow the **Rail Baltica Design Guidelines**, particularly the following ones:

- General Requirements

In the **Rail Baltica Design Guidelines "**General Requirements" Section 14. System Equipment Locations the specification and the details of the land plot reservation areas reserved for the installation of system equipment are included:

Figure 12: Specification and the Details of the Land Plot Reservation Areas Reserved for the Installation of System Equipment



Source: Rail Baltica Design Guidelines "General Requirements" Section 14

In the land plot reservation area, there is a sections destined to cross-border digital infrastructure, where there is space reserved for the deployment of the next equipment:

- Telecommunication Equipment Cabinets

These facilities can be used for the installation of the edge Computing equipment and needed infrastructure.

The dark fibre optical cables required for connecting the edge data equipment should be leased between the rail administrator and the Neutral Host. A clear limit between the railway infrastructure and the Neutral Host infrastructure should be established through specific optical distribution frames (ODFs) installed at the cross-border digital infrastructure in the land plot area, avoiding any kind of interference of the Neutral Host in the railway FO infrastructure.

2.2.4.3 Impact on Project Timeline

The deployment of edge computing centres along the line could be carried out in parallel to the deployment of the 5G network without any significant impact on Rail Baltica timeline.

Including the design of the smart station infrastructure in the design phase, makes it possible to minimise the impact on the project timeline, since the design and deployment can be carried out simultaneously with the rest of the station installations.

2.2.4.4 Impact on Cost

The deployment of edge computing centres along the line will not have a big impact on costs because part of the investment would already be addressed by the implementation of the 5G mobile network.

Despite of the previous costs, the Neutral Host model will help to share this cost with other stakeholders interested in the deployment of the edge computing centres.

2.2.4.5 Funding Programmes

This specific output is developed for all the information network and digital infrastructure paragraphs in section *3.2.2.5 Information Network and Digital Infrastructure Funding Programmes*. The content can be found there, which is the same for all information networks and digital infrastructure synergy proposals.

2.2.5 INFORMATION NETWORK AND DIGITAL INFRASTRUCTURE FUNDING PROGRAMMES

Considering the analysis of **funding sources** carried out in section 3.1. *Synergy Components of CEF and other Development Programmes and of the Impact of State Aid and Other Rules for Synergistic Opportunities*, the **deployment of 5G networks, high-capacity broadband backbone networks and digital infrastructure** could benefit from the following ones:

- **CEF2 funding**: *Article* 8 of Regulation (EU) 2021/1153 states *Projects of common interest in the area of digital connectivity infrastructure* which would fit to related **deployment of 5G networks, high-capacity broadband backbone networks and digital infrastructure:**

Article 8 deals with projects of common interest in the area of digital connectivity infrastructure as it follows:

*1. Projects of common interest **in the area of digital connectivity infrastructure** are those projects that make an important contribution to the Union's strategic connectivity objectives and/or **provide the network infrastructure** supporting the digital transformation of the economy and society, as well as the Union's Digital Single Market.*

2. Projects of common interest in the area of digital connectivity infrastructure shall meet the following criteria:

*(a) the project contributes to the specific objective provided for in **Article 3(2), point (c).***

*(b) the project deploys the **best available and best suited technology for that specific project,** which proposes the best balance in terms of data flow capacity, transmission security, network resilience, cyber security and cost efficiency.*

4. Without prejudice to the award criteria laid down in Article 14, priority for funding shall be determined taking into account the following criteria:

*(a) actions contributing to **deployment of and access to very high capacity networks, including 5G systems** and other state of-the-art connectivity, in accordance with Union strategic connectivity targets in areas where socioeconomic drivers are located shall be prioritised, taking into account the connectivity needs of those areas and the additional area coverage generated, including for households, in accordance with Part V, point 1, of the Annex; stand-alone deployments to socioeconomic drivers shall be eligible for funding, provided that those deployments are economically proportionate and physically practicable.*

*(c) actions contributing to **the deployment of 5G corridors along major transport paths, including on the TEN-T,** such as those listed in Part V, point 3, of the Annex, shall be prioritised to ensure coverage along those major transport paths, **enabling the uninterrupted provision of synergy digital services,** taking into account its socioeconomic relevance relative to any currently installed technological solutions in a forward-looking approach.*

*(d) projects of common interest which aim **to deploy** or significantly upgrade **cross-border backbone networks** linking the Union to third countries and to reinforce links between electronic communications networks within the Union territory, including submarine cables, shall be prioritised according to the extent to which they significantly contribute to the increased performance, resilience and very high capacity of those electronic communications networks.*

- **CEF2 funding**: Article 9 of Regulation (EU) 2021/1153 states the following *eligible actions* related to **deployment of 5G networks, high-capacity broadband backbone networks and digital infrastructure:**

2. In the transport sector, only the following actions shall be eligible to receive Union financial support under this Regulation:

(b) actions relating to smart, interoperable, sustainable, multimodal, inclusive, accessible, safe and secure mobility:

(ii) actions supporting telematic applications systems in accordance with Article 31 of Regulation (EU) No 1315/2013, for the respective modes of transport, including in particular:

- ***for railways: ERTMS.***
- *for inland waterways: River Information Services (RIS).*
- *for road transport: Intelligent Transport Systems (ITS).*
- *for maritime transport: Vessel Traffic Monitoring and Information Systems (VTMIS) and e-Maritime services, including single-window services such as the maritime single window, port community systems and relevant customs information systems.*
- *for air transport: air traffic management systems, in particular those resulting from the Single European Sky ATM Research (SESAR) system.*

4. In the digital sector, only the following actions shall be eligible to receive Union financial support under this Regulation:

*(a) actions supporting the **deployment of and access to very high-capacity networks, including 5G systems, capable of providing gigabit connectivity** in areas where socioeconomic drivers are located.*

*(c) actions **implementing the uninterrupted coverage with 5G systems of all major transport paths, including the TEN-T**, such as the actions listed in Part V, point 3, of the Annex.*

*(d) actions supporting **the deployment of new** or the significant upgrading of existing **backbone networks**, including submarine cables, **within and between Member States** and between the Union and third countries, such as the action listed in Part V, point 3, of the Annex, as well as other actions supporting the deployment of backbone networks referred to in that point.*

*(d) actions implementing **digital connectivity infrastructure requirements related to cross-border projects in the areas of transport** or energy or **supporting operational digital platforms directly associated to transport** or energy infrastructures, or both.*

- **CEF2 funding**: Article 10 of Regulation (EU) 2021/1153 states *Synergies between the transport, energy and digital sectors*, which would fit to related **deployment of 5G networks, high-capacity broadband backbone networks and digital infrastructure:**

*1. Actions **contributing simultaneously to the achievement of one or more objectives of at least two sectors**, as provided for in Article 3(2), points (a), (b) and (c), shall be eligible to receive Union financial support under this Regulation and to benefit from a higher co-funding rate, in accordance with Article 15. Such actions shall be implemented through work programmes addressing at least two sectors and including specific award criteria and shall be financed with budget contributions from the sectors involved.*

Regarding CEF2 funding, the timetable below describes the foreseen distribution of calls and the type of actions to take place over the entire CEF Digital funding period from 2021-2027.

Table 2 Distribution of calls and the type of actions to take place over the entire CEF Digital funding period from 2021-2027

CEF2 Digital 5G corridor deployment calendar										
Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Early Wave	Call Q4-Q1		Deployment (CEF/RRF)							
1st big Wave	Call Q4-Q1		Studies							
			Call Q1-Q2	Deployment (CEF/RRF)						
2nd big Wave (TBC)			Call Q1-Q2	Studies						
				Call Q1-Q2	Deployment (tbc)					
Last Wave (TBC)										

Source: Commission Implementing Decision on the financing of the Connecting Europe Facility – Digital sector and the adoption of the multiannual work programme for 2021-2025

- **InvestEU**: This programme will leverage substantial private and public funds that are protected through an EU budget guarantee that builds on the successful implementation of the European Fund for Strategic Investments (EFSI). One of its objectives is supporting financing and investment operations related to sustainable investment in the areas of transport, including multimodal transport, road safety and the renewal and maintenance of rail and road infrastructure, digital and transport systems, improving interconnection levels, digital connectivity and access, including in rural areas.

- **European Regional Development Fund (ERDF) and Cohesion Fund (CF)**:
  - The ERDF contributes to reducing disparities between the levels of development of the various regions within the EU and supports investments through dedicated national or regional programmes, including investments in infrastructure, equipment, software and intangible assets.
  - The CF provides support to Member States with a gross national income (GNI) per capita below 90% EU-27 average to strengthen the economic, social and territorial cohesion of the EU, including Estonia, Latvia and Lithuania for 2021-2027 period. This fund supports investments in the field of environment and trans-European networks.

- **Recovery and Resilience Facility (RFF)**: the aim of the RFF is to mitigate the economic and social impact of the COVID-19 pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions. A Member State wishing to receive a financial contribution from RFF shall submit to the European Commission a recovery and resilience plan. Estonia, Latvia and Lithuania have presented their Recovery and Resilience Plans, including investments and measures to increase the sustainability of transport and mobility.

  The **scope of the funding programme is set in Article 3,** being the second policy area digital transformation:

  The scope of application of the RFF shall refer to policy areas of European relevance structured in six pillars including digital transformation in its section b).

2.3 ENERGY INFRASTRUCTURE

Reflecting the importance of tackling climate change in line with the European Union's commitments to implement the Paris Agreement and the United Nations Sustainable Development Goals, RB GP should pursue synergetic actions to contribute to mainstreaming climate actions and to the achievement of an overall target of at least 30 % of Union budget expenditure supporting climate objectives.

Through its actions, the RB GP should contribute of the overall financial envelope to climate objectives, based, inter alia, on the following elements:

(i) expenditure relating to railway infrastructure, charging infrastructure, alternative and sustainable fuels, electricity transmission, electricity storage, and renewable energy.

(ii) multimodal transport, provided that it enables the use of renewable hydrogen to be increased.

The detailed climate expenditure tracking coefficients applied should be consistent with those set out in Annex I to Regulation (EU) 2021/1060 of the European Parliament and of the Council of ERDF and CF[8], where applicable.

Proposed energy infrastructure synergetic actions in Rail Baltica cross-border project enable the cost-effective deployment of renewable energy in Baltic area and the achievement of the Union's binding target of at least 32 % renewable energy in 2030 as referred to in Article 3 of Directive (EU) 2018/2001.

Actions include the generation of renewable energy from wind, solar energy, their connection to the grid and additional elements such as storage or conversion facilities. Actions would not be limited to the electricity sector and can cover other energy carriers and potential sector coupling with, for example hydrogen storage and transport.

2.3.1 INSTALLATION OF RENEWABLE ENERGY GENERATION SOURCES. PV MODULES AND MINI WIND TURBINES

2.3.1.1 Synergy Scope

The synergy consists of installing small wind turbines and PV modules to generate electric energy from renewable sources to be consumed in Rail Baltica's non-traction power supply system and preferably for the self-consumption with surplus option to be sold to the electricity companies.

[8] Regulation (EU) 2021/1060 of the European Parliament and of the Council of 24 June 2021 laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, the Just Transition Fund and the European Maritime, Fisheries and Aquaculture Fund and financial rules for those and for the Asylum, Migration and Integration Fund, the Internal Security Fund and the Instrument for Financial Support for Border Management and Visa Policy.

The main goals of this synergy are to reduce:

- the electrical energy consumption
- the environmental impact
- the production of carbon dioxide
- the costs of the electricity costs by self-consumption of the generated energy and by selling the surplus of generated energy that cannot be consumed simultaneously in Rail Baltica's electrical installations.
- and improve the efficiency of the non-traction power supply system, as the energy is produced in sites closer to the consumption site and therefore reducing energy losses

In accordance with the analysis carried out, both ways of generating energy, from PV modules as well as from mini wind turbines, are the optimal ones for several reasons:

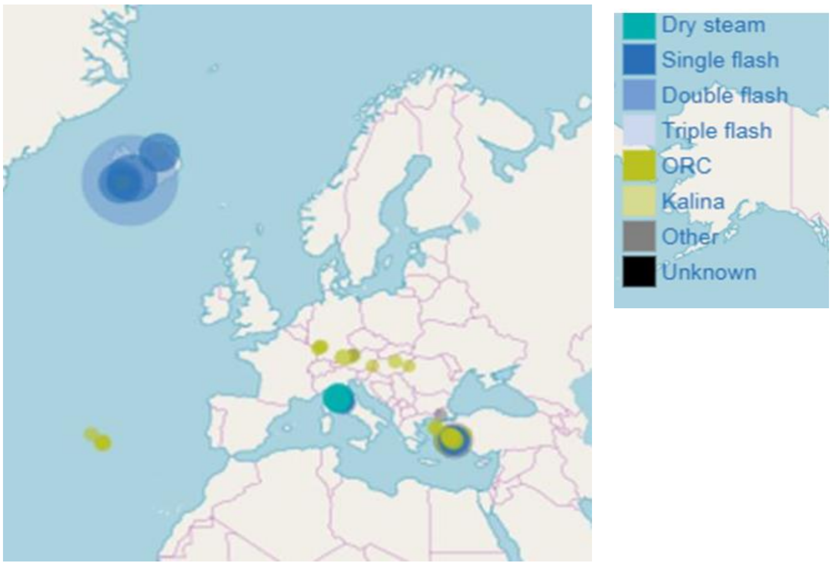
- the equipment to build solar and wind plants (such as PV modules, mini wind turbines and inverters) is a proven technology
- the CAPEX (Capital Expenditures), OPEX (Operational Expenditures) and LCC (Life Cycle Costs) are lower than other solutions of generating renewable energy
- long useful life
- the plants are easy to design, build, operate and maintain
- the supply and commissioning of the equipment and installations of the solar and wind plants could be carried out by a lot of companies as it is a liberalised market

Other forms of producing renewable energy from other sources have been studied, such as for geothermal and biomass plants, but they are not a good option for Rail Baltica's electrical system as other proposed in this report:

- Geothermal plants.

The following map shows the points with the greatest geothermal energy potential in Europe.

Figure 13: Europe Market for Geothermal Power



Source: https://ec.europa.eu/jrc/en/news/earths-geothermal-hotspots-new-dataset-launched

It is noted that the necessary conditions do not exist in the Baltic countries to produce electricity through geothermal-linked steam turbines or other technology.

The largest potential for geothermal energy within the Baltic countries is in Lithuania[9]. A study of geothermal energy in this country concludes by saying that it is not convenient to install geothermal power plants for the production of electrical energy[10].

This technology has a considerable economic potential only in areas where thermal water or steam is found concentrated at depths less than 3 km in restricted volumes, especially in regions with volcanic activity or fumaroles and hot springs, which are normally found near edges of the tectonic plates. The Baltic countries are not close to any plate boundaries.

- Biomass plants. These plants burn biological material to produce electrical energy. They are built far from urban centres, airports, railways, etc.

Small renewable plants, wind, as well as solar ones, would be built in Rail Baltica properties such as building roofs, parking lots, unused lands, etc. The properties should be selected so that the investment is minimal.

[9] https://www.geothermal-energy.org/explore/our-databases/geothermal-power-database/#electricity-generation-by-country

[10] https://www.geothermal-energy.org/pdf/IGAstandard/WGC/2000/R0653.PDF

These plants supply power directly to alternating-current (AC) non-traction power supply systems, in the same way these plants are connected to another electrical installations. It is not necessary a special design to integrate these plants in the non-traction power supply system.

There are the following installations options:

1. Self-consumption with surpluses. The energy surplus (energy generated and not consumed in the railway installations) is sold to the electricity companies.
2. Self-consumption without surpluses. All generated energy is consumed in the railway installations, which is achieved in two ways:
    a. Ensuring that the consumption curve is always above the generation curve, $P_{CONSUMED}(t)>P_{GENERATED}(t)$.
    b. Installing a self-consumption power regulator that ensures that the generated power does not exceed the consumed power at any time. This option implies that the generation capacity of the plant is not optimised, but nevertheless it is feasible option.

The current “Design Guideline: Railway Energy: Part 3 Non-traction Power Supply” includes the following statement: “It shall be verified if local redundant solar panel solutions or a small wind turbine could be an option”, so both sources of energy may be considered in the detailed design and the next stages.

The design should consider:

- Depending on the generated power, the wind or/and solar generators should be connected in low or medium voltage to the non-traction power supply system.
- In order to measure the energy transfer to the electrical grid, the measuring equipment must be able to measure the energy be-directionally: the one consumed and the one generated.

The energy generated by the PV power plants and mini wind turbines supplies energy to the non-traction installations, so that the consumptions fed by the non-traction installations are also supplied by the PV power plants and mini wind turbines.

Batteries for storing the excess of generated energy are not necessary and they are usually not installed in mini wind and solar plants as there is either no excess energy generated or if there is, it can be transferred to the electrical grid.

In remote and rural applications where the electrical grid does not reach or is very weak, batteries are often installed close to small renewable generators.

It is possible to combine the two ways of generation of electricity from renewable sources (mini wind and PV modules) to optimise energy generation cycles in 24-hour periods. Solar plants do not generate during hours of darkness, and wind turbines do not generate when the wind speed is not enough. A possible solution is to build solar and wind plants together wherever possible, so the power generation curve would be more uniform, making it easier to adjust generation and consumption.

The construction of a big number of small wind and solar plants is recommended, so the goals described above can be achieved.

The power of the small solar and wind plants should range between 10 and 100 kWp, Kilowatts peak, to adjust theses power plants to the demanded power of the non-traction installation. The installed power in technical buildings is usually less than 100 kW. In addition, throughout its operation, not all the equipment demands power simultaneously, and furthermore, each equipment does not always demand its nominal power but rather a lower power. Therefore, the average value of the power demanded at a technical building is usually much lower than the installed power. To adjust the installed power to the demanded power implies to make design, construction, operation and maintenance easier and more economical (within this power range there is a distinction between mini wind turbines and wind turbines).

Mini wind turbines are regulated by the international standard IEC 61400-2 ed 3. which applies to wind turbines with a swept area of less than 200 m^2 and generating electricity at a voltage of less than 1,000 V AC and 1,500 V DC for both on-grid and off-grid applications. Typically, mini wind turbines have a power between 3 and 60 kW.

The main advantages of small wind turbines are the ease of installation (low height, low weight), more possible installation sites: roofs of buildings, car parks, their lower power facilitates their use in small installations, they are compatible with solar inverters, they have low maintenance and have a useful life of 25 years, it is a proven technology, and this range of power is very adjusted to the needs of the non-traction power supply system.

Within the mini wind turbines there is a difference regarding the power control implemented. Turbines with less than 10 kW of peak power normally have a passive variable pitch power controller. This regulation system makes it possible to maintain the nominal operation of the turbine for a certain amount of the wind speed. This value is normally close to the nominal speed, so that strong wind speeds can stop the operation of the turbine. On the other hand, turbines above 10 kW usually have a better power control called active variable pitch power controller, which allows the turbine to operate almost exactly at the rated power at all wind speeds.

Small turbines have applications in a wide range of fields such as telecommunications, agricultural, residential, village and hotel industry.

For example, the regional government of Aragón (a Spanish region) supplies electricity to the telecommunication stations with renewable energy from small solar plants and mini wind turbines and uses batteries to ensure the power supply of the equipment in the remote area where the electrical grid does not reach.

Wind turbines with a capacity of 60-100 kW have a higher performance than mini wind turbines, but they need more space for their installation. Due to their high power, their use should be focused on self-consumption with surpluses or limiting the generation of electricity.

Figure 14: Mini Wind Turbine for Telecommunications

Source: Government of Aragón

Regarding the interests of Rail Baltica, this synergy would not have a significant impact on the timeline of the project if considered from the beginning of the design phase and developed parallel to the rest of the works with the appropriate means.

Distributed renewable micro-generation along the railway network is a measure currently being implemented across Europe to de-carbonise the sector.

Another advantage of this measure is that by creating new micro-generation points along the rail network and injecting surplus power into the grid, which is shared by the three Baltic states, it gets more meshed and more powerful. Through the digitalisation of measurements, it is possible to evaluate consumption data, purchased energy, surplus energy and thus to estimate different metrics such as self-consumption percentages. In other words, the system is digitalised.

In summary, this synergy will contribute to de-carbonise the railway environment, increase the energy efficiency, promote renewable energies and has the following associated socio-economic benefits that will allow for a quick payback:

- it reduces the amount of energy that must be purchased from the grid
- locally generated energy is consumed reducing energy losses due to transport
- surplus energy not consumed instantly is sold to the grid
- currently, the technology required has undergone a very significant cost reduction

Therefore, it is concluded that this synergy is perfectly aligned with the interests of Rail Baltica.

2.3.1.2 Review of Areas of the Rail Baltica Design Guidelines

- This synergy only affects “Railway Energy: Part 3 Non-traction Power Supply. As mentioned, only the installation of small renewable plants connected to non-traction installations has been considered. Due to the complexity of installing large renewable energy generation power plants that provide power to the traction power system, mainly because of the absence of converters in the market that capture the energy from these generation sources and transfer it into the OCS.
- The current guideline makes the following statement: “In general, it shall be verified if local redundant solar panel solutions or a small wind turbine could be an option”. Therefore, both options may be considered in the design and the next stages of non-traction power supply system.
- Depending on the power supplied by the renewable plants, PV modules or mini-wind turbines, the connection to the non-traction electrical system may be made in MV or LV:
    - MV, high power. Connection to substations MV / LV, there are two alternatives:
        - connection to MV / LV substations with power supply to consumers and power transfer from renewable sources
        - connection to exclusive MV / LV substations, dedicated only to transfer the power generated by renewable sources
    - LV, reduced power supplied at the level of electrical cabinets
- The installation of renewable plants could be supported by batteries, which allow to take advantage of the energy generated in its entirety in the railway installation, meaning that the excess energy not consumed should not be returned to the grid. The installation of batteries would allow:
    - When consumption exceeds generation, the difference is provided by the battery and the rest by the electrical network.
    - When the generation exceeds the consumption, the excess is stored in the batteries.

(However, as explained as explained above, batteries are not recommended for the small power plants proposed).

2.3.1.3 Impact on Project Timeline

If small renewable energy generation plants are considered in the systems design phase, their construction must be compatible with the expected timeline. It involves an additional cost but is compatible with CEF funding priorities and contributes to achieve the objectives of “Fit For 55”.

TWhen considering the implementation of renewable energy generation in the design phase, it is possible to minimise the impact on the project time, as the design, the construction, the testing and the commissioning are carried out simultaneous with the rest of the electrical installation

There is only a little impact in Rail Baltica timeline, very difficult to quantify, due to a small increase in complexity, the need to install more equipment and more labour.

2.3.1.4 Impact on Cost

Taking this measure into account in the initial design phase means that implementation costs are lower.

- Cost of PV plants

The costs depend mainly on the peak power of the installation, but it is also important to consider that the location, the technology of the module, the possible inclusion of batteries and mounting structures that give variability to the installation also have an influence.

The costs are estimated as a function of peak power and are based on data from the Spanish government eprocurement platform place (PLACE). This platform publishes information about prices of tenders published by public administration. Companies apply for the tender and submit a bid in order to be awarded the project. The award price is normally lower than the tender price. In the figure, the green dots represent the tender price, and the orange dots represent the award price (not all the award prices appear in the analysed documentation).

Table 3: Distribution of Bids

Power Peak Installations	Upper Reference	Average Awarded	Lower Reference
0-10 kWp	2.50 €/Wp	1.54 €/Wp	1.00 €/Wp
10-100 kWp	2.25 €/Wp	1.21 €/Wp	0.75 €/Wp

Source: INECO based on data from the Spanish Public Sector Procurement Platform

- Cost of Mini Wind Turbines Plants

The costs of the wind turbine, and the tower that supports it, increase with the power and size of the wind turbine. In general, the produced power will increase with the height of the tower as the wind speed increases with height. A taller tower is a significant financial investment, but the payback period is usually short. In addition, installation costs are very high depending on the location (e.g., accessibility and height), and any requirement for batteries and converters.

It is also important to know where the most frequent and strongest winds come from, in relation to the location where a wind turbine is to be installed. Whenever possible, this direction should be free of obstacles.

Regarding the wind speed of the location, it is important that the average wind speed exceeds 2 m/s, which is the minimum speed for the wind turbine to function and it is also recommended that it is close to but does not exceed the nominal speed at which maximum electricity production is achieved.

If the previous criteria are met, the payback period of the investment decreases considerably.

The retail prices of RyseEnergy's turbines and towers are shown below, as a reference:

Table 4: Wind Turbines Price List

Wind Turbines				
Model	**Power [kWp]**	**Type of Connection**	**Articles Included**	**Price [€]**
E3	3	On-Grid	Grid Connected, 1 ph., 50/60 Hz, 220V Grid controller and Inverter. (Configurable)	14,000
E3	3	Off-Grid	Battery connected DC 48V, with battery charger. (Configurable)	11,500
E5	5	On-Grid	Remote Monitoring Grid Connected, 3 ph., 50/60 Hz, 400 V with Grid Controller and Inverter. (Configurable)	14,500-15,200
E5	5	Off-Grid	Battery connected DC 48V, with battery charger	11,800
E10 GW-133-JP	10	On-Grid	Remote Monitoring Grid Connected, 3 ph., 50/60 Hz, 400 V with Grid Controller and Inverter. (Configurable)	38,200-72,700
E11 G11-std G-11-US	11	On-Grid	Remote Monitoring Grid Connected, 3 ph., 60 Hz, 480 V with Grid Controller and Inverter. (Configurable)	38,200-59,000
E20	20	On-Grid	Remote Monitoring Grid Connected, 3 ph., 50/60 Hz, 400 V with Grid Controller and Inverter. (Configurable)	72,700
N-55	55	On-Grid	Remote Monitoring Grid Connected, 3 ph., 50 Hz, 400 V with Grid Controller and Inverter.	453,120
E60	70	On-Grid	Remote Monitoring Grid Connected, 3 ph., 50/60 Hz, 400 V with Grid Controller and Inverter.	229,800

Source: Data from Ryse Energy

Table 5: Towers Price List

Towers

Model	Height [m]	Type	Price [€]
E5	15	Lattice with turbine coupling	2,500
E5	15	Monopole	4,500
E5	15	Tilt-up lattice	2,300
GW-133	15	Lattice	10,700
G-10	15	Lattice	10,700
G-11	15	Lattice	10,700
E5	18	Lattice with tower coupling	2,900
E5	18	Tilt-up lattice	3,100
E20	18	Lattice	6,800
E20	18	Monopole	17,800
E5	18	Tilt-up system	4,100
E20	18	Hydraulic Tilt-up	14,900
E20	18	Monopole Cable	7,700
E20	18	Cable Tilt-up	21,800
GW-133	18	Lattice	10,700
G-11	18	Lattice	10,700
GW-133	18	Monopole	13,400
G-11	18	Monopole	13,400
GW-133	18	Tilt-up	16,700
G-10	18	Tilt-up	16,700
G-11	18	Tilt-up	16,700
E20	21	Lattice	8,600
GW-133	27	Monopole	32,900
G-10	27	Monopole	32,900

G-11	27	Monopole	32,900
E20	28	Lattice	11,700

Source: Data from Ryse Energy

2.3.1.5 Funding Programmes

This synergy is compatible with CEF funding priorities because it contributes to the de-carbonisation of the railway, promotes renewable energy, and increases the generation capacity of the three Baltic states. Therefore, energy supply is strengthened and increase his security. In addition, the dependence on fossil fuels is reduced and the internal energy market is strengthened.

In conclusion, this synergy is an eligible action because it contributes to the achievement of the objectives referred in the article 3.2.b of CEF funding programmes.

2.3.2 UTILISATION OF THE ENERGY SUBSYSTEM (MAINLY TRACTION SUBSTATIONS) TO TRANSFER RENEWABLE ELECTRICAL ENERGY TO THE ELECTRICAL GRID

2.3.2.1 Synergy Scope

The synergy consists of using the Rail Baltica´s electrical infrastructure connected to the electrical grid, mainly TSS, to transfer the energy generated by Rail Baltica or third-party renewable power plants (such as solar, wind and hydraulic power plants located close to Rail Baltica´s electrical infrastructure), to the electrical grid.

The main aim is to give an additional functionality to the TSS. Currently their function has been to transform or convert (it depends on the type of TSS) the voltage of the distribution or transmission electrical grid into the voltage used by trains. The additional functionality of TSS would be to transfer the produced energy in nearby renewable plant to the electrical grids.

The biggest benefit of this synergy can be obtained if the energy generated by the nearby renewable power plant belonging to Rail Baltica could be consumed in railway installations, and its excess could be sold to the electricity companies (DSO and TSO). In this case, the business model should be based on maximising self-consumption of the energy produced, as well as the sale of surpluses to the market.

If the plant belongs to a third party, the TSS would be a way to transfer the renewable energy generated by nearby renewable power plants to the electrical grid. In this case, the business model should be based on renting the part of the TSS used to transfer the energy.

For both cases, the "traction power system Design Guideline" should be reviewed. It involves a design review, which could affect the timetable, as well as slightly the cost. The additional cost is totally compatible with CEF funding priorities.

The schemes of the two options would be significantly different:

- Third-party plants: Basically, an additional way to transfer energy to the electrical grid would have to be added in the TSS, with its own equipment for measuring the exported energy to the electrical grid.
- Rail Baltica plants: The connection of the renewable power plant should be integrated into the TSS. The measuring equipment should measure the consumed energy and the exported one. This is the best synergy option.

The mains benefits of producing renewable electricity are to reduce:

- the electrical energy consumption
- the environmental impact
- the production of carbon dioxide
- part of the costs of the electricity bill by self-consumption of the generated energy and by selling the surplus of generated energy that cannot be consumed simultaneously in Rail Baltica's electrical installations
- and improve the efficiency of the traction power supply system, as the energy produced closer to consumption sites and therefore the energy loss is reduced

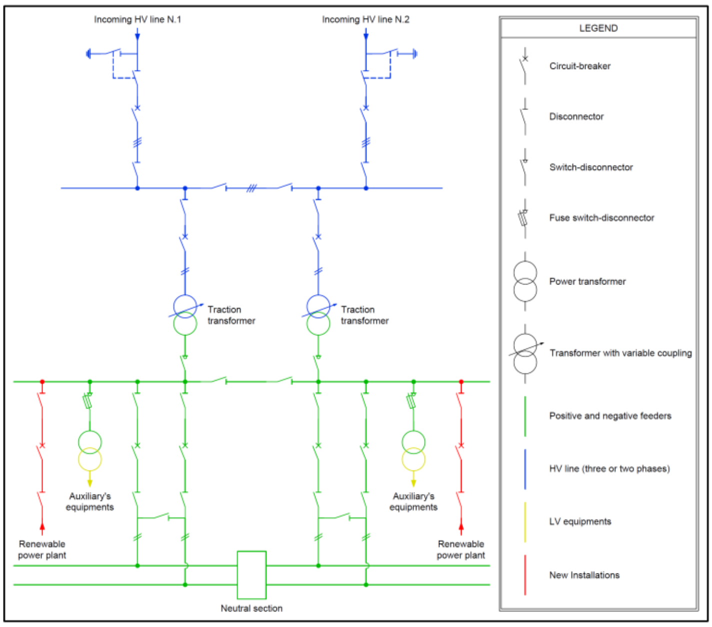
All contributes to achieving the "Fit for 55" objectives.

The following simplified TSS single-line diagrams shows two options to connect the renewable energy powerplant to the TSS:

- Option 1. Connection to the 2x25 kV (positive and negative feeders) busbar.

The cost of the actions to carry out this option should not exceed one million euros, although it depends on the final scheme of the TSS.

Figure 15: Layout of Connection to the 2x25 kV (Positive and Negative Feeders) Busbar



Source: Rail Baltica Global Project Synergies Study (2022) based on Guideline "Railway Energy: Part 1 traction power system". RBR (2019)

- Option 2. Connection to the High Voltage TSS Busbar

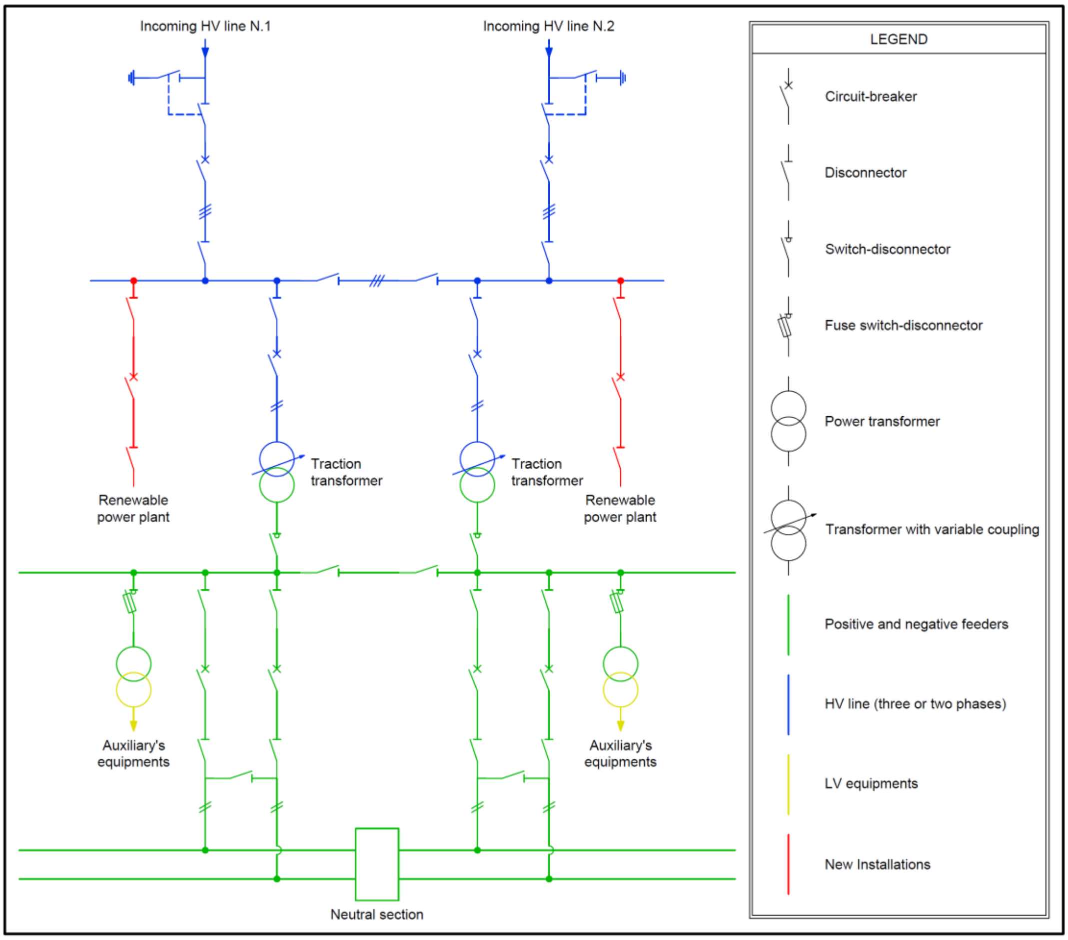
  The cost for implementation of this option depends on the voltage of the incoming lines. It should not exceed the 2 Mio €, depending on the final scheme of the TSS.

This measure contributes to achieving some of the Rail Baltica Synergies priorities. First of all, considering this measure from the beginning of the design and adapting the guidelines to take it into account, means that in the future it will not be necessary to incur in a big increased cost. Adapting already existing installations, makes it is necessary to stop their operation, deal with more restrictions etc. (as already happened in other countries, like Spain).

The necessary actions to implement out this synergy do not have a significant impact on the timeline and the works can be integrated with the rest of the project.

This synergy is an innovative one, which is currently beginning to be implemented in other countries such as Spain and will be completely digitalised in order to be able to remotely manage all the data.

Figure 16: Layout of Connection to the High Voltage TSS Busbar



Source: Rail Baltica Global Project Synergies Study (2022) based on Guideline "Railway Energy: Part 1 traction power system". RBR (2019)

The main idea is that the new functionality of the TSS is used with renewable plants, mainly for solar and wind power, which will contribute to the de-carbonisation of the three Baltic states.

The economic benefits would be obtained from renting the part of the TSS used to transfer the energy to the electrical grid if the renewable power generation plants belong to third parties or the reduction of the energy purchases to the grid and the sale of surpluses if the renewable plant belongs to Rail Baltica. The second option is strongly recommended if in line with Rail Baltica ENE policies.

Another advantage of this synergy is that by creating new ways of transferring energy to the grid shared by the three Baltic countries, the grid gets more meshed and powerful. It has to be taken into account that RB has taken the decision to go to the SFC route for electrification. SFCs will be installed in traction substations (TSS), instead of traction transformers and this option will slightly improve the quality of the public electrical network that feeds TSS due to:

- SFCs stabilise the electrical grid voltage level. Consuming or injecting reactive energy to the electrical grid, it is possible to lower or raise the electrical grid voltage, respectively.
- SFCs improve the electrical grid power factor, which implies an improvement of the system efficiency, since the losses in energy transport are lower.
- Supplying a lot of SFC-TSS (TSS with SFCs), more than TR-SS (TSS with traction transformers) makes the electrical grid more meshed and, consequently, more powerful and stable.

Therefore, installing SFC in TSS is an additional measure that contributes to improving the quality and stability of the electrical network.

In addition, smart-grids solutions will be considered in the design of the energy subsystem railway electrical system to improve the quality of the energy subsystem and the public electrical network, to reduce the energy consumption of the railway traction and non-traction installations, to make easier and more efficient the operation and maintenance of equipment and installations, to extend the useful life of equipment and installations, etc.

For these reasons, it is recommended that Rail Baltica contemplates the integration of this synergy from the beginning of the systems design phase.

2.3.2.2 Review of Areas of the Rail Baltica Design Guidelines

This synergy only affects the design guideline: “Railway Energy: Part 1 Traction Power System”.

Some sections of the design guidelines should be reviewed, for example:

- 1.1. European standards

It is necessary to consider European Directives on electric power generation and self-consumption.

- 2.2. Description of Traction Electrification System. It is necessary to add the new functionality of the TSS:

  “Traction Power Substations (SS) – An electrical installation where power is received at high voltage and transformed to the voltage and characteristics required at the catenary and negative feeders for the nominal 2x25 kV system and transfers the generated energy through close renewable energy plants to the electrical grid, containing equipment such as transformers, circuit breakers and sectionalising switches. It also includes the incoming lines from the power supply utility”.

- 2.5. Performance Requirements

  The traction substations shall be designed to transfer the power of the close renewable plants during the best conditions (maximum generated power).

- 3.2. Traction Power Substation

  The simplified traction power substation's single-line diagram should be modified (previously, two scheme proposals were included).

- 3.3. HV Utility Grid Interface

The transferred energy to the electrical grid must apply with the quality standards, it must apply with the standard: EN 50160 "Voltage characteristics of electricity supplied by public distribution networks". Mainly, it refers to the fulfilment of the following parameters:

  - power frequency
  - voltage magnitude variations
  - rapid voltage changes
  - supply voltage dips
  - short interruptions of supply voltage
  - long interruptions of supply voltage
  - temporary power frequency over-voltages
  - transient over-voltages
  - supply voltage unbalance
  - harmonic voltage
  - inter-harmonic voltage

- 3.6. Electrical Protection Coordination

  The protection system of the traction substations must be reviewed because now the substation can function as a generator, not only as a consumer and need new electrical protections.

2.3.2.3 Impact on Project Timeline

By considering the implementation of the new TSS functionality in the design phase, the impact on the timeline can be minimised as construction, testing and commissioning can be carried out simultaneously with the rest of the works to build the TS.

2.3.2.4 Impact on Cost

The additional cost of enabling the TSS to function as a generator would be between 500,000 and 2,000,000 €, depending on the type of connection. In any case, it depends on the type of connection, the final design of TSS and the type of TSS: TSS with traction transformer, TSS with SFC (Static Frequency Converter), TSS with compensators (SVC, Static Var Compensator, or STATCOM, Static Compensator), etc.

It is recommended that Rail Baltica becomes the owner of renewable energy power plants. The approximated cost of a solar farm depends on the installed power of the power plants.

Table 6: Distribution of TSS to Function as a Generator Bids (prices in € of 2021)

Power Peak Installations	Upper Reference	Estimated Investment Cost Ratio	Lower Reference
>100 kWp	2.00 €/Wp	1.25 €/Wp	0.50 €/Wp

Source: INECO based on data from the Spanish Public Sector Procurement Platform

The case study E2.1. shows that in Spain, RENFE will invest 233 million € in solar PV, in 390 MWW for self-consumption on high-speed train. The difference to the three Baltic states is that in Spain this possibility was not considered from the beginning and therefore significantly increased the costs of adapting the TSS.

2.3.2.5 Funding Programmes

This synergy, in its ideal form, contributes to improving the transmission grid, the electricity generation mix and security of supply by facilitating the integration of renewable energy power plants. In addition, the dual use of TSS contributes to increasing their efficiency, reduces their electricity costs and de-carbonises the local economy.

All of the above makes the synergy an eligible option that contributes to achieving the objectives of article 3.2.b of the CEF funding priorities.

Therefore, it is an opportunity eligible within the 2021-2027 Multiannual Financial Framework.

2.3.3 DEVELOPMENT OF BATTERY ELECTRICAL VEHICLE (BEV) CHARGING INFRASTRUCTURE

2.3.3.1 Synergy Scope

The synergy consists of making a BEV charging network supplied from the Rail Baltica traction and non-traction power supply systems.

The supply from the traction power supply system would only be made from traction substations, TSS or autotransformers centres (ATS), paralleling post (PP) and switching posts (SWP). Feeding from the OCS is not considered, due to the elevated costs and complexity; there are better options to supply electric BEV chargers.

As explained below, feeding BEV chargers has an important role in the design guidelines ("non-traction power supply system" and "traction power supply system") because they are high power demanding consumers.

If the supply to BEV chargers is considered during the systems design phase, their construction should be compatible with the expected timeline. This involves an additional cost but is compatible with CEF funding priorities. It is a high initial investment, but it will have a very quick payback period due the many obtained profits by carrying out these facilities; sale of electric energy, to rent the parking spaces to charge the vehicles, to rent the used railway installations, etc.

Additionally, requirement for availability of electrical vehicle charger also comes from legislation that all new bigger buildings should implement such facilities in Estonia[11].

There are many alternatives for feeding the electrical vehicle chargers from the Rail Baltica power supply system. These alternatives must be analysed during the design phase of the non-traction and traction power supply systems. Some supply possibilities are described below:

- From traction power supply system, TSS or autotransformer centres (PP or SWP):
    - from the busbar "+25 kV and -25 kV, positive and negative feeders", adding a new step-down power transformer to reduce the voltage and to feed the electrical BEV chargers. High voltage transport of the power would allow the BEV chargers to be away from the TSS or SWP or PP.
    - from a low voltage busbar, fed from the auxiliary service transformer. In this case, the electrical vehicle charger must be close to the TSS or SWP or PP.
- From non-traction power supply system:
    - substations MV/LV
        - from a new step-down power transformer to be installed
        - from the installed step-down power transformers of the substations MV/LV
    - other low voltage point, busbars throughout the non-traction system

The traction and non-traction system should be dimensioned to transport the demanded power by the BEV chargers.

Different types of BEV chargers and connectors must be considered in the design in order to supply the different kinds of BEV vehicles:

[11] https://news.err.ee/1069468/new-renovated-buildings-must-include-electric-car-chargers-from-2021

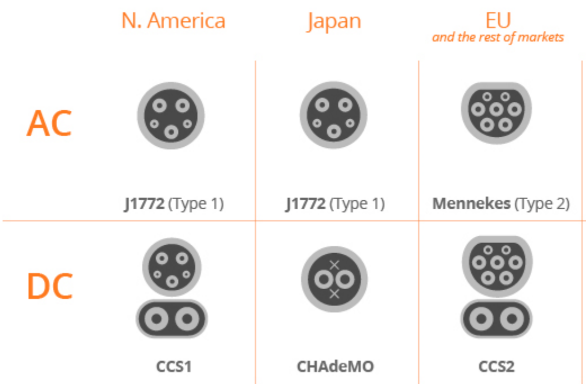
Types of charging

- semi-fast charging
- fast charging
- ultra-fast charging

Types of connectors:

- slow/fast charging (AC):
  - type 1 (Yazaki): 3.7-7 kW, standard US connector
  - type 2 (Mennekes): 3.7-22kW, by far the most common connector on new cars
- Rapid charging (DC):
  - combined Charging System (CCS): 50-350 kW likely to become most popular DC standard
  - CHAdeMO 50-100 kW
  - type 2 (Mennekes): it could also supply up to 250kW in DC (only Tesla superchargers provide DC via this connector)

Figure 17: Most Important Standard BEV Charging Connector Types



Source : https://evcharging.enelx.com/resources/blog/552-ev-charging-connector-types

The type of charger that should be implemented will be the one that complies with the European Union's standard model and therefore allows integration with the rest of Europe.

The promotion of electro-mobility as a tool to meet the de-carbonisation objectives of "Fit for 55". It requires EU Member States to ensure a number of recharging stations are in place for BEV in urban nodes.

The European regulation also includes some requirement such as the maximum distance between charging stations should not exceed 60 km.

A proposal for the installation sites of these chargers, in order to meet the requirements of "Fit for 55", considering roads and population, would be the following:

Figure 18: BEV Charging Infrastructure Proposal Under "Dig Once" Perspective

Source: RAIL BALTICA Synergies Study (2022)

The proposal consists of 21 recharging points in the big cities and freight terminals and 27 recharging points in local stations. A total of 48 different locations.

The number of non-overlapping inhabitants that will be served by stations within a range of 25 km is shown in the following table:

Table 7: Number of non-overlapping inhabitants that will be served by BEV Charging Infrastructure within a range of 25 km

BEV Station Type	Name	Number of Residents	Percentage over total population (3 countries)
Freight Terminals & Big Cities	Muuga Freight Terminal	45,171	0.74%
Freight Terminals & Big Cities	Ülemiste Passenger Terminal	340,419	5.56%

Freight Terminals & Big Cities	Ülemiste Vehicle Loading Station	118,811	1.94%
Freight Terminals & Big Cities	Soodevahe Dry Port	13,222	0.22%
Local Station	Soodevahe Station	12,547	0.21%
Local Station	Kurtna Local Station	37,459	0.61%
Local Station	Kohila Local Station	12,244	0.20%
Local Station	Rapla Local Station	19,817	0.32%
Local Station	Järvakandi Local Station	5,319	0.09%
Local Station	Tootsi Local Station	9,982	0.16%
Freight Terminals & Big Cities	Pärnu Freight Terminal	22,073	0.36%
Freight Terminals & Big Cities	Pärnu Passenger Terminal	39,263	0.64%
Local Station	Häädemeeste Local Station	5,822	0.10%
Local Station	Salacgrīva Local Station	8,748	0.14%
Local Station	Skulte Local Station	14,156	0.23%
Freight Terminals & Big Cities	Skulte Freight Terminal	8,832	0.14%
Local Station	Ādaži Military Station	49,131	0.80%
Freight Terminals & Big Cities	Salaspils Freight Handling Terminal	73,829	1.21%
Local Station	Acone Local Station	106,228	1.74%
Freight Terminals & Big Cities	Rīga International Passenger Station (RCS)	485,369	7.93%
Freight Terminals & Big Cities	Rīga Airport Cargo Yard	128,271	2.10%
Freight Terminals & Big Cities	Riga Airport (RIX) International Passenger Station	13,406	0.22%
Local Station	Janunmārupe Local Station	42,985	0.70%
Local Station	Iecava Local Station	19,761	0.32%
Local Station	Bauska Local Station	26,480	0.43%
Local Station	Vaškai Station	11,187	0.18%
Local Station	Joniškėlis Station	30,683	0.50%
Freight Terminals & Big Cities	Panevėžys Freight terminal	17,739	0.29%
Freight Terminals & Big Cities	Panevėžys International Passenger Station	75,708	1.24%
Local Station	Uliūnai Station	30,465	0.50%
Local Station	Anciškis Station	12,086	0.20%
Local Station	Pasraučiai Station	35,762	0.58%
Local Station	Jonava Station	38,270	0.63%
Freight Terminals & Big Cities	Kaunas Airport (KUN) Passenger Station	9,344	0.15%

Freight Terminals & Big Cities	Karmelava Freight Station	20,919	0.34%
Freight Terminals & Big Cities	Kaunas International Passenger Station	278,845	4.56%
Freight Terminals & Big Cities	Kaunas Freight Terminal	61,913	1.01%
Local Station	Juragiai Station	39,159	0.64%
Local Station	Ažuolu Būda Station	18,297	0.30%
Freight Terminals & Big Cities	Marijampolė Freight Station	7,621	0.12%
Local Station	Marijampolė Passenger Station	65,187	1.07%
Local Station	Kaišiadorys Station	23,480	0.38%
Local Station	Žasliai Station	19,439	0.32%
Local Station	Vievis Station	16,995	0.28%
Local Station	Lentvaris Station	48,769	0.80%
Freight Terminals & Big Cities	Vaidotai Freight Terminal	34,780	0.57%
Freight Terminals & Big Cities	Vilnius International Passenger Station	554,317	9.06%
Freight Terminals & Big Cities	Vilnius airport (VNO) Passenger Station	32,587	0.53%
TOTAL		3,142,897	51.35%

Source: INECO based on RB Global Project Synergies Study data (2022). The number of non-overlapping inhabitants served by each location has been obtained from GIS population data provided by RBR (Grid_Baltics_1k_Statistic_data_Total_Population.shp), as the result of intersection with 25 km buffers from each station and their Thiessen polygons (which allocate space to the nearest point feature, i.e., they define an area around a point where every location is nearer to that point than to all the others).

The total sum of residents with BEV for each type of station within a range of 25 km is:

- local stations: 3,024,363 (49.41% over 3 countries total population)
- big cities and freight terminals: 2,842,427 (46.44% over 3 countries total population)

If this option is considered from the initial design phase, its implementation with the rest of the infrastructure is simpler and does not cause any important increase in the timeline

The implementation of these chargers is by itself an innovation and a beginning for a more sustainable society, in addition, thanks to the improvements in the measurement and protection devices, it will be possible to operate, monitor and control such systems remotely.

This charging infrastructure throughout the three Baltic state creates a connection between and encourages travel and routes through the Baltic countries by BEVs.

By increasing the number of electric chargers, the population is encouraged to use BEVs, which have a lower carbon footprint over the course of their lifetime than cars using traditional, internal combustion engines. Therefore, emissions are reduced helping de-carbonisation.

This network of chargers, benefits will generate profits by charging the energy supplied to consumers (private BEVs).

2.3.3.2 Review of areas of the Rail Baltica Design Guidelines

This synergy affects to the following Design Guidelines:

- Railway Energy. Part 1: traction power system
- Railway Energy. Part 3: non-traction power supply

Both design guidelines do not include supplying power to BEV chargers. BV chargers are high demanding power consumers and therefore the traction and non-traction power supply systems should be dimensioned to transport the demanded power this equipment from the design stages.

There is no single solution to feed BEV chargers, so, several proposals must be analysed in the design.

2.3.3.3 Impact on project timeline

When considering the construction of BEV charging infrastructure in the design phase, it is possible to minimise the impact on the project time, as the design, the construction, the testing and the commissioning are carried out simultaneously with the rest of the electrical installation

There is only a little impact (very difficult to quantify) on the RB timeline due to a slight increase in complexity, the need to install more equipment and more labour costs.

2.3.3.4 Impact on Cost

BEV charging infrastructure would affect the foreseen costs of the Rail Baltica network because the power supply systems should be adapted to feed these new power consumers.

The cost of adapting the power supply system is depending totally on the solution that is defined to power the BEV chargers from the power supply system, e.g., its number, power or location.

In the previous map, which shows the proposal for the location of the chargers, approximately 51 stations are suggested, although the power and the number of chargers in each station must be specified in order to make a first study of the cost of the installation.

Some important European manufactures of BEV chargers are ABB, INGETEAM and Schneider Electric.

Below are the prices of Schneider Electric chargers for the retail market in Spain, only the first model is capable of charging two BEV at the same time.

Table 8: Types of Chargers and his Prices (Prices in € of 2021)

Model	Number of Outputs	Type of Outputs	Price
EVD1S24THB2	3 (2 outputs in DC and 1 in AC)	- CHAdeMO (DC, 24 kW, 500 V) - CCS (DC, 24 kW, 530 V) - T2S (AC, 22 kW, 400 V)	35,300 €
EVD1S24THB	2 outputs in DC	- CHAdeMO (DC, 24 kW, 500 V) - CCS (DC, 24 kW, 530 V)	34,700 €
EVD1S24T0H	1 output in DC	- CHAdeMO (DC, 24 kW, 500 V)	25,100 €
EVD1S24T0B	1 output in DC	- CCS (DC, 24 kW, 530 V)	24,500 €

Source: Schneider Electric

The impact on cost depends mainly on the maximum charging power capable of providing and the available number of charging types. An approximation would be around 50,000 € per BEV charger plus the cost of the installation that depends on the characteristics of each project and can vary between €25,000 and €100,000 per BEV charger. In any case, each BEV supply solution will have a different cost.

2.3.3.5 Funding Programmes

The development of a BEV charging infrastructure, that interconnects the three Baltic states and links their most populated areas, means de-carbonising road transport and promoting sustainable and accessible mobility for most of the population. It is an alternative that acts to mitigate pollution from vehicles that run on fossil fuel combustion engines.

In addition, this synergy is a cross-border action as BEVs from other European countries can use Rail Baltica installations on their journey. This synergy is taking advantage of parts of the railway infrastructure by giving it a dual use.

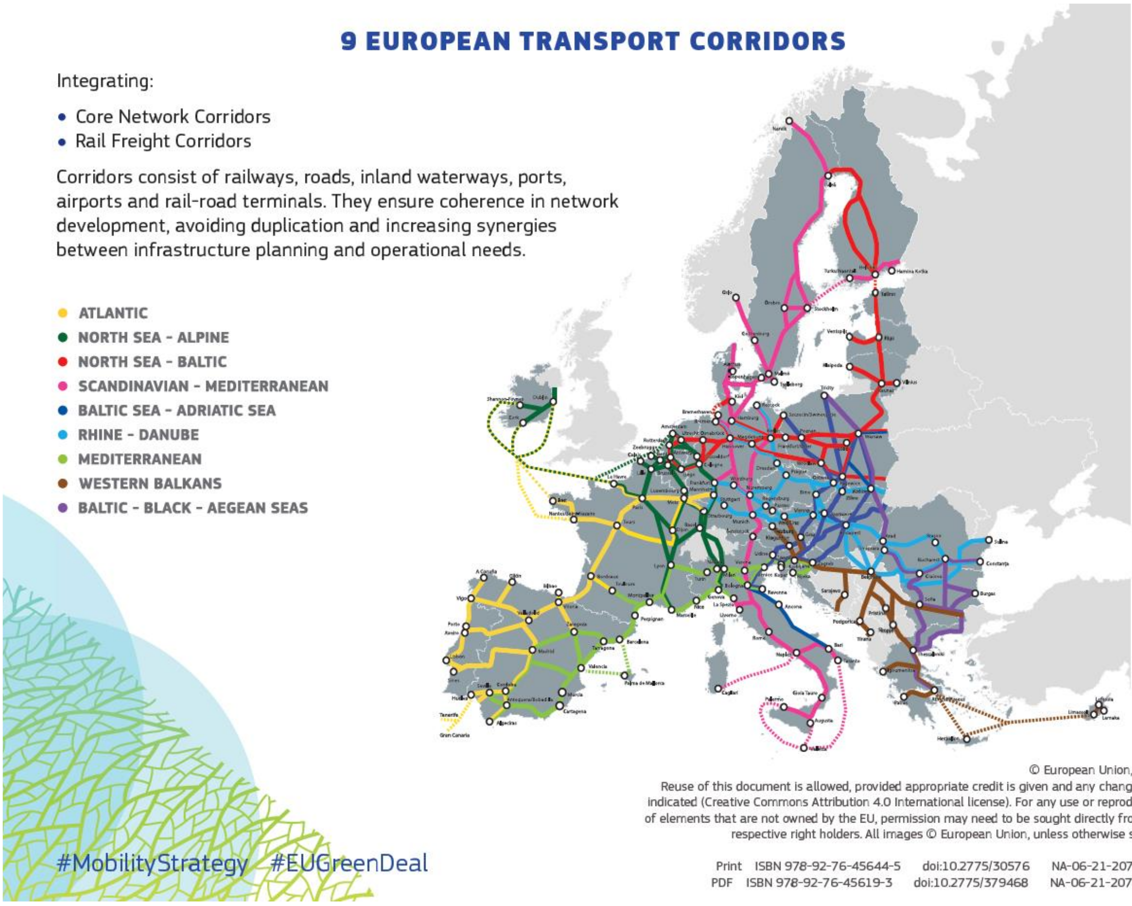
It is an eligible action because it contributes to the achievement of the article 3.2.a of CEF objectives.

2.3.4 DEVELOPMENT OF FUEL CELL ELECTRICAL VEHICLE (FCEV) INFRASTRUCTURE

2.3.4.1 Synergy Scope

The synergy consists in the deployment of a key part of the network of hydrogen vehicle charging infrastructure of the three Rail Baltica countries taking advantage of the “Dig Once” perspective of the Global Project. This charging network infrastructure is one of the main new requirements that are going to be come into effect with the amendment of DIRECTIVE 2014/94/EU on the deployment of alternative fuels infrastructure that Member States shall ensure that a minimum number of publicly accessible hydrogen refuelling stations are put in place by 31 December 2030, in their territory.

Figure 19: 9 European Transport Corridors (Creating a Green and Efficient Trans-European Transport Network 2021)



Source: https://ec.europa.eu/commission/presscorner/detail/en/fs_21_6779

In the proposal currently under negotiation, the requirement is that Member States shall ensure that accessible hydrogen refueling stations with a minimum capacity of 2 t/day and equipped with at least a 700 bar dispenser are deployed with a maximum distance of **150 km in-between them along the TEN-T core and the TEN-T comprehensive network:** however deployment in the Rail Baltica corridor needs to align with other objectives such as promoting multimodal integration (especially given states or third parties can deploy at other locations in order to meet the maximum distance requirement).

They shall ensure that by 31 December 2030, at least one publicly accessible hydrogen refueling station is deployed in each urban node. An analysis on the best location shall be carried out for such refueling stations that shall in particular consider the deployment of such stations in multimodal hubs where also other transport modes could be supplied.

The European regulation also includes some requirement such as the maximum distance between charging station should not exceed 150 km. A proposal for the location of these chargers to meet the requirements of "Fit for 55" explained above, considering the roads and the population, would be the following:

Figure 20:Hypothetical FCEV Charging Infrastructure Proposal Under "Dig Once" Perspective

Source: RB Synergies Study (2022)

The boundaries of our synergy implementation scope are the one defined for the rail corridor. Although, for the purposes of framing actions in the regional context and in the resolution of policies such as fit 5050 maps have been developed that cover the road environment and locations outside the rail corridor.

The hypothetical FCEV charging infrastructure proposal consists of 5 recharging points in RB project's freight terminals and 4 additional recharging points at other TEN-T roads core network locations. A total of 9 different locations.

The number of non-overlapping inhabitants that will be served by stations within a range of 25 km is shown in the following table:

Table 9: Number of Non-overlapping Inhabitants that Will be Served by FCEV Charging Infrastructure Within a Range of 25 km

FCEV Station Type	Name	Number of Residents	Percentage Over Total Population (Three Countries)
Rail Baltica project's freight terminals	Muuga Freight Station	507,276	8,29%
Rail Baltica project's freight terminals	Pärnu Freight Terminal	66,678	1,09%
Other TEN-T Roads Core Network location[12]	Tartu	139,612	2,28%
Other TEN-T Roads Core Network location	Ventspils	39,957	0,65%
Rail Baltica project's freight terminals	Salaspils Freight Handling Terminal	646,397	10,56%
Other TEN-T Roads Core Network location	Rezekne	58,612	0,96%
Rail Baltica project's freight terminals	Panevėžys Freight terminal	125,380	2,05%
Other TEN-T Roads Core Network location	Klaipeda	241,463	3,95%
Rail Baltica project's freight terminals	Kaunas Freight Terminal	400,509	6,54%
TOTAL		2,225,884	36,37%

Source: INECO based on Rail Baltica Global Project Synergies Study data (2022). The number of non-overlapping inhabitants served by each location has been obtained from GIS population data provided by RBR (Grid_Baltics_1k_Statistic_data_Total_Population.shp), as the result of intersection with 25 km buffers from each station and their Thiessen polygons (which allocate space to the nearest point feature, i.e., they define an area around a point where every location is nearer to that point than to all the others).

The total sum of residents with FCEV for each type of station within a range of 25 km is:

- 5 Rail Baltica project's freight terminals: 1,746,240 (28.53% over 3 countries total population)
- 4 other TEN-T roads core network location: 479,644 (7.84% over 3 countries total population)

[12] TEN-T Roads Core" locations are not considered a Rail Baltica synergy, but are indicated for information only

The achievement of the “Fit for 55 goals” and of the European Green Deal is a clear way to boost intermodal national, regional and local mobility, including improved access to TEN-T and cross-border mobility, for hydrogen vehicles in rural and urban areas of the Rail Baltica economic corridor.

The FCEV charging infrastructure could be seen as one of the stages for a more sustainable society, in addition, thanks to the improvements in the measurement and protection devices, it will be possible to operate and know information remotely. This charging infrastructure is creating a connection between the countries, encouraging travel and routes through them.

Under this approach the following opportunities for EU policy framework could be achieved:

- promotion of the deployment of hydrogen refuelling stations for railway public transport services
- facilitation of the deployment of recharging stations for light-duty and (particularly) heavy-duty vehicles at private locations that are not accessible to the public such as freight terminals
- promotion of alternative fuels infrastructure in urban nodes, in particular with respect to publicly accessible hydrogen recharging points
- ensuring that the deployment and operation of recharging points contribute to the flexibility of the energy system and to the penetration of renewable electricity into the electric system
- a deployment plan for alternative fuels infrastructure in rail freight terminals near Baltic ports interconnected by TEN-T road core network, in particular for hydrogen, for port services as defined in Regulation (EU) 2017/352 of the European Parliament and Council
- enabling the distribution of hydrogen as rail cargo to provide a “virtual pipeline”

2.3.4.2 Review of Areas of the Rail Baltica Design Guidelines

Currently, the design guidelines do not include aspects related to this system.

The proposal for the directive defines some technical targets for hydrogen refuelling infrastructure for road vehicles:

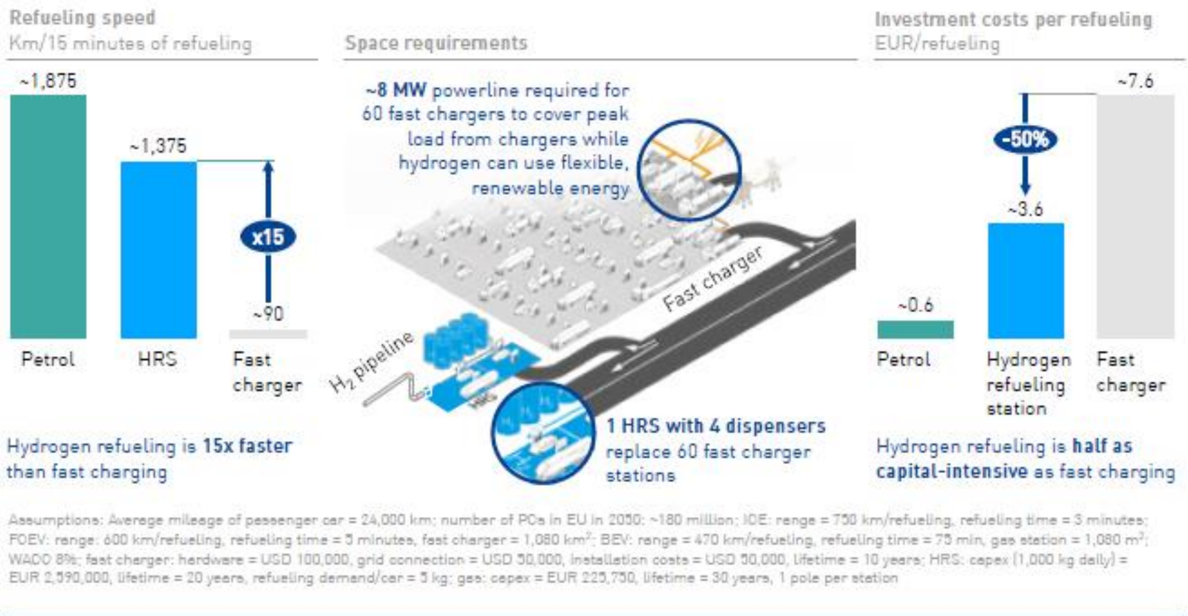
- Member States shall ensure that by 31 December 2030 publicly accessible hydrogen refuelling stations with a minimum capacity of 2 t/day and equipped with at least a 700 bars dispenser are deployed with a maximum distance of 150 km in-between them along the TEN-T core and the TEN-T comprehensive network.
- Liquid hydrogen shall be made available at publicly accessible refuelling stations with a maximum distance of 450 km in-between them.
- Member States shall ensure that by 31 December 2030, at least one publicly accessible hydrogen refuelling station is deployed in each urban node.
- An analysis on the best location shall be carried out for such refuelling stations that shall in particular consider the deployment of such stations in multimodal hubs where also other transport modes could be supplied.
- Neighbouring Member States shall ensure that the maximum distance of 150 km is not exceeded for cross-border sections of the TEN-T core and the TEN-T comprehensive network.

- The operator of a publicly accessible refuelling station or, where the operator is not the owner, the owner of that station in accordance with the arrangements between them, shall ensure that the station is designed to serve light-duty and heavy-duty vehicles. The Directive mentions that in freight terminals, operators or owners of these publicly accessible hydrogen refuelling stations shall ensure that these stations also serve liquid hydrogen.

Specific requirements would be applied for technical specifications for hydrogen refuelling points for motor vehicles, preferable to be gathered in a dedicated guideline:

- Outdoor hydrogen refuelling points dispensing gaseous hydrogen used as fuel on board motor vehicles shall comply with the technical specifications of the ISO/TS 20100 Gaseous Hydrogen Fuelling Specification.
- The hydrogen purity dispensed by hydrogen refuelling points shall comply with the technical specifications included in the ISO 14687-2 standard.
- Hydrogen refuelling points shall employ fuelling algorithms and equipment complying with the ISO/TS 20100 Gaseous Hydrogen Fuelling Specification.
- Connectors for motor vehicles for the refuelling of gaseous hydrogen shall comply with the ISO 17268 Gaseous Hydrogen Motor Vehicle Refuelling Connection Devices Standard.

Figure 21: Implications of Refuelling Speed (FCEV and BEV Fast Chargers) on Space Requirements and Investments Costs per Refuelling



Source: HYDROGEN ROADMAP EUROPE. FCH (2019)

Based on the Fuel Cells and Hydrogen Joint Undertaking (FCH) studies, the differences in required space for FCEV charging infrastructure, associated to the higher refuelling speed, are particularly important in

European cities and along highways. BEV Fast-charging stations handling the same number of vehicles need 10 to 15 times the space of a comparable FCEV charging infrastructure.

2.3.4.3 Impact on Project Timeline

The design and construction of FCEV charging infrastructure around terminal and intermodal areas could be carried out parallel to the construction of the Rail Baltica network with no impact on Rail Baltica timeline.

2.3.4.4 Impact on Cost

FCEV charging infrastructure would not affect the foreseen costs of the Rail Baltica network, except for the case that some rail-specific facilities to feed railway rolling stock would be installed.

2.3.4.5 Funding Programmes

The development a FCEV charging infrastructure that interconnects the three Baltic states and connect their main populated areas means decarbonising the road transport and promoting sustainable and accessible mobility for the majority of the population. It is an alternative that can mitigate pollution from vehicles that run on fossil fuel combustion engines.

In addition, this synergy is a cross-border action because allows FCEVs from other European countries can use Rail Baltica installations on their journey. It also applies to freight services in the TEN-T corridor.

Therefore, it is an eligible option because it contributes to the achievement of the CEF objectives of its overall financial envelope to climate objectives, based, on the following coefficients: (i) 100% for expenditure relating to railway infrastructure, charging infrastructure, alternative and sustainable fuels, CO2 transport and renewable energy; (ii) 40 % multimodal transport provided that it enables the use of renewable hydrogen or bio-methane to be increased.

As already mentioned, an important objective of the CEF is to deliver increased synergies and complementarity between the transport, energy and digital sectors. For that purpose, the CEF should provide for the adoption of work programmes that could address specific intervention areas, for instance as regards connected and automated mobility or sustainable alternative fuels.

Article 3.1 of Regulation (EU) 2021/1153 emphasises facilitating the synergies among the transport, energy and digital sectors and to facilitate cross-border cooperation in the area of energy, including renewable energy.

Article 7 includes information about the cross-border projects in the field of renewable energy and art. 7.3 states that studies aiming to develop and identify cross-border projects in the field of renewable energy shall be eligible for funding.

Art 7.4 highlight that in cross-border projects in the field of renewable energy are eligible for Union funding for works if they meet the following additional criteria:

- the project specific cost-benefit analysis pursuant to Part IV, point 3, of the Annex is compulsory for all supported projects and takes into account any revenues resulting from support schemes, has been performed in a transparent, comprehensive and complete manner and provides evidence concerning the existence of significant cost savings or benefits, or both, in terms of system integration, environmental sustainability, security of supply or innovation.
- the applicant demonstrates that the project would not materialise in the absence of the grant or that the project cannot be commercially viable in the absence of the grant, which surely will be the current market playground for the deployment of hydrogen fuel stations.

2.3.4.6 State aid rules impacting on BEV and FCEV synergistic opportunities

Annex 2 developed the analyses of the impact of State Aid and other rules for the synergistic opportunities proposed. The particularities of the norms defining State Aid compatible with the EU regulation of the internal market in the Energy sectors are discussed in the final subsections of paragraph 3.

Despite EU law including a general prohibition of State Aid in the energy sector, the Commission will continue to support ongoing Member State efforts to design pan-European Important Projects of Common European Interest (IPCEI) that jointly overcome market failures by enabling breakthrough innovation and infrastructure investments in key green and digital priorities as this synergy action in the land of hydrogen development. The upcoming IPCEI State Aid Communication will further enhance the openness of IPCEIs to pool national and EU resources for this synergy action.

State Aid is examined under The Guidelines on State Aid for Environmental Protection and Energy (EEAG), and its ongoing revision, focusing on helping to reach the EU´s environment and energy objectives in a cost-effective manner with minimum distortions of competition and trade.

The EEAG includes criteria for supporting energy infrastructure, focusing on projects that improve cross-border energy flows and promote infrastructure in Europe's less developed regions.

Infrastructure investments made within the framework of a legal monopoly are not subject to State Aid rules, provided a number of requirements are met.

– A Transmission System Operator (TSO) or a Distribution System Operator (DSO) is legally the only entity entitled to make a certain type of investment and no other entity can operate an alternative network.

– If the operator of the energy infrastructure is active in another (geographical or product) market that is open to competition, the cross-subsidy must be excluded for which separate accounts are required.

– In case of a natural monopoly, the infrastructure is not designed to selectively favour a specific undertaking or sector, but provides benefits for the society in general, given that access and use of this infrastructure is subject to third party access requirements under the EU energy market legislation ("Third Package").

As a general rule, Member States must ensure that the funding provided for the construction of the infrastructure cannot be used to cross-subsidise or indirectly subsidise other economic activities, including the operation of the infrastructure.

However, State Aid could be considered admissible if the operators who make use of the subsidised infrastructure provide services to end-users are assigned on the basis of a competitive, transparent, non-discriminatory and unconditional tender. In this case, it can be presumed that the fee it pays for the right to exploit the energy infrastructure is in line with market conditions.

2.4 LOCAL CONNECTIONS FOR INDUSTRIAL, DEFENCE AND LOGISTIC AREAS

The Rail Baltica Global Project should carry out actions contributing to the development of local connections for industrial areas on the complementarity of all modes of transport in order to provide for efficient, interconnected and multimodal networks and ensure cross-border connectivity with the neighbouring countries.

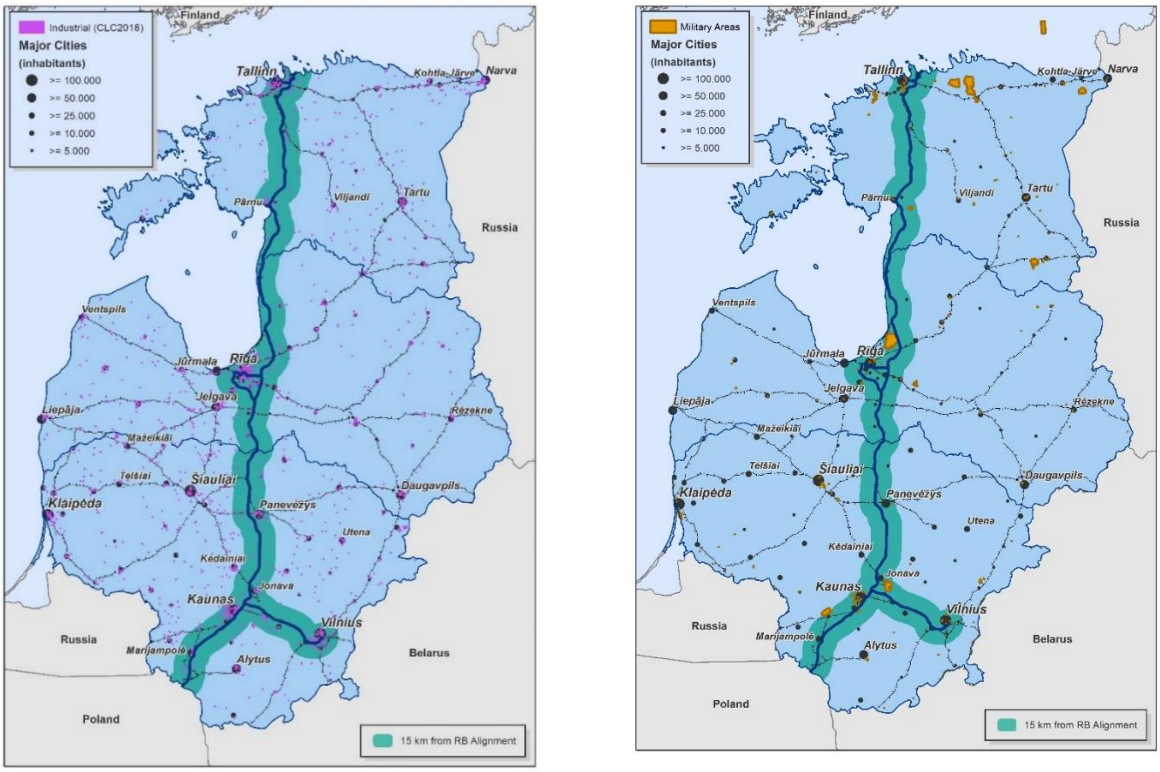
These actions should include:

- actions to remove interoperability barriers as defined in Article 3, point (o), of Regulation (EU) No 1315/2013, notably barriers when delivering corridor/network effects, including actions promoting an increase in rail freight traffic and automatic gauge-change facilities.
- actions supporting projects of common interest in order to connect the trans-European network with infrastructure networks of neighbouring countries as defined in Article 8 (1) of Regulation (EU) No 1315/2013

2.4.1 SYNERGY SCOPE

Planning, design and construction of railway branches from Rail Baltica network to relevant private industrial sidings or logistics/military areas in order to increase rail accessibility and freight traffic in the RB project.

Figure 22: Location of Industrial and Military Areas in Proximity of the Rail Baltica Network



2.4.2 REVIEW OF AREAS OF THE RAIL BALTICA DESIGN GUIDELINES

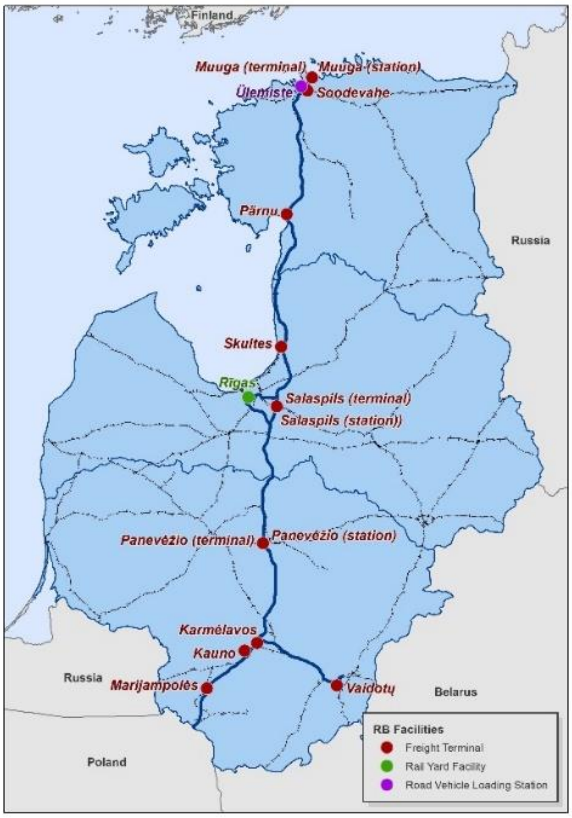
The design parameters for the connection of railway branches would be constrained by the layout of Rail Baltica network. Compatibility with road traffic infrastructure and urban planning is required.

The design of railway branches to industrial areas for freight traffic should follow the **Rail Baltica Design Guidelines**, particularly the following ones:

- Railway Alignment - Mixed Traffic Line
- Railway Superstructure - Tracks
- Technical Specification - Rails
- Railway Energy - Catenary

Therefore, railway branches must be designed for standard gauge, maximum train length of 1050 m, axle loads of 25 tonnes, train speed up to 120 km/h, electrified with 25 kV AC and compatible with ERTMS.

Figure 23: RB Freight Terminals and Installations



Source: Rail Baltica Web GIS

As stated in the **Rail Baltica Operational Plan**, current market situation and demand forecasts indicate that most of the Rail Baltica freight will be transported using containers. Nevertheless, the results of the terminal studies indicate that dry bulk materials will gain a small but considerable share of the overall freight volumes along Rail Baltica. Shipment of dry bulk materials is traditionally dependant on local consolidation close to the (natural) production sites and dedicated loading points for transhipment to rail (e. g. grain conveyor) or from private railway sidings. The design of the intermodal terminals and sidings for dry bulk material shall facilitate optional handling of block trains without interfering with other businesses.

Another potential **cargo type** could be considered in local connections to Rail Baltica network. Apart from bulk hydrogen transport mentioned in section 2.4.4, solid municipal waste could be transported by rail from several small towns to a central processing facility with possible carbon / energy capture, which would benefit from economies of scale compared to each community having its own waste management facilities.

Specific recomendations[13] to be applied for the connection of industrial areas to the Rail Baltica corridor, should be gathered in a dedicated guideline:

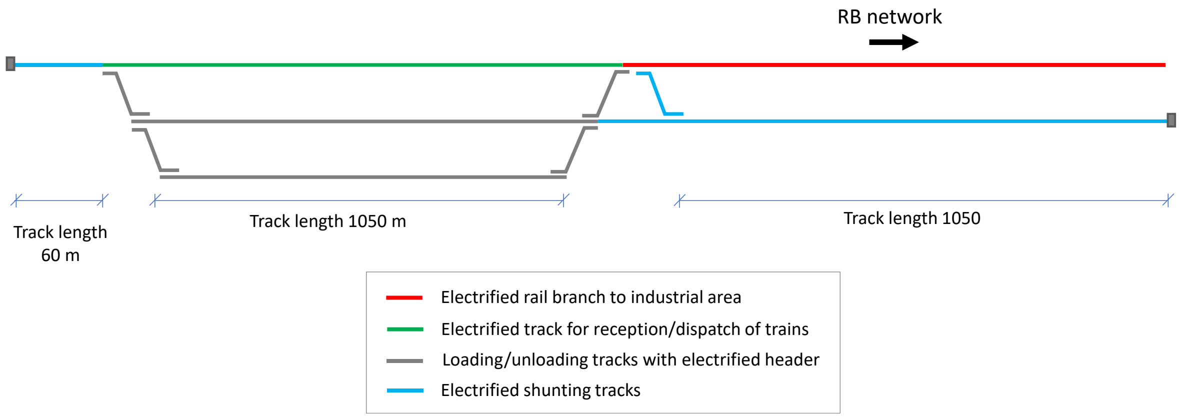
- maximum length of the rail branch from an industrial area to Rail Baltica layout: 15 km
- minimum freight traffic: 5 trains/week (each way)
- design of industrial siding:
    - minimum number of loading/unloading tracks: 2
    - length of tracks: 1050 m (minimum of 750 m)
    - electrification of access to the siding

Those parameters, which are recommendations for the future dedicated guideline, come from our technical experience (mainly economic feasibility analysis of rail connections to freight terminals) and from the analysis of Rail Baltica layout (distances on GIS from Rail Baltica rail line to main existing logistic nodes).

The following figure illustrates a **proposal for the design of industrial sidings** to be connected to RB network.

[13] Those parameters, which are recommendations for the future dedicated guideline, come from consultant technical experience (mainly economic feasibility analysis of rail connections to freight terminals) and from the analysis of Rail Baltica layout (distances on GIS from Rail Baltica rail line to main existing logistic nodes).

Figure 24: Proposal of Design for Industrial Sidings



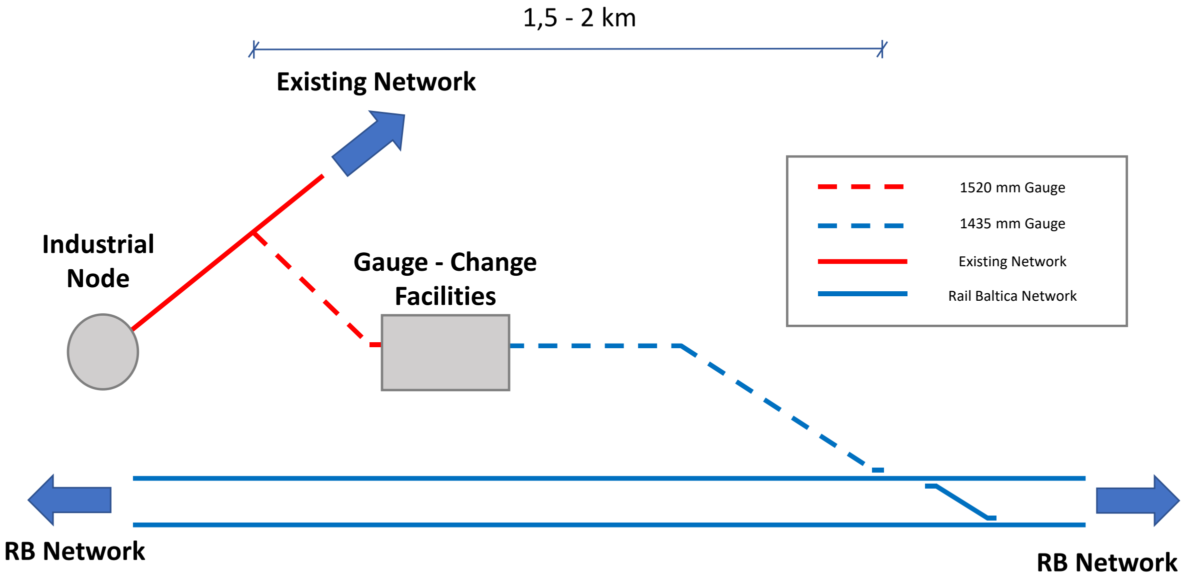
The previous requirements and design of industrial sidings could be modified according to specific cost-benefit analyses to be carried out for each local connection or to operational/capacity restrictions.

In the case of **existing industrial sidings or terminals** that are currently connected to the conventional rail network (1520 mm) and are considered relevant for the Rail Baltica project, specific rail branches can be designed and built for connecting them to the Rail Baltica infrastructure (1435 mm), implementing a gauge changeover installation in this new branch in order not to interfere with traffic in both networks.

Even though automatic gauge-change facilities have not yet been developed for freight trains, these facilities are a case of success when it comes to passenger trains. It shall be mentioned the case of success of the SUW 2000 automatic gauge changing facilities, especially the ones located in the border between Poland and Ukraine (more specifically in Dorohusk and Mostyska), allowing long distance trains to run from Krakow to Kyiv. These actions could boost regional connectivity for passengers and potentially the technology could be developed to allow the mixed use of the infrastructure.

As mentioned in the Rail Baltica Operational Plan, the usage of **gauge changing facilities** and innovative freight wagons would be a means to extend the range of Rail Baltica to railway sidings (e.g., for chemical and fertilizer industry, building material, wood loading, paper industry) within each of the three Baltic states. Furthermore, such a solution might be advantageous to quickly deploy military equipment using Rail Baltica.

Figure 25: Proposal of Design for Gauge-change facilities in Local Connections



Source: Synergies Study 2022

Another possible solution for railway connections to industrial nodes with an existing access to 1520 mm rail network and with a significant volume of traffic between this node and a specific destination in standard gauge (through Rail Baltica network) would be to establish a **rolling highway** (piggyback rail services) between these two points, including an interchange terminal between both networks where trucks (or semi-trailers using a tractor unit) could descend from one railway platform to get on the other in an efficient way. In this case truck drivers / fleet operators would not have to learn different processes / procedures for the different railways and automated tractor tugs could do transhipment between 1520 & 1435 rail networks, although specific investments and technical requirements should be considered as analysed in “Piggyback Transportation Services and Related Areas” study[14].

As for **military transport**, operational conditions related to exceptional oversize rail services should apply, with special facilities for loading of military vehicles and a respectively aligned layout of the track systems, following the considerations regarding aspects of secrecy indicated in the Rail Baltica Operational Plan.

Regarding the construction of the new railway, necessary measures should be taken in order to enable **continuous pedestrian access** from or to the housing developments surrounding stations or railway branches. Thus, similarly to any linear infrastructure project (road, rail, etc), each individual railway branch

[14] https://www.railbaltica.org/wp-content/uploads/2021/05/Piggyback-Transportation-Services-and-Related-Areas.pdf

or station access project should conduct the necessary analysis in order to promote accessibility, preferably through overpasses or underpasses.

This circumstance should be taken into consideration during the feasibility studies and design concept phases of the railway branch project, following the "Dig Once" perspective, which promotes the synchronisation of the necessary infrastructural design elements and future functionalities and with other relevant surrounding infrastructure developments.

2.4.3 IMPACT ON PROJECT TIMELINE

The design and construction of **railway branches to industrial sidings could be carried out parallel** to the construction of the Rail Baltica network with **no impact on the project timeline**.

Nevertheless, it is recommended to consider future connections in the Rail Baltica layout of possible rail branches to relevant industrial areas for later implementation.

Regarding the timeline of local connections for industrial areas, the following phases could be considered:

- **Planning phase**: comprising feasibility studies (including an analysis of funding sources) and Strategic of Environmental Assessment (SEA) with an estimated term of 6 - 9 months.
- **Design phase**: including the detailed design of the rail branches and the industrial sidings, the detailed implementation action plan, administrative permits and licences and the application for European/national funding, lasting around 10 - 15 months.
- **Construction phase**: depending on the complexity of works (possible structures), the construction of rail branches and industrial siding would take 12 - 24 months.

Therefore, the total duration for the implementation of a rail connection from the Rail Baltica network to an industrial area is estimated to amount to 28 - 48 months.

2.4.4 IMPACT ON COST

Local connections for industrial areas do not affect the foreseen costs of the Rail Baltica network, except for the case that specific rail diversions are installed in advance for relevant connections.

Regarding the **cost of rail branches**, an average cost of €4M/km can be estimated for the construction and installation of railway platforms, tracks, energy, signalling and other sub-systems.

As for the **cost of industrial sidings**, considering the design of tracks included in section 2.4.1, the costs are estimated around €10M for the railway infrastructure, excluding the logistics area related to freight handling and other specific distribution, storage and consolidation activities specific for each industrial area.

Despite the estimated average costs mentioned above, it is important to point out that the assessment of costs for the construction of railway branches and industrial sidings depend on each project design and will have to be developed in accordance with the specific circumstances of the industrial area.

In the case of **existing industrial sidings or terminals** that are currently connected to the conventional rail network, a similar average cost per km can be considered for rail branches to Rail Baltica network, with an additional 3-4 M€ for the gauge changeover installation.

2.4.5 FUNDING PROGRAMMES

For the development of local connections from Rail Baltica network to industrial areas it is necessary to reach **agreements with national, regional and local authorities**, including arrangements for funding sources: private funding, State Aid and EU support for "greening" and modal shift to rail.

Taking into account the analysis of **funding sources** described in Annex 2, local connections for industrial areas could benefit from the following ones:

- **CEF2 funding**: Article 9 of Regulation (EU) 2021/1153 states the following eligible actions related to railway branches and industrial sidings:

  *2. In the **transport sector**, only the following actions shall be eligible to receive Union financial support under this Regulation:*

  *(a) actions relating to **efficient, interconnected, interoperable and multimodal networks for the development of railway**, road, inland waterway and maritime infrastructure:*

  > *(v) actions supporting projects of common interest in order to **connect the trans-European network with infrastructure networks of neighbouring countries** as defined in Article 8(1) of Regulation (EU) No 1315/2013*

  *(b) actions relating to **smart, interoperable, sustainable, multimodal, inclusive, accessible, safe and secure mobility**:*

  > *(iii) actions supporting **sustainable freight transport services** in accordance with Article 32 of Regulation (EU) No 1315/2013 and actions to reduce rail freight noise*
  >
  > *(v) actions to **remove barriers to interoperability** as defined in Article 3, point (o), of Regulation (EU) No 1315/2013, notably barriers when delivering corridor/network effects, including **actions promoting an increase in rail freight traffic** and **automatic gauge-change facilities***
  >
  > *(x) actions **improving transport infrastructure accessibility and availability for security and civil protection purposes** and actions adapting the transport infrastructure for Union external border checks purposes with the aim of facilitating traffic flows*

  *(c) under the specific objective referred to in Article 3(2), point (a)(ii), and in accordance with Article 12, actions or specific activities within an action, supporting parts, new or existing, of the TEN-T suitable for military transport, in order to **adapt the TEN-T to dual-use infrastructure requirements**.*

- **Invest EU**: this programme will leverage substantial private and public funds that are protected through an EU budget guarantee that builds on the successful implementation of the European

Fund for Strategic Investments (EFSI). One of its objectives is supporting financing and investment operations related to sustainable investment in the areas of transport, including multimodal transport, road safety and the renewal and maintenance of rail and road infrastructure.

- **European Regional Development Fund (ERDF) and Cohesion Fund (CF)**:
  - The ERDF contributes to reducing disparities between the levels of development of the various regions within the EU and supports investments through dedicated national or regional programmes, including investments in infrastructure, equipment, software and intangible assets.
  - The CF provides support to Member States with a gross national income (GNI) per capita below 90% EU-27 average to strengthen the economic, social and territorial cohesion of the EU, including Estonia, Latvia and Lithuania for 2021-2027 period. This fund supports investments in the field of environment and trans-European networks.
- **Recovery and Resilience Facility (RFF)**: the aim of the RFF is to mitigate the economic and social impact of the COVID-19 pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions. A Member State wishing to receive a financial contribution from RFF shall submit to the European Commission a recovery and resilience plan. Estonia, Latvia and Lithuania have presented their Recovery and Resilience Plans, including investments and measures to increase the sustainability of transport and mobility.

State Aid: several EU countries, such as Germany, Sweden, Italy, Luxembourg or Croatia, support rail freight and combined transport through national funding programmes. These aid measures can only be implemented after approval by the European Commission and are specific for the operational phase.

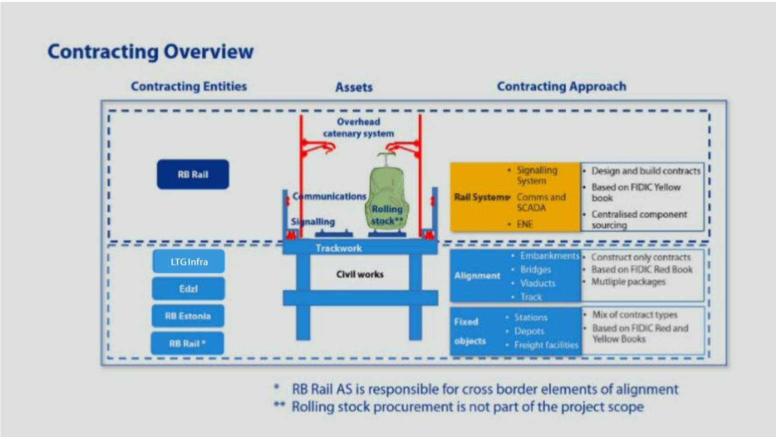
3 APPLICABILITY OF KEY RECOMMENDATIONS AND SYNTHESIS OF INTERNATIONAL BEST PRACTICE AND OPPORTUNITIES WITH RESPECT TO COMPONENTS OF CEF AND OTHER DEVELOPMENT PROGRAMMES AND AREAS OF RAIL BALTICA DESIGN GUIDELINES

This chapter summarises the applicability of key recommendations and the synthesis of Annex 1 (International best practice and opportunities), the review and assessment of opportunities and best practices and lessons learned in the field of synergistic opportunities, with respect to Annex 2 (synergy components of CEF and other development programmes and of the impact of state aid and other rules), the critical analysis of the synergy components of the Connecting Europe Facility and other national and European development programmes, as well as of the impact of State Aid and other rules for synergistic/catalytic opportunities, and the review of areas identified in the context of the Rail Baltica Design Guidelines for demonstrating where proposed areas/activities could be captured without significant change in terms of impact on project timeline or costs.

RB GP is an example for implementation of cross-border projects with a high degree of complexity regarding the planning, the contracting approach and the implementation. The integration is shown by the establishment of RBR, a joint venture, with an interstate joint governance structure. This structure allocates competencies between RBR and national implementing bodies for the provision of construction works of Rail Baltica HSR assets (Figure 26: Provision of Construction Works of Rail Baltica HSR).

Rail Baltic Estonia OU (Estonia), Eiropas Dzelzceļa līnijas SIA, Edzl (Latvia), Rail Baltica statyba UAB and Lietuvos geležinkeliai JSC, LGI (Lithuania) are the national implementing bodies. All construction carried out by the implementing bodies is done under the supervision of RB Rail and is based on common procurement principles, rules and contract templates.

Figure 26: Provision of Construction Works of Rail Baltica HSR



Source: Rail Baltica Industry Day (2021)

The state beneficiaries of the Rail Baltica project are the three Baltic governments represented by state ministries – Estonia's Ministry of Economic Affairs and Communications, Latvia's Ministry of Transport and Lithuania's Ministry of Transport and Communications.

Therefore, due to the governance bodies and integration procedures set up by the beneficiary states, there should in theory be the possibility to ensure a high level of integration of planning, design, procurement strategy and implementation of investments. The holistic vision is also expected to be projected onto the operation phase of the cross-border project. This foundation will allow funding and prioritisation of any of the synergetic elements proposed in this Rail Baltica Global Project Synergies Study (2022). These key recommendations provide guidance for the value maximisation of the Rail Baltica global project from the "Dig Once" perspective, in order to be able to calibrate more precisely the necessary infrastructural design elements, future functionalities and related developments, assess the potential future business cases for various services/offerings, as well as provide insights to national governments on opportunities to co-synchronise relevant infrastructure developments with the delivery of Rail Baltica.

3.1 TELECOMUNICATIONS WAYLEAVES

3.1.1 COMPATIBILITY WITH CEF FUNDING PRIORITIES:

The synergic opportunity is fully aligned with EU funding objectives. Mainly because this 5G mobile technology requires a fixed network to operate, with many additional sites, especially antennas and microcells, all of them connected through fibre.

On 9 March 2021, the Commission adopted the Communication "The 2030 Digital Compass: the European way for the Digital Decade" ('Digital Compass Communication'[15]). This includes addressing vulnerabilities and dependencies as well as accelerating investment. The Communication proposed to agree on a set of digital principles, to launch rapidly important multi-country projects, and to prepare a legislative proposal setting out a robust governance through a monitoring and cooperation mechanism with Member States, to ensure progress – the Policy Programme "Path to the Digital Decade ('Policy Programme')".

Under the Multiannual Financial Framework, the MFF, the digital strand of CEF is worth €2.07 billion (in current prices) and will fund connectivity projects in the period 2021-2027. Actions foreseen under CEF Digital include:

[15] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions 2030 Digital Compass: the European way for the Digital Decade, COM/2021/118 final/2, 9. 3. 2021.

- developing and making available very high-capacity networks, including 5G systems, across Europe
- supporting increased security, resilience and capacity of the digital backbone networks in the EU
- boosting the digitalisation of transport and energy networks

Europe has set ambitious objectives for the 5G deployment. According to the 5G Digital it is planned to provide financial support of approximately €1 billion for 5G corridor deployment during the EU budget period 2021-2027. This will be reinforced by national projects under the RRF.

CEF Digital will fund projects that contribute to the deployment of 5G infrastructure along cross-border corridors. Cross-border connectivity will ensure the continuity of 5G services across borders and in important industry cases. This includes connected and automated mobility, automated manufacturing operations and more. The investments will be dedicated to motorways, ports, railways and in-land waterways to enable innovative services for passenger and freight transport.

CEF Digital will fund projects that deploy 5G connectivity for smart communities, for example schools, hospitals and community centres to improve access to online services and digital skills.

3.1.2 IMPACT ON PROJECT GUIDELINES, TIMELINE AND COSTS

Firstly, it shall be noted that Rail Baltica Design Guidelines do not concern concepts such as "Rights of Way" / "Wayleaves" or similar since these are not engineering matters but rather a regulatory and legal framework issue. One of the objectives of this action is to deliver increased synergies and complementarity enhancing the effectiveness of one or more policy actions at national level and minimising the cost of implementation improving the socio-economic benefits.

The railway operator, IM and/or RUs, is the one responsible for the asset where the railway is framed for conditions of reliability, availability, maintenance, safety and security and be the one who grant accessibility to third-party providers (such as telecom providers) for example via the bidding process of contract or lease agreement.

The demand of the private sector is huge, and the railway operator should focus on extending the open communications networks, this can also be with the means of a commercial partner. This agent act as a private investor of a comparable size operating in the normal conditions of a market economy[16].

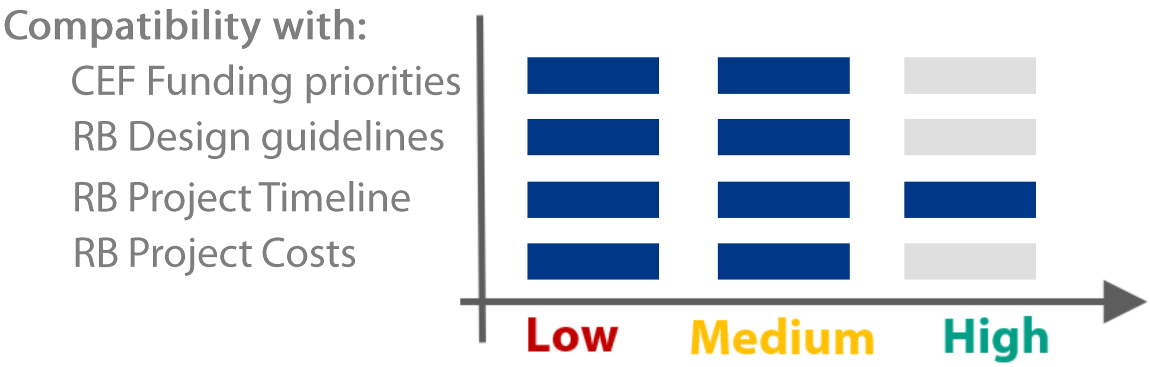
[16] For further information about when a public authority or NBPI can be considered to act like a private investor ("market economy operator test"), see the above-mentioned notice on the notion of State aid and the RRF State aid guiding templates "Guiding template: Measures to support the deployment and take-up of fixed and mobile very - high-capacity networks, including 5G and fibre networks"

In any case, it is recalled what is indicated in section 3.1.2.4 of this Report with respect to the European Commission Directive of December 2012 in which revised guidelines were adopted to achieve the ambitious goals of the EU Digital Agenda, such as reinforcement of open access, in which the consumers should benefit from a truly open network where competition is ensured.

Therefore, this would be consistent with European CEF Digital regulations which aims to guarantee open access, in which the consumers should benefit from a truly cross-border open network where competition is ensured. Secondly, the 5G Action Plan and more recently the Digital Compass 2030 set ambitious objectives for pan-European deployment of 5G connectivity infrastructure along major transport corridors, such as in the Rail Baltica countries.

Project guidelines, timeline and cost could be reviewed under the experience of the seven 5G cross-border corridor projects resulted from last CEF calls. This experience also gives insights into service requirements and network deployment planning in view of the Connecting Europe Facility 2 Digital programme (CEF2-Digital). CEF2-Digital will provide financial support to the deployment of 5G corridors, with a focus on cross-border sections and other economically challenging areas.

Figure 27: Dark Fibre Optic Network Impact Assessment and Risk Management



Source: Synergies Study 2021-2022

3.1.3 ALIGNMENT WITH RAIL BALTICA SYNERGIES PRIORITIES OF APPLICATION BY RAIL BALTICA STAKEHOLDERS

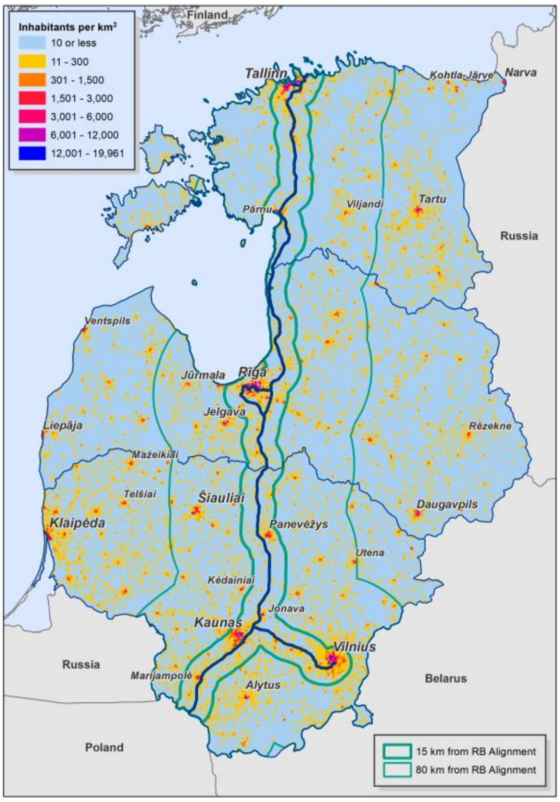
“Dig Once” perspective: This approach highlights the chance to provide the national governments the opportunities to co-synchronise relevant regional fibre optic deployment in the Rail Baltica economic corridor. It is mainly because Rail Baltica has space for those assets owned and managed by the railway infrastructure manager(s), and the requirements of offering services as “open access” given that these are CEF-funded assets.

Connectivity and access to digital services are a key elements in invigorating the EU's rural and regional communities.

This kind of transactions have positive results for the telecommunications industry and infrastructure by enabling the creation of a neutral telecommunications infrastructure operator at a cross national-wide level as well as the integration of the European fibre optic networks, improving the quality and performance of the services they offer.

This case study is a clear example of cross-sector infrastructure sharing projects supporting national innovation and digitalisation goals. Investments in connectivity infrastructure will translate into better commercial, trade and research networks.

Figure 28: Rail Baltica as a Digital and Economic Corridor Impact on Both Rural and Urban Areas



Source: Rail Baltica as a Digital Corridor (RB Rail, June 2021)

Rail Baltica could facilitate an IP cross-border backbone, a high-capacity interconnection between internet exchanges and data centres; seamless connections between the three Baltic states and major universities, hospitals, and research centres, among other strategic installations.

Large transport/energy projects can co-deliver opportunities for digital infrastructure with:

- savings from co-delivery

- projects encouraged to address digital infra co-delivery - especially cross-border infrastructure projects
- details of CEF Digital programmes expected during 2021 (see Case Study W.1 References)
- open access principles for deliver dark fibre optic infrastructure capacity. Meaning that all suppliers are able to obtain access to network facilities on equal terms and prices. Open access is paramount if the new digital economy is not to fall back into monopoly.
- “Dig Once” perspective: This approach highlights the change to provide providing Neutral Host services.

3.1.4 TAKEAWAYS - POTENTIAL BENEFITS/APPLICABILITY TO THE RAIL BALTICA CASE

Commercial stakeholders (i.e., telecom companies): Offering dark fibre optic open access to telecommunication providers creates synergies for a fast introduction of broadband communication networks in Rail Baltica countries.

Rail Baltica: Coverage for transport corridors, multimodal transport data space and support for private and public deployments (industrial, innovation hubs, hospitals and community services)

Support for gigabit services to regional/rural socio-economic drivers

Figure 29: Potential Benefits/Applicability to the Rail Baltica Case

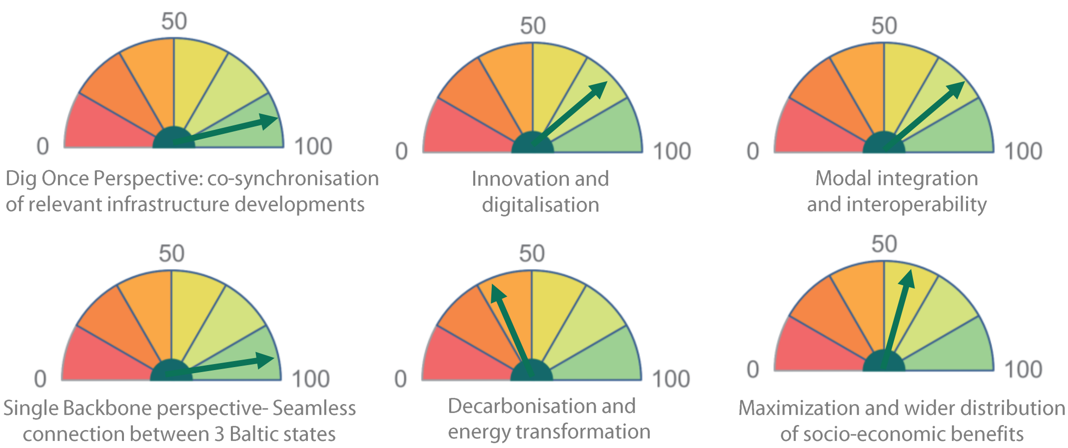
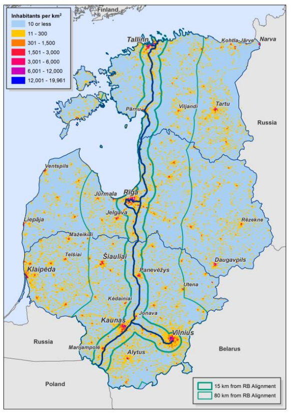


Table 10: Synergetic action Telecommunications Wayleaves

 Digital and economic corridor impact on both rural and urban areas	**Telecommunications Wayleaves** Future technical functionalities and related developments of synergy action The railway operator, IM and/or RUs, is the one responsible for the asset where the railway is framed for conditions of reliability, availability, maintenance, safety and security and be the one who grant accessibility to third-party providers (such as telecom providers) for example via the bidding process of contract or lease agreement. This would be consistent with European CEF Digital regulations which aims to guarantee open access, in which the consumers should benefit from a truly cross-border open network where competition is ensured. The demand of the private sector is huge, and the railway operator should focus on extending the open communications networks, this can also be with the means of a commercial partner. The demand of private sector and the railway operator should be focus on extending the open cross-border communications networks. This can also be with the means of a commercial partner to operate the communication part.
Benefits that maximise the value of the Rail Baltica global project from the "Dig Once" perspective	In Europe "planning and development of the railway network is usually carried out by a ministerial body. Construction and maintenance are typically carried out by a designated infrastructure owner. New public railway lines usually have to be approved by parliament as they are typically major investments that will have extensive influence on the entire transport network in a region. Policy-making and decision-making processes are usually very comprehensive and complex for new railway lines and often take very long. Private involvement with regard to railway lines mainly concerns the operation of rail services. Connectivity and access to digital services are a key element in invigorating the EU's rural and regional communities. This kind of transactions has positive results for the telecommunications industry and infrastructure by enabling the creation of a neutral telecommunications infrastructure operator at a cross-border national-wide level as well as the integration of the European fibre optic networks, improving the quality and performance of the services they offer. This case study is a clear example of cross-sector infrastructure sharing projects supporting national innovation and digitalisation breakthroughs. Investments in connectivity infrastructure will translate into better commercial, trade and research networks.
Contribution to the achievement of objectives of CEF sectors	Transport ☒ Digital ☒
Synergy components of relevant European funding programmes	The synergic opportunity is fully aligned with EU funding objectives. Mainly because this 5G mobile technology requires a fixed network with many additional sites, especially antennas and microcells, all of them connected through fibre.
Compatibility with Design Guidelines and Rail Baltica work programme	It shall be noted that RB Design Guidelines do not include concepts such as "rights of way", "wayleaves" or similar since these are not engineering matters but rather a regulatory and legal framework issue. One of the objectives of this action is to deliver increased synergies and complementarity enhancing the effectiveness of one or more policy actions at national level and minimising the cost of implementation improving the socio-economic benefits. It is recommended to seek legal advice at national level before entering into any sort of agreement in this matter given the complexity and the long-term impact this may have. As a result it is of utmost importance for all operators to know beforehand which are the applicable laws, which entity has jurisdiction to grant public rights of way and which entity is responsible for resolving disputes. In many countries, authorisation to use public lands may

	also be subject to legislation aiming at meeting other objectives, such as environmental protection or the preservation of historic sites etc.
Best practices and lessons learned	**Rail operator Iarnród Éireann, Ireland**. "A number of telecom companies have approached rail operator Iarnród Éireann seeking to use its communications lines to develop their own networks. https://www.irishtimes.com/business/telcos-approach-irish-rail-over-network-development-1.1006746 **ADIF's Railway Fibre optic open access Spain.** ADIF is currently designing a new business model intending to manage its share of fibre optics. The intention is to take part in the promotion of 5G technology, like Reintel, and participate in the digitalisation of both urban and rural environments. https://www.ree.es/en/press-office/news/press-release/2020/12/ADIF-av-and-reintel-renew-their-commitment-maintenance-and chapter 8 DEVELOPMENT OF 5G TRANSPORT CORRIDORS https://www.lamoncloa.gob.es/presidente/actividades/Documents/2020/230720-Espa%C3%B1aDigital_2025.pdf

Source: Rail Baltica Global Project Synergies Study (2022)

3.2 INFORMATION NETWORKS AND DIGITAL INFRASTRUCTURE

3.2.1 DEPLOYMENT OF 5G MOBILE CROSS-BORDER NETWORK. NEUTRAL HOST

3.2.1.1 Compatibility with CEF Funding Priorities

The Connecting Europe Facility (CEF) program will support investments in Europe's transport, energy and digital infrastructure. It supports trans-European networks and infrastructures which fill the gaps and missing links of Europe´s energy, transport and telecommunication sectors.

The digital part of the CEF will fund connectivity projects of common EU interest and contribute to deploying Gigabit and 5G networks across the EU. CEF funds will contribute to the deployment of access to safe and secure very high-capacity digital networks and 5G systems.

A trans-European 5G network, deployed for providing high bandwidth digital mobile access services and helping to extend 5G, aligns with EU funding objectives. 5G cross-border corridors are part of EU research & innovation projects.

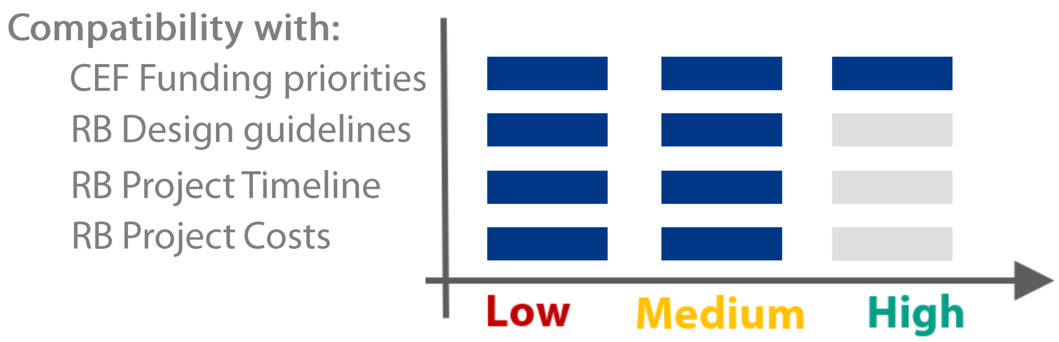
3.2.1.2 Impact on Project Guidelines, Timeline and Costs

Design and installation of a 5G network along the railway line, installed and operated by a Neutral Host, does not impact directly on the railway operator´s mobile network (FRMCS) design.

The deployment of 5G mobile networks is very expensive in cost and time. The implementation of a 5G mobile network capable of providing advanced services require a great number of NR nodes to be deployed.

The deployment of a 5G network providing advanced high bandwidth services is very expensive. Nevertheless, railway operators will need to deploy these networks in the mid-term in order to support future gigabit train services. Not deploying these networks will result in a lack of quality of the offered services.

Figure 30: Impact Assessment and Risk Management of Deployment of 5G Mobile Network, Neutral Host



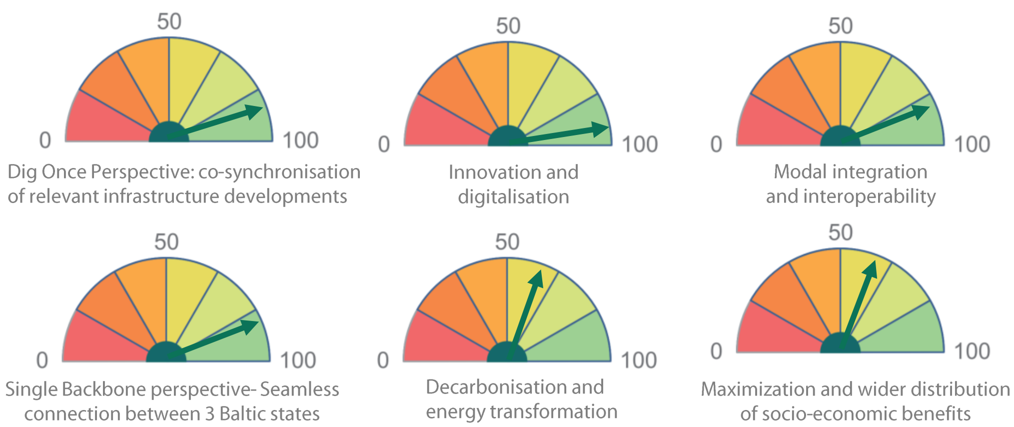
Source: Synergies Study 2021-2022

3.2.1.3 Alignment with Rail Baltica Synergies Priorities in Case of application by Rail Baltica Stakeholders

A 5G network along the railway line, installed and operated by a Neutral Host and providing advanced 5G services along the corridor, matches with **Rail Baltica Synergies priorities** in the following way:

- "Dig Once" perspective: The own railway mobile network infrastructure and infrastructure to share with MNOs or other non-Railway entities can be deployed simultaneously.
- Innovation and digitalisation: 5G mobile networks play an important role in society digitalisation.
- Modal integration and interoperability: 5G networks can also offer ETCS services helping interoperability.
- Single-Backbone perspective: seamless connection between the three Baltic states: the 5G network will interconnect the Baltic states with a high-bandwidth network.
- De-carbonisation and energy transformation: Network sharing reduces equipment installation, contributing to savings in energy and de-carbonisation.
- Maximise trade and synergy opportunities in the corridor developing potential services: Provision of new high-value 5G services requiring high-data bandwidth.

Figure 31: Alignment with Rail Baltica Synergies Priorities of Deployment of 5G Mobile Network, Neutral Host



Source: Synergies Study 2021-2022

3.2.1.4 *Takeaways - Potential Benefits/Applicability to the Rail Baltica Case*

The following **benefits** would be linked to the implementation of a 5G network along the railway line providing advanced 5G services along the corridor:

- 5G is key for society digitalisation, enabling the provision of new high-value services.
- 5G technology is more efficient and provides higher bandwidth, lower latency, more capacity and reliability than previous mobile generations or other similar technologies, such as Wi-Fi or communication via satellite.
- A neutral-host 5G mobile network can allow to manage the transmission of voice, data and video for the following on-board and on-track data services:
    - performance communication services
    - business communication services
    - high-definition on-board video (real time video on-board)
- Railway operator and other entities can collaborate in the deployment of 5G mobile networks, sharing resources and reducing costs, and increasing the services offered.
- Special attention must be taken at cross-borders, areas where 5G coverage changes between MNO from different countries without handover (no existing handover between networks belonging to different operators).
- A 5G mobile communication network deployed and managed by a Neutral Host and offering services to other entities, contributes to the deployment of digital 5G access communication networks in rural and less populated areas.

The following table summarises the applicability of key recommendations and the synthesis of WP2.1-WP2.6 with respect to WP3.1 and WP3.2 regarding of the deployment of 5G mobile network via the Neutral Host model.

Table 11: Synergetic Action Synthesis of the Deployment of 5G Mobile Network. Neutral Host

	Deployment of 5G Mobile cross-border Network. Neutral Host
	**Future technical functionalities and related developments of synergy action** Deployment of a 5G network along the railway line, installed and operated by a Neutral Host, and providing advanced 5G services along the corridor. The 5G mobile network should support advanced high bandwidth 5G services, so it needs to be deployed at mid (2.1-2.6 GHz, 3.3-4.2 GHz) and high (e.g., 26 GHz and 40 GHz) spectrum bands. Decision makers are national governments and the European institutions because it is a cross-border project, and an opportunity for co-synchronising relevant infrastructure developments with the delivery of Rail Baltica project.

Benefits that maximise of the value of the Rail Baltica global project from the "Dig Once" perspective	A 5G network installed along the railway line will contribute to the deploying of gigabit and 5G networks across the EU and to the deployment of access to safe and secure very high-capacity digital networks and 5G systems. The implementation of 5G advanced services included in performance and business applications, such as video on-demand, will require rolling out a 5G network, offering mid and high spectrum radio coverage all along the corridor. Potential stakeholders benefiting from the 5G cross-border network deployed and operated by the Neutral Host are at least the following entities are Municipalities and local governments in the proximity of the Baltic corridor. Mobile network operators, Administrators and operators of roads and highways in the proximity of the Baltic corridor, Industrial players, Logistic areas, Defence, nodes, technology parks, university campuses, ports, mining, construction sites, commercial areas, venues and other entities and the Rail Baltica railway administrator itself.
Contribution to the achievement of objectives of CEF sectors	Transport ☒ Digital ☒
Synergy components of relevant European funding programmes	The digital part of the CEF will fund connectivity projects of common EU interest and contribute to deploying Gigabit and 5G networks across the EU. A trans-European 5G network, deployed for providing high bandwidth digital mobile access services and helping to extend 5G, aligns with EU funding objectives. Article 8 of Regulation (EU) 2021/1153 states Projects of common interest in the area of digital connectivity infrastructure which would fit to related deployment of 5G networks, high-capacity broadband backbone networks and digital infrastructure. Article 9 of Regulation (EU) 2021/1153 indicates several eligible actions for CEF2 funding which would fit to related deployment 5G networks, high-capacity broadband backbone networks and digital infrastructure, as they are actions supporting the deployment of and access to very high-capacity networks, including 5G systems, capable of providing gigabit connectivity. Section 2.3. of *Commission Implementing Decision on the financing of the Connecting Europe Facility – Digital sector and the adoption of the multiannual work programme for 2021-2025* lists key topics targeting specific types of deployment projects which can be supported by CEF Digital, including: - The deployment of and access to very high-capacity networks, including 5G systems, capable of providing Gigabit connectivity in areas where socioeconomic drivers are located; - Uninterrupted coverage with 5G systems of all major transport paths, including the trans-European transport networks; Section 3.1.3. of *Commission Implementing Decision on the financing of the Connecting Europe Facility – Digital sector and the adoption of the multiannual work programme for 2021-2025* mentions that "Funding of sharing models regarding both passive and active infrastructure is encouraged to increase the efficient use of funds provided under this programme. The sharing by network operators of passive, but also active equipment (e.g., through a Neutral Host model) should aim at substantially reducing network deployment costs and at the same time at facilitating the energy efficient use of resources when deploying and operating the 5G infrastructure."
Compatibility with Design Guidelines and Rail Baltica work programme	Design and installation of a 5G network along the railway line, installed and operated by a Neutral Host, does not impact directly on the railway operator´s mobile network (FRMCS) design.
Best practices and lessons learned	**Haifa Nazareth LRT Project. Mobile Communication Network.** *"The mobile communication system for Haifa–Nazareth LRT Project consists of an LTE Advanced Pro network compliant to 3GPP Release 15 (supporting NSA-5G) including voice, data and video"*. https://www.transisrael.co.il/ContentPage?id=97 **5GMED: Figueres–Perpignan Mediterranean Cross-Border Corridor.** *"Network infrastructure deployed by MNOs, Neutral Hosts, as well as road and rail operators, based on 5G and offering support for AI functions"*.

	https://5g-ppp.eu/5gmed/ **Cellnex On Tower France Acting as a Neutral Host.** *"On Tower France offers co-location services, installing its own infrastructure and allowing for mobile carriers to install their telecommunications and wireless radio broadcast equipment".* https://www.cellnextelecom.com/on-tower-france/ **Cereixal Smart Tunnel.** *"5G Galicia (Spain) Pilot project promoted by the Ministry of Economic Affairs and Digital Transformation".* https://www.revistaitransporte.com/testing-of-smart-tunnel-and-assisted-driving-with-5g/ https://www.ineco.com/webineco/en/news/ineco-promotes-smart-roads-collaborating-deployment-5g-cereixal-tunnel **Spanish Railway Administrator (ADIF) Mobile Network Sharing Model.** *"Spanish Railway Administrator (ADIF) provides mobile network resources to MNOs through a Neutral Host model, building an independent and separated passive infrastructure to share by all the interested MNOs".* http://www.adifaltavelocidad.es/es_ES/infraestructuras/telecomunicaciones/telecomunicaciones.shtml

Source: Rail Baltica Global Project Synergies Study (2022)

3.2.2 DEPLOYMENT OF A FO BACKBONE TRANSPORT CROSS-BORDER NETWORK. NEUTRAL HOST

3.2.2.1 Compatibility with CEF Funding Priorities

The Connecting Europe Facility (CEF) programme supports investments in Europe's transport, energy and digital infrastructure. It supports trans-European networks and infrastructures which fill in the missing links of Europe´s energy, transport and telecommunication sectors.

CEF Digital funds connectivity projects of common EU interest and contribute to deploying gigabit and 5G networks across the EU. CEF funds will contribute to the deployment of access to safe and secure very high-capacity digital networks and 5G systems.

A trans-European high-capacity communication transport network, deployed for providing digital data transport, is in line with EU funding objectives.

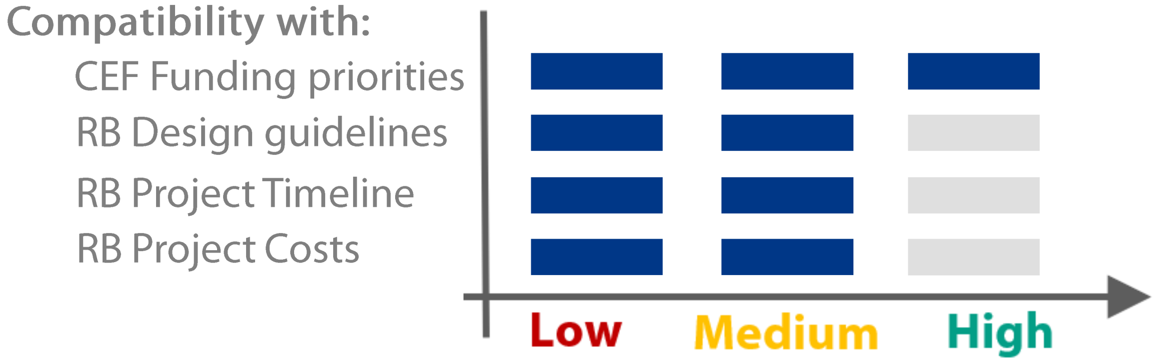
3.2.2.2 Impact on Project Guidelines, Timeline and Costs

Fibre optic backbone transport network can be designed to be deployed as an independent project interconnected with separated optical resources, in order to avoid any impact on current network designs.

Costs in the deployment of a communication transport network, based in advanced transport equipment, are significantly lower than those involved in the deployment of additional fibre optical cables.

The required time for deployment of a communication transport network is lower than the time required for laying of additional fibre optical cables.

Figure 32: Impact Assessment and Risk Management of Deployment of Backbone Transport Network, Neutral Host



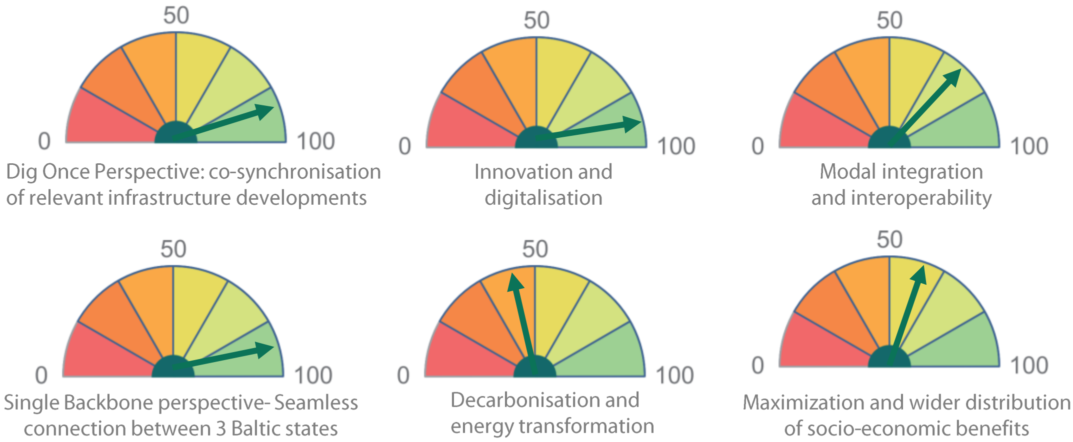
Source: Synergies Study 2021-2022

3.2.2.3 Alignment with Rail Baltica Synergies Priorities of application by Rail Baltica Stakeholders

A fixed backbone transport network based on fibre optic technology along the railway line (installed and operated by a Neutral Host), providing broadband access and transport communication services along the corridor, match with **Rail Baltica Synergies priorities** as follows:

- "Dig Once" perspective: A fibre optic transport network can be deployed simultaneously with the optical fibre cable laying.
- Innovation and digitalisation: fibre optic transport network foster the digitalisation of transport networks.
- Modal integration and interoperability: Fibre optic transport network is a multi-access and multi-protocol network, allowing the interconnection of diverse access networks.
- Single backbone perspective-seamless connection between the three involved Baltic states: The transport backbone network would interconnect the Baltic states with a high bandwidth network.
- De-carbonisation and energy transformation: Digitalisation, optimised processes and reduced travels, contributing to savings in energy.
- Maximise trade and synergy opportunities in the corridor developing potential services / offering: Provision of new high-value services requiring high-data bandwidth.

Figure 33: Alignment with Rail Baltica Synergies Priorities of Deployment of Backbone Transport Network, Neutral Host



Source: Synergies Study 2021-2022

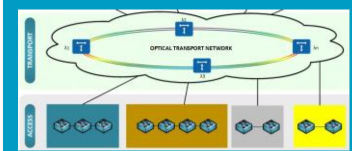
3.2.2.4 Takeaways - Potential Benefits/Applicability to the Rail Baltica Case

The following **benefits** would be linked to the implementation of a fixed backbone transport network based on fibre optic technology along the railway line, providing broadband access and transport communication services:

- Railways are going both digital and wireless. Smart management, HD video surveillance, Wi-Fi connections, and wireless transmission services are becoming increasingly important to railway and non-railway systems. The growing bandwidth demand of the railway systems will require more transmission resources on the own backbone networks. Railway backbone networks face huge challenges.
- Introduction of modern fixed network technology will increase railway communication backbone network capacity, releasing bandwidth and allowing to create synergies with telecommunication and internet providers.
- A communication transport network operated by a Neutral Host for offering transmission services to other entities, contributes to the deployment of broadband access communication networks in rural and less populated areas.

The following table summarises the applicability of key recommendations and synthesis of WP2.1-WP2.6 with respect to WP3.1 and WP3.2 regarding of the deployment of a FO backbone transport network via the Neutral Host model.

Table 12: Synergetic Action Synthesis of the Deployment of a FO Backbone Transport Network. Neutral Host

<table>
<tr><td rowspan="2">
</td><td colspan="5">Deployment of a FO Backbone Transport cross-border Network. Neutral Host</td></tr>
<tr><td colspan="5">Future technical functionalities and related developments of synergy action
Deployment of a fixed backbone transport network based on fibre optic technology along the railway line, installed and operated by a Neutral Host, and providing broadband access and transport communication services along the corridor.
Deployment of an optical transport network helps to create a managed optical backbone transport network along the Baltic corridor suitable for other non-rail uses. This network could be used for offering telecommunication transport and access services in areas along the line and at its proximity. Local connections with particular relevance in the field of dual use of infrastructure would be an independent network connecting all defence facilities along the corridor and in the field of solving market failures would be the deployment of FO connections to rural areas.</td></tr>
<tr><td>Benefits that maximise of the value of the Rail Baltica global project from the “Dig Once” perspective</td><td colspan="5">A backbone transport network based on fibre optic technology installed along the railway line will contribute to the deploying of gigabit and 5G networks across the EU and to the deployment of access to safe and secure very high-capacity digital networks and 5G systems.
Introduction of modern fixed network technology will increase railway communication backbone network capacity, releasing bandwidth and allowing to create synergies with telecommunication and internet providers.
A communication transport network operated by a Neutral Host for offering transmission services to other entities, contributes to the deployment of broadband access in rural and less populated areas.</td></tr>
<tr><td>Contribution to the achievement of objectives of CEF sectors</td><td>Transport</td><td>☒</td><td>Digital</td><td>☒</td><td></td></tr>
</table>

Synergy components of relevant European funding programmes	The digital part of the CEF will fund connectivity projects of common EU interest and contribute to deploying Gigabit and 5G networks across the EU. A trans-European high-capacity communication transport network, deployed for providing digital data transport, is in line with EU funding objectives. Article 8 of Regulation (EU) 2021/1153 states Projects of common interest in the area of digital connectivity infrastructure which would fit to related deployment of 5G networks, high-capacity broadband backbone networks and digital infrastructure. Article 9 of Regulation (EU) 2021/1153 indicates several eligible actions for CEF2 funding which would fit to related deployment 5G networks, high-capacity broadband backbone networks and digital infrastructure, as they are actions supporting the deployment of and access to very high-capacity networks, including 5G systems, capable of providing gigabit connectivity. Section 2.3. of *Commission Implementing Decision on the financing of the Connecting Europe Facility – Digital sector and the adoption of the multiannual work programme for 2021-2025* lists key topics targeting specific types of deployment projects which can be supported by CEF Digital, including: - Deployment of new or significant upgrade of existing backbone networks including submarine cables, within and between Member States and between the Union and third countries, to the extent to which they significantly contribute to the increased performance, resilience and very high capacity of the electronic communications networks;
Compatibility with Design Guidelines and Rail Baltica work programme	Fibre optic backbone transport network can be designed to be deployed as an independent project interconnected with separated optical resources, in order to avoid any impact on current network designs.
Best practices and lessons learned	**Haifa Nazareth LRT Project. FO Backbone Transport Network.** *"The communication backbone network at Haifa Nazareth project provides a transmission medium for all voice, data and video traffic between all LRT System facilities".* https://www.transisrael.co.il/ContentPage?id=97

Source: Rail Baltica Global Project Synergies Study (2022)

3.2.3 DESIGN OF SMART STATIONS. INSTALLATION OF SMART STATIONS INFRASTRUCTURE AND PROVISION OF SMART SERVICES

3.2.3.1 Compatibility with CEF Funding Priorities

The Connecting Europe Facility (CEF) programme will support investments in Europe's transport, energy and digital infrastructure. It supports trans-European networks and infrastructures which fill the gaps in the missing links of Europe´s energy, transport and telecommunications sectors.

The digital part of the CEF will fund connectivity projects of common EU interest, and contribute to the deployment of, and access to, safe, secure and high-capacity digital networks and 5G systems.

Smart stations, included in the Smart City strategy, contribute to the digitalisation of the society and aligns with EU funding objectives.

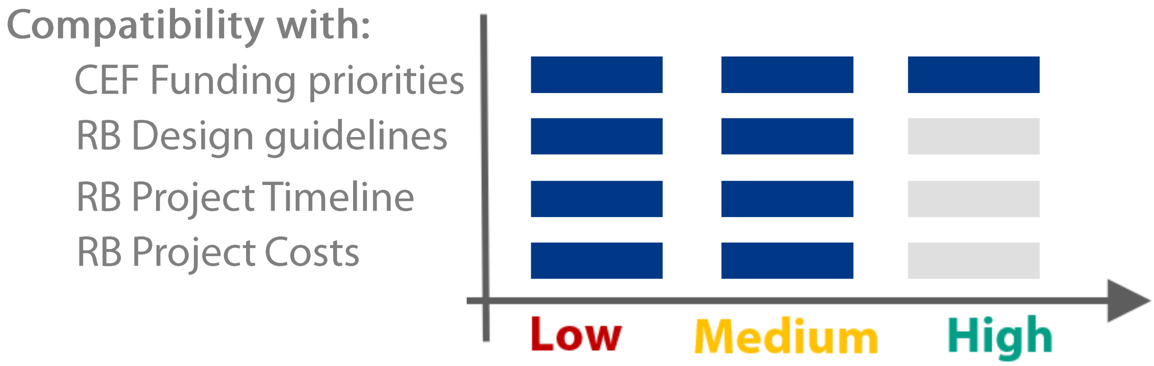
3.2.3.2 Impact on Project Guidelines, Timeline and Costs

Optimisation and important cost-saving can be achieved including “Smart Station” requirements in railway station design from the beginning.

Costs in the deployment of Smart Station communication networks and services are high, but they are costs that will have to be mandatory addressed in the mid-term.

Deployment of the Smart Station infrastructure can be carried out simultaneously with station construction.

Figure 34: Impact Assessment and Risk Management Design of Smart Stations



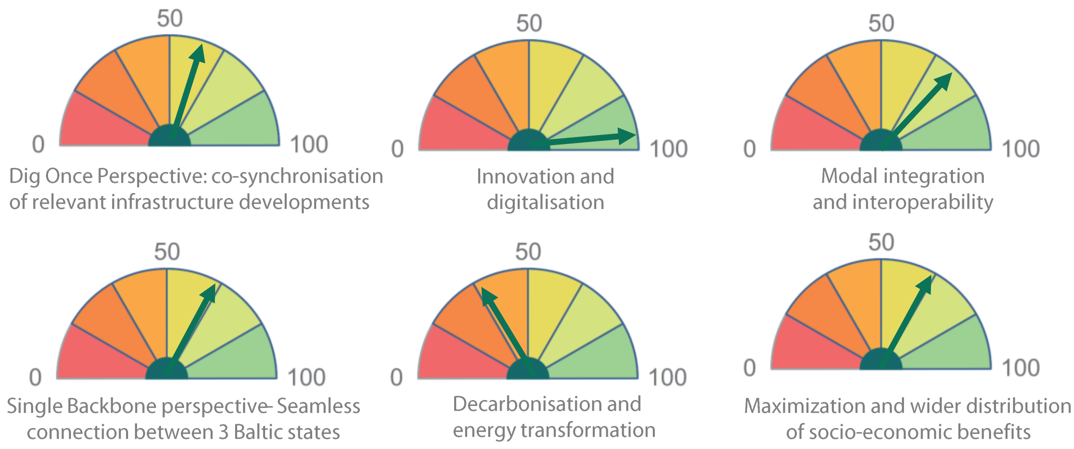
Source: Synergies Study 2021-2022

3.2.3.3 Alignment with Rail Baltica Synergies Priorities of application by Rail Baltica Stakeholders

Deployment of Smart Station digital infrastructure and digital services at the Rail Baltica Railway corridor stations match with **Rail Baltica Synergies priorities** as follows:

- "Dig Once" perspective: Significant benefits can be achieved by integrating Smart Station with railway station projects.
- Innovation and digitalisation: Smart Stations foster the digitalisation of transport modes and cities.
- Modal integration and interoperability: The correct integration of the Smart Station into the Smart City strategy is key for optimising intermodal transportation.
- Single backbone perspective-seamless connection between the three Baltic states: Similar services offered in the different stations of the corridor help to improve the rail passenger experience.
- De-carbonisation and energy transformation: Digitalisation optimises processes and contributes to energy-savings.
- Maximising trade and synergy opportunities in the corridor developing potential services: Provision of new high-value services at the stations.

Figure 35: Alignment with Rail Baltica Synergies Priorities of Deployment of Design of Smart Stations



Source: Synergies Study 2021-2022

3.2.3.4 Takeaways - Potential Benefits/Applicability to the Rail Baltica case

The following **benefits** would result from the implementation of Smart Station digital infrastructure and digital services at the RB Railway corridor stations:

- Increase of customer satisfaction and improvement of the rail customer experience (CX).

- Additional revenues with provision of new high-value services.
- Reduction of the station's operation and maintenance cost.
- Improvement in inter-modality and multimodality.
- Provision of entertainment and cultural activities, increasing attractiveness for tourism.
- Integration with Smart City allows to increase participation in public life. Smart Cities help to improve citizen engagement and give residents platforms to interact with city institutions and local administrations helping to improve the quality services through the citizens feedback. As far as the smart station be integrated with the smart city, this citizen participation is also promoted.

The following table summarise the applicability of key recommendations and the synthesis of WP2.1-WP2.6 with respect to WP3.1 and WP3.2 regarding of the design of smart stations, installation of smart stations infrastructure and provision of smart services.

Table 13: Synergetic Action Synthesis of the Installation of Smart Station Infrastructure and Provision of Smart Services

<table>
<tr><td rowspan="2">
</td><td colspan="5">Installation of Smart Station Infrastructure and Provision of Smart Services</td></tr>
<tr><td colspan="5">Future technical functionalities and related developments of synergy action
Development of "Smart Station" digital infrastructure and digital services at the RB Railway corridor stations, implementing the systems and technologies required for the provision of smart services, and deepening in the digitalisation and connectivity of the corridor railway stations.
The digitalisation of the railway stations should consist of two main parts:
- Deploying of digital and telecommunication infrastructures consisting mainly of broadband backbone communication networks all over the railway station
- Implementation and provision of advanced digital services.</td></tr>
<tr><td>Benefits that maximise of the value of the Rail Baltica global project from the "Dig Once" perspective</td><td colspan="5">Smart stations, included in the Smart City strategy, contribute to the digitalisation of the society. Smart Stations foster the digitalisation of transport modes and cities.
The correct integration of the Smart Station with the Smart City strategy is key for optimising intermodal transportation.
Smart stations increase customer satisfaction and improve the rail customer experience (CX).
Smart stations allow the generation of additional revenues with provision of new high-value services, reducing the station's operation and maintenance cost. They should also be part of renewable energy potential and could have higher decarbonization rating.</td></tr>
<tr><td>Contribution to the achievement of objectives of CEF sectors</td><td>Transport</td><td>☒</td><td>Digital</td><td>☒</td><td></td></tr>
<tr><td>Synergy components of relevant European funding programmes</td><td colspan="5">The digital part of the CEF will fund connectivity projects of common EU interest and contribute to deploying Gigabit and 5G networks across the EU.
Smart stations, included in the Smart City strategy, contribute to the digitalisation of the society and aligns with EU funding objectives.
Article 8 of Regulation (EU) 2021/1153 states Projects of common interest in the area of digital connectivity infrastructure which would fit to related deployment of 5G networks, high-capacity broadband backbone networks and digital infrastructure.</td></tr>
</table>

	Article 9 of Regulation (EU) 2021/1153 indicates several eligible actions for CEF2 funding which would fit to related deployment 5G networks, high-capacity broadband backbone networks and digital infrastructure, as they are actions supporting the deployment of and access to very high-capacity networks, including 5G systems, capable of providing gigabit connectivity. Section 2.3. of *Commission Implementing Decision on the financing of the Connecting Europe Facility – Digital sector and the adoption of the multiannual work programme for 2021-2025* lists key topics targeting specific types of deployment projects which can be supported by CEF Digital, including: - The implementation of digital connectivity infrastructures related to cross-border projects in the areas of transport or energy and/or supporting operational digital platforms directly associated to transport or energy infrastructures
Compatibility with Design Guidelines and Rail Baltica work programme	Deployment of the Smart Station infrastructure can be carried out simultaneously with station construction. Costs in the deployment of Smart Station communication networks and services are high, but they are costs that will have to be mandatory addressed in the mid-term.
Best practices and lessons learned	**Maria Zambrano "Smart Station" Advanced Services.** *"Implementation of new use cases based in 5G or fixed broadband access at the high-speed rail station Maria Zambrano (Málaga)".* https://www.europapress.es/andalucia/malaga-00356/noticia-vodafone-concluye-casos-uso-5g-desplegados-estacion-maria-zambrano-malaga-20211020160253.html

Source: Rail Baltica Global Project Synergies Study (2022)

3.2.4 DEPLOYMENT OF EDGE COMPUTING INFRASTRUCTURE

3.2.4.1 Compatibility with CEF Funding Priorities

The Connecting Europe Facility (CEF) programme will support investments in Europe's transport, energy and digital infrastructure. It supports trans-European networks and infrastructures which fill the gaps and missing links of these sectors.

The digital part of the CEF will fund connectivity projects of common EU interest and targets the following specific objectives:

- contributing to the deployment of safe and secure very high-capacity digital networks and 5G systems
- supporting an increased resilience and capacity of the digital backbone networks on EU territories by linking them to neighbouring territories
- fostering the digitalisation of transport and energy networks

Edge computer centres are necessary for the deployment of efficient 5G networks, contribute to the digitalisation of the society, and are aligned with EU funding objectives.

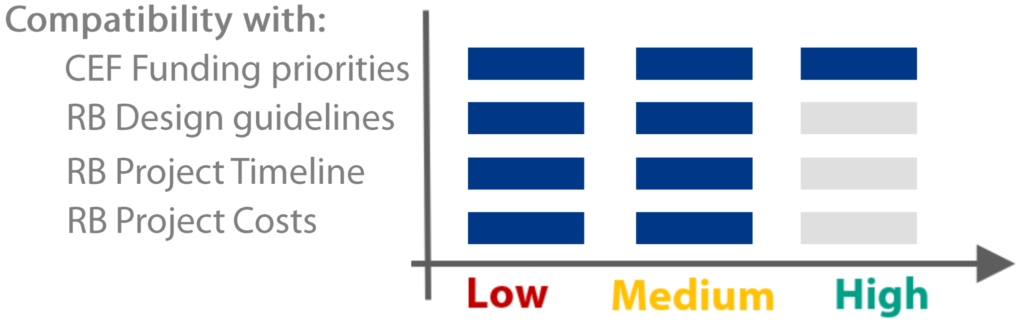
3.2.4.2 Impact on Project Guidelines, Timeline and Costs

Edge computing centres are part of the 5G network and the design and installation of a 5G network along the railway line operated by a Neutral Host, does not impact directly on the railway operator´s mobile network design.

Edge computing centres being part of the 5G network, they will be installed together with the deployment of the 5G network, so the infrastructure will be ready to be offered to other entities or third parties without big additional investments.

Not deploying these edge computing centres would lead to a reduction of the quality of the offered services.

Figure 36: Impact Assessment and Risk Management Deployment of Edge Computing Infrastructure



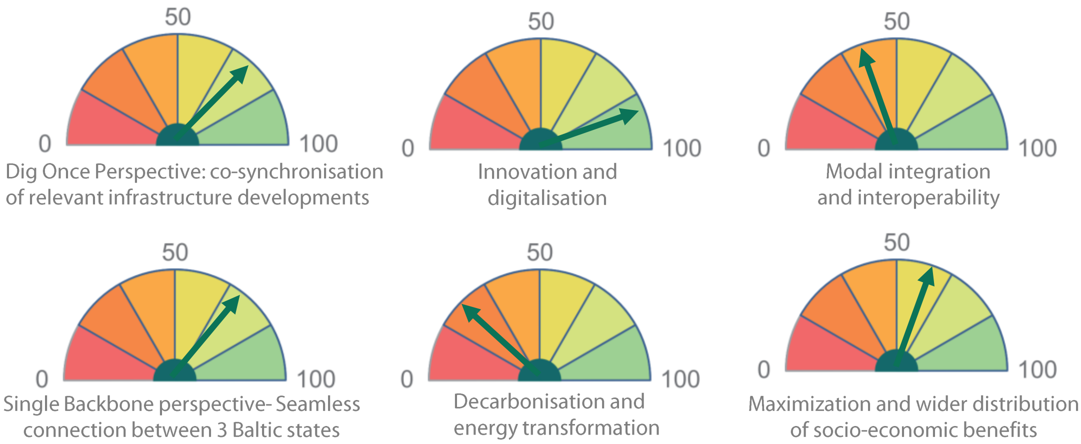
Source: Synergies Study 2021-2022

3.2.4.3 Alignment with Rail Baltica Synergies Priorities of application by Rail Baltica Stakeholders

Deployment of edge computing infrastructure along the RB railway corridor match with **Rail Baltica Synergies priorities** as follows:

- "Dig Once" perspective: Edge computing Infrastructure and 5G network can be deployed simultaneously.
- Innovation and digitalisation: Edge computing centres, together with 5G mobile networks, will play an important role in society digitalisation and provision of new advanced services.
- Modal integration and interoperability: Edge computing centres will support the implementation of new advanced services helping interoperability and modal integration.
- Single backbone perspective-seamless connection between the three Baltic states: Edge computing centres shall support a 5G network interconnecting the Baltic states with a high-bandwidth network.
- De-carbonisation and energy transformation: Edge computing centres replace computing at remote cloud centres increasing efficiency.
- Maximise trade and synergy opportunities in the corridor developing potential services: Provision of new advanced services requiring very low latency.

Figure 37: Alignment with Rail Baltica Synergies Priorities of Deployment of Edge Computing Infrastructure



Source: Synergies Study 2021-2022

3.2.4.4 Takeaways - Potential Benefits/Applicability to the Rail Baltica Case

The following **benefits** would be achieved through the implementation of edge computing infrastructure along the RB Railway corridor:

- the European Commission is promoting cloud computing, being one of the key priorities of the digital agenda for Europe
- edge computing enables provision of new high-value services
- contribution to further digitalisation of the society
- additional revenue sources

The following table summarise the applicability of key recommendations and synthesis of WP2.1-WP2.6 with respect to WP3.1 and WP3.2 regarding of the deployment of edge computing centre infrastructure.

Table 14: Synergetic Action Synthesis of the Deployment of Edge Computing Infrastructure

<table>
<tr><td rowspan="2"></td><td colspan="4">Deployment of Edge Computing Infrastructure</td></tr>
<tr><td colspan="4">Future technical functionalities and related developments of synergy action
The deployment of edge computing infrastructure along the railway, offering edge computing services, operated by a Neutral Host which operates the edge data centre hardware or offers space for installing third-party data centres.
For the deployment of low latency 5G services, 5G networks have introduced edge computing data centres located at the same site that the new radio Centralised Unit (CU). The provision of services requiring low latencies will request service applications running on edge data centres instead of on the cloud.</td></tr>
<tr><td>Benefits that maximise of the value of the Rail Baltica global project from the “Dig Once” perspective</td><td colspan="4">Edge computer centres are necessary for the deployment of efficient 5G networks, contributing to the digitalisation of the society.
Edge computing enables provision of new high-value services.</td></tr>
<tr><td>Contribution to the achievement of objectives of CEF sectors</td><td>Transport</td><td>☒</td><td>Digital</td><td>☒</td></tr>
<tr><td>Synergy components of relevant European funding programmes</td><td colspan="4">The digital part of the CEF will fund connectivity projects of common EU interest and contribute to deploying Gigabit and 5G networks across the EU.
Edge computer centres are necessary for the deployment of efficient 5G networks, contribute to the digitalisation of the society, and are aligned with EU funding objectives.
Article 8 of Regulation (EU) 2021/1153 states Projects of common interest in the area of digital connectivity infrastructure which would fit to related deployment of 5G networks, high-capacity broadband backbone networks and digital infrastructure.
Article 9 of Regulation (EU) 2021/1153 indicates several eligible actions for CEF2 funding which would fit to related deployment 5G networks, high-capacity broadband backbone networks and digital infrastructure, as they are actions supporting the deployment of and access to very high-capacity networks, including 5G systems, capable of providing gigabit connectivity.
Section 2.3. of Commission Implementing Decision on the financing of the Connecting Europe Facility – Digital sector and the adoption of the multiannual work programme for 2021-2025 lists</td></tr>
</table>

	key topics targeting specific types of deployment projects which can be supported by CEF Digital, including: - The implementation of digital connectivity infrastructures related to cross-border projects in the areas of transport or energy and/or supporting operational digital platforms directly associated to transport or energy infrastructures.
Compatibility with Design Guidelines and Rail Baltica work programme	Edge computing centres are part of the 5G network and the design and installation of a 5G network along the railway line operated by a Neutral Host, does not impact directly on the railway operator´s mobile network design.
Best practices and lessons learned	https://www.americantower.com/us/solutions/data-centers/edge/ https://cellnextelecom.fr/en/home-page/products-services/edge-datacenters/

Source: Rail Baltica Global Project Synergies Study (2022)

3.3 ENERGY INFRASTRUCTURE

This section summarises the synergy impacts on the Rail Baltica project for each case study.

3.3.1 INSTALLATION OF RENEWABLE ENERGY GENERATION SOURCES. PV MODULES AND MINI WIND TURBINES

3.3.1.1 Compatibility with CEF Funding Priorities

This synergy is an eligible to CEF funding priorities because:

- It contributes to the de-carbonisation of railways, promotes renewable energy and increases the generation capacity of the three Baltic States.
- The energy supply is strengthened and its security increased.
- It reduces the dependence on fossil fuels
- It strengthens the internal energy market.

3.3.1.2 Impact on Project Guidelines, Timeline and Costs

Design guidelines: the installation of small renewable energy generation plants only affects “Railway Energy. Part 3: Non-traction power supply”. The current guideline includes the possibility of supplying energy generated by solar panels and mini wind turbines.

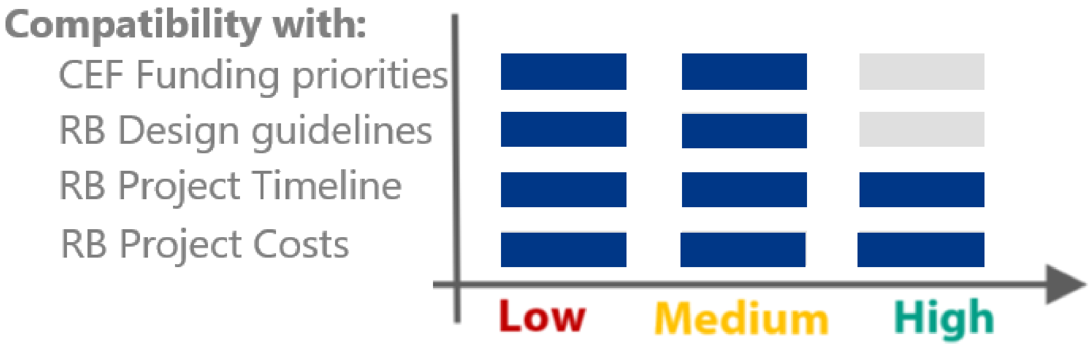
Project timeline and costs: If small renewable energy generation plants are considered in the systems design phase, their construction must be compatible with the expected timeline. It involves an additional cost but is compatible with CEF funding priorities and contributes to achieve the objectives of “Fit For 55”.

The installation of PV solar and mini wind turbines plants implies a little impact in RB timeline, very difficult to quantify, due to a small increase in complexity, the need to install more material and more labor. Taking this measure into account from the initial design phase means that implementation costs are lower.

Typically, the costs are estimated as a function of peak power:

- PV installations of 0-10 kWp: 2,00 €/Wp
- PV installations of 10-100 kWp: 1,50 €/Wp

Figure 38: Impact Assessment and Risk Management of Installation of Renewable Energy Generation Sources, PV Modules and Mini Wind Turbines



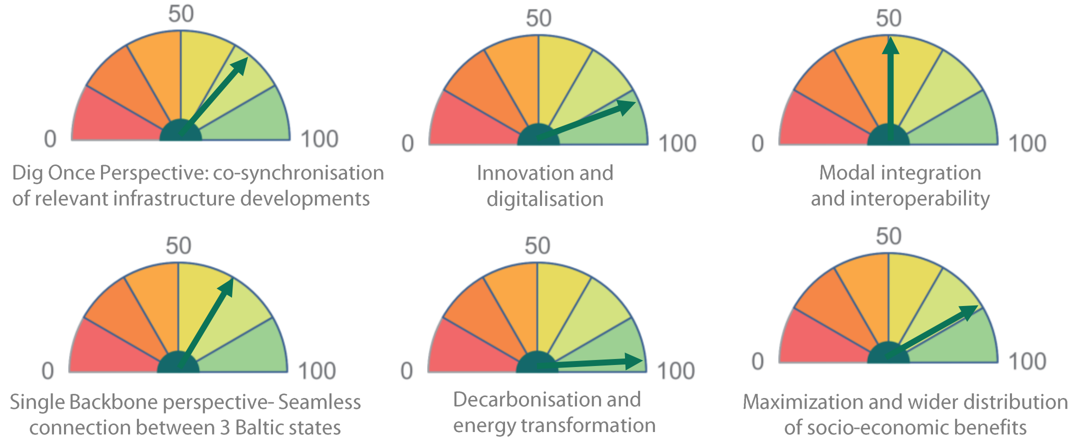
Source: Synergies Study 2021-2022

Have been inserting systems, to avoid our stakeholders thinking these things should have been done before now & therefore now too late. If they are systems (particularly ENE or CCS) we are starting those designs now & this is the perfect time to bring it in.

3.3.1.3 Alignment with Rail Baltica Synergies Priorities of application by Rail Baltica Stakeholders

- “Dig Once” perspective: the installation of small renewable energy generation sources would not have a significant impact on the timeline if it is considered from the beginning of the design phase and developed in parallel with the rest of the works.
- Innovation and digitalisation: the system is digitalised. Measurements can be taken and read remotely, and therefore it is possible to evaluate consumption data, purchased energy, surplus energy and estimate different metrics such as self-consumption percentages.
- Modal integration and interoperability: the synergy has no impact on this issue.
- Single Backbone perspective-seamless connection between the three 3 Baltic states: new micro-generation points along the rail network which can injecting surplus power into the grid, which is shared by the three Baltic states, they make the grid more meshed, more powerful.
- De-carbonisation and energy transformation: distributed renewable micro-generation along the railway network is a measure currently being implemented across Europe to decarbonise the sector.
- Maximising trade and synergy opportunities in the corridor by developing potential services:
    - the amount of energy that must be purchased from the grid is reduced
    - locally generated energy is consumed, avoiding transport losses
    - the energy that is not consumed instantly is sold to the grid
    - the necessary technology has undergone a very significant cost reduction

Figure 39: Alignment with Rail Baltica Synergies Priorities of Installation of Renewable Energy Generation Sources, PV Modules and Mini Wind Turbines



Source: Synergies Study 2021-2022

3.3.1.4 Takeaways - Potential Benefits/Applicability to the Rail Baltica Case

The most notable points in relation to this issue are:

- The equipment to build solar and wind plants (PV modules, mini wind turbines, inverters etc.) is a proven technology
- The CAPEX (Capital Expenditures), OPEX (Operational Expenditures) and LCC (Life Cycle Costs) of solar and wind plants are lower than other solutions of generating renewable energy
- The average useful life of the solar plants and mini wind turbines is 30 and 25 years respectively.
- Both kind of plants are easy to design, build, operate and maintain
- The supply and commissioning of the equipment and installations of the solar and wind plants could be carried out by a lot of companies as it is a liberalized market

The new points of renewable energy generation should be located close to the consumption's points, thus reducing the transport energy losses, and achieving greater energy efficiency

The following table summarises the applicability of key recommendations and the synthesis of WP2.1-WP2.6 with respect to WP3.1 and WP3.2 regarding the installation of renewable energy generation sources. PV modules and mini wind turbines

Table 15: *Synergetic Action Synthesis of the Installation of Renewable Energy Generation Sources. PV Modules and Mini Wind Turbines*

<table>
<tr><th></th><th colspan="3">Installation of Renewable Energy Generation Sources. PV Modules and Mini Wind Turbines</th></tr>
<tr><td></td><td colspan="3">Future technical functionalities and related developments of synergy action

The object is installing mini wind turbines and PV modules in Rail Baltica properties to generate electric energy to be consumed in non-traction power supply system. The preferable option of connection is self-consumption with selling the surplus, energy that cannot be consumed simultaneously in Rail Baltica’s electrical installations, to the electricity companies.</td></tr>
<tr><td>Benefits that maximise of the value of the Rail Baltica global project from the “Dig Once” perspective</td><td colspan="3">• The impact on the timeline is low when considered from the beginning of the design phase and developed in parallel with the rest of the works with the appropriate means
• The system is digitalised, which means that consumption data, purchased energy, surplus energy, etc. can be evaluated remotely
• The grid become more meshed
• Contributes to de-carbonising the railway environment
• Reduces the amount of energy that must be purchased from the grid
• The energy not consumed instantly is sold to the grid
• Avoid transport losses
• It is a proven and low-cost technology</td></tr>
<tr><td>Contribution to the achievement of objectives of CEF sectors</td><td>Energy</td><td>☒</td><td></td></tr>
<tr><td>Synergy components of relevant European funding programmes</td><td colspan="3">Energy: Article 3.2.b of the CEF
I. to contribute to the development of projects of common interest relating to further integration of an efficient and competitive internal energy market, interoperability of networks across borders and sectors, facilitating de-carbonisation of the economy, promoting energy efficiency and ensuring security of supply.
II. to facilitate cross-border cooperation in the area of energy, including renewable energy</td></tr>
<tr><td>Compatibility with Design Guidelines and Rail Baltica work programme</td><td colspan="3">The installation of small renewable energy generation plants only affects “Railway Energy. Part 3: Non-traction power supply”. The current guideline includes the possibility of supplying energy generated by solar panels and mini wind turbines.</td></tr>
<tr><td>Best practices and lessons learned</td><td colspan="3">Small renewable energy parks in Spanish railway administrator (ADIF) properties. “Fight against climate change”.

Belgium’s Solar Tunnel. “An international milestone: It is connected to the rail infrastructure services and with the traction system”

Helsinki Station Solar Power Plant. “Renewable energy to maintain trains”

Mini Wind Turbines in ADIF Properties. “Using the energy of the wind”

Höflein Lower Austria Wind Power Plant to Produce Traction Power. “A future project”

The Green Valley Lines in Wales. “A viability study about installing PV and wind plants to decarbonizes the Green Valley train lines”</td></tr>
</table>

Source: Rail Baltica Global Project Synergies Study (2022)

3.3.2 UTILISATION OF THE ENERGY SUBSYSTEM, MAINLY TRACTION SUBSTATIONS, TO TRANSFER RENEWABLE ELECTRICAL ENERGY TO THE ELECTRICAL GRID

The aim of the future technical functionalities and related developments of synergy actions is using the Rail Baltica´s electrical infrastructure connected to the electrical grid, mainly TSS, to transfer, to the electrical grid, the energy generated by Rail Baltica´s or third parties in renewable power plants (generating e.g. solar, wind and hydraulic energy), located close to the Rail Baltica´s electrical infrastructure. It is preferable that the renewable power plant using the TSS belongs to Rail Baltica because the energy could be consumed in railway installations and any excess sold to DSO and TSO.

Due to RB has taken the decision to go to the SFC route for electrification, so, SFCs will be installed in traction substations (TSS), instead of traction transformers. This option will slightly improve the quality of the public electrical network that feeds TSS.

Additionally, smart-grids solutions should be considered in the design of the Energy Subsystem. This option will improve the Energy Subsystem: reducing the energy consumption, making easier and more efficient the operation and maintenance of equipment and installations, extending the useful life of equipment and installations, etc.

3.3.2.1 Compatibility with CEF funding Priorities

This synergy is eligible to CEF funding priorities because:

- it contributes to improving the distribution and transmission grids, the electricity generation mix and security of supply by facilitating the integration of renewable plants
- the dual use of TSS contributes to increasing their efficiency, reduces their electricity costs and de-carbonises the local economy

3.3.2.2 Impact on Project Guidelines, Timeline and Costs

Design guidelines:

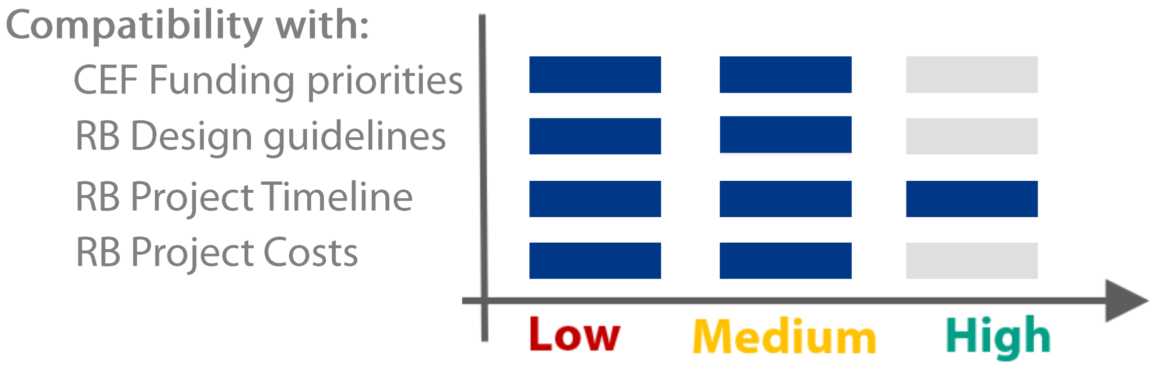
The utilisation of the energy subsystem, mainly traction substations for transferring renewable electrical energy to the electrical grid only affects the guideline "Railway Energy. Part 1: traction power system".

Project timeline and costs:

Taking this measure into account from the initial design phase minimises its impact on the timeline and in the costs. The first approximation of additional cost for enabling the TSS to function as a generator will be between 500.000 and 2.000.000 €, depending on the type of connection, the final design of TSS and the type of TSS.

The cost of a solar farm is 1,25 €/Wp for installations with a peak power bigger than 100 kWp

Figure 40: Impact Assessment and Risk Management of Utilisation of Energy Subsystem to Transfer Renewable Energy to the Electrical Grid

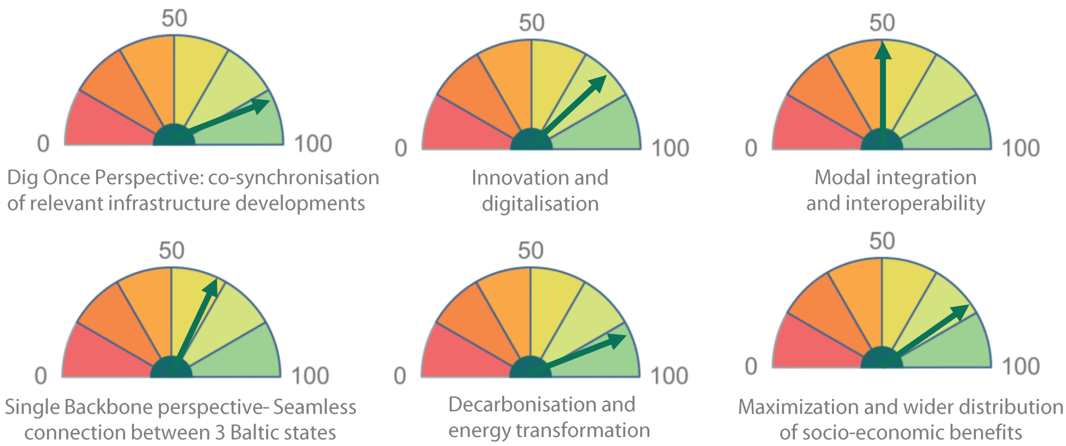


Source: Synergies Study 2021-2022

3.3.2.3 Alignment with Rail Baltica Synergies Priorities of application by Rail Baltica stakeholders

- "Dig Once" perspective: considering this measure from the beginning of the design and adapting the guidelines to take it into account means that in the future no big amounts of costs will incur. The works that need to be carried out in order to implement this synergy can be perfectly integrated with the rest of the project.
- Innovation and digitalisation: the installations will be completely digitalised to be able to remotely manage all the data.
- Modal integration and interoperability: the synergy has no impact on this issue
- Single backbone perspective-seamless connection between three Baltic states: the synergy makes the grid more meshed, more powerful.
- De-carbonisation and energy transformation: if the new functionality of the TSS is used with renewable plants, mainly solar farms, and wind farms, which would contribute to the de-carbonisation of the three Baltic states
- Maximisation and wider distribution of socio-economic benefits:
    - economic benefits from renting the part of the TSS used to transfer the energy to the electrical grid if the renewable plants belong to third parties
    - reduction of the energy purchases to the grid and the sale of surpluses if the renewable plant belongs to Rail Baltica
    - reduction of the environmental impact
    - Increased efficiency of the traction power supply system, due to energy production closer to consumption and therefore less transport related energy losses

Figure 41: Alignment with Rail Baltica Synergies Priorities of Utilisation of Energy Subsystem to Transfer Renewable Energy to the Electrical Grid



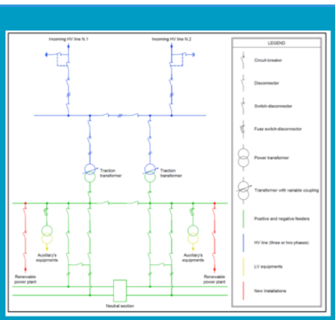
Source: Synergies Study 2021-2022

3.3.2.4 Takeaways - Potential Benefits and Applicability to the Rail Baltica Case

The biggest benefit of this synergy can be obtained if the renewable energy power plant belongs to Rail Baltica, as when the energy is generated in nearby plants it can be consumed in the railway installations and its excess can be sold to the electrical companies (DSO and TSO). In this case, the business model should be based on maximizing self-consumption of the energy produced, as well as the sale of surpluses to the market.

The following table summarises the applicability of key recommendations and the synthesis of WP2.1-WP2.6 with respect to WP3.1, and WP3.2 regarding the utilisation of the energy subsystem to transfer renewable electrical energy to the electrical grid.

Table 16: Synergetic Action Synthesis of Utilisation of the Energy Subsystem to Transfer Renewable Electrical Energy to the Electrical Grid

	Utilisation of the Energy Subsystem to Transfer Renewable Electrical Energy to the Electrical Grid
	Future technical functionalities and related developments of synergy actions The aim is using the Rail Baltica electrical infrastructure connections to the electrical grid, mainly TSS, to transfer the energy generated by Rail Baltica or third parties in renewable power plants (generating e.g. solar, wind and hydraulic energy), located close to the Rail Baltica infrastructure to the electrical grid. It is preferable that the renewable power plant using the TSS belongs to Rail Baltica because the energy could be consumed in railway installations and any excess sold to DSO and TSO.

Benefits that maximise of the value of the Rail Baltica global project from the "Dig Once" perspective	Utilisation of the energy subsystem to transfer renewable electrical energy to the electrical grid along the RB railway corridor match with RB Synergies priorities as follows: • the necessary works to implement this synergy can be perfectly integrated with the rest of the project • the installations will be completely digitalised, so all data can be monitored and managed remotely • the grid becomes more meshed • contribution to de-carbonisation he railway environment • economic benefits from renting the part of the TSS used to transfer the energy to the electrical grid if the renewable plants belong to third parties • reduction of the energy purchases to the grid and the sale of surpluses if the renewable plant belongs to Rail Baltica improvement of the efficiency of the traction power supply system
Contribution to the achievement of objectives of CEF sectors	Energy ☒
Synergy components of relevant European funding programmes	**Energy:** Article 3.2.b of the CEF I. to contribute to the development of projects of common interest relating to further integration of an efficient and competitive internal energy market, interoperability of networks across borders and sectors, facilitating de-carbonisation of the economy, promoting energy efficiency and ensuring security of supply. II. to facilitate cross-border cooperation in the area of energy, including renewable energy
Compatibility with Design Guidelines and Rail Baltica work programme	Some sections of the design guideline "Railway Energy. Part 1: Traction Power System" must be reviewed in order to include and explain the new functionality of the TSS, which now can work like a generator, not only as a consumer.
Best practices and lessons learned	**Dual Use of TSS. RENFE and ADIF.** "Adaptation of the TSS to transfer the electricity produced in newly built PV plants belonging to the railway administrator".

Source: Rail Baltica Global Project Synergies Study (2022)

3.3.3 DEVELOPMENT OF BATTERY ELECTRICAL VEHICLE (BEV) CHARGING INFRASTRUCTURE

3.3.3.1 Compatibility with CEF Funding Priorities

This synergy is an eligible project to CEF funding priorities because:

- The development of a BEV charging infrastructure contributes to improve the communications between the most populated areas and de-carbonising the road transport
- It is a cross-border action, because it allows BEVs from other European countries can use Rail Baltica installations on their journey.
- It gives a dual use to parts of the railway infrastructure

3.3.3.2 Impact on Project Guidelines, Timeline and Costs

Design guidelines:

This synergy affects to the following Design Guidelines:

- Railway Energy. Part 1: traction power system
- Railway Energy. Part 3: non-traction power supply

Both design guidelines do not include supplying power to BEV chargers. BV chargers are high demanding power consumers, therefor the traction and non-traction power supply systems should be dimensioned to transport the demanded power this equipment from the design stages.

There is no single solution to feed BEV chargers, so, several proposals must be analysed in the design.

Project timeline and costs:

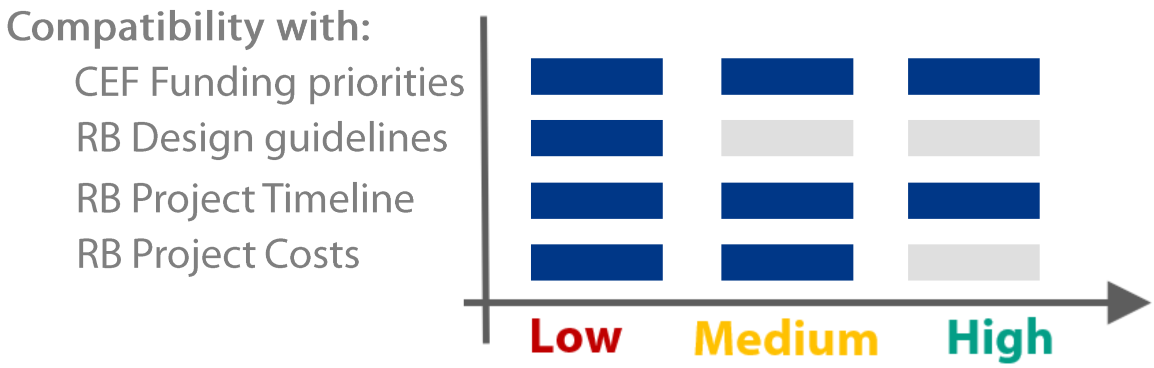
When considering the construction of BEV charging infrastructure in the design phase, it is possible to minimise the impact on the project time, as the design, the construction, the testing and the commissioning are carried out simultaneously with the rest of the electrical installation

There is only a small impact (very difficult to quantify) on the RB timeline due to a slight increase in complexity, the need to install more equipment and more labour costs.

BEV charging infrastructure would affect the foreseen costs of the Rail Baltica network because the power supply systems should be adapted to feed these new power consumers.

The cost of adapting the power supply system is depending totally on the solution that is defined to power the BEV chargers from the power supply system, its number, its power, its location, etc.

Figure 42: Impact Assessment and Risk Management of Development of BEV Charging Infrastructure Synergy

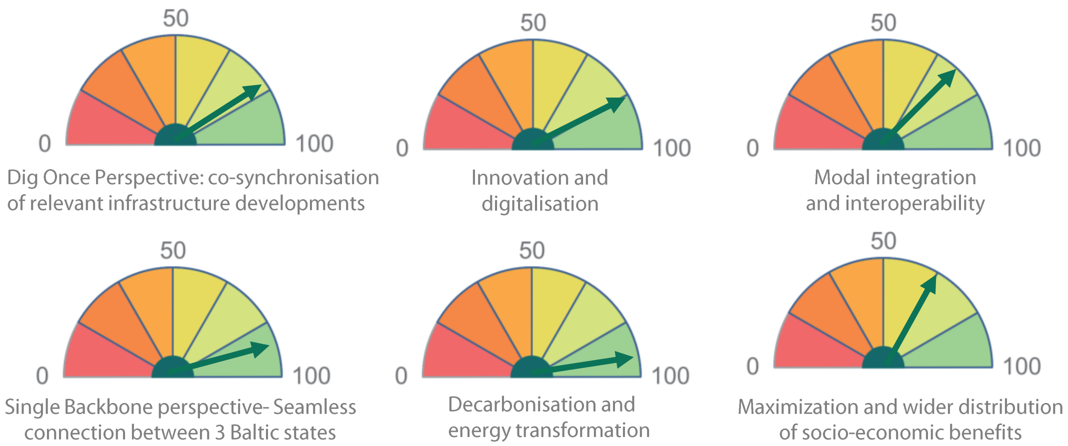


Source: Synergies Study 2021-2022

3.3.3.3 Alignment with Rail Baltica Synergies Priorities of application by Rail Baltica Stakeholders

- "Dig Once" perspective: the installation of the charging infrastructure would not have a significant impact on the timeline if it is considered from the beginning of the design phase and developed parallel to the rest of the works, otherwise the impact on the timeline will be much more significant.
- Innovation and digitalisation: the implementation of these chargers is by itself an innovation and a beginning for a more sustainable society, in addition, thanks to the improvements in the measurement and protection devices, it will be possible to operate and know information remotely.
- Modal integration and interoperability: the integration with the rest of Europe is complete as almost any car in Europe will be able to make use of this charging infrastructure
- Single Backbone perspective-seamless connection between the three Baltic states: this charging infrastructure throughout the three Baltic states, a connection between them is created, encouraging travel and routes through the Baltic countries by BEVs
- De-carbonisation and energy transformation: the increased use of BEVs will reduced the emissions emitted into the environment.
- Maximise trade and synergy opportunities in the corridor developing potential services:
  - meet the requirements of "Fit for 55"
  - obtain benefits from selling energy
  - create a common infrastructure throughout the three countries

Figure 43: Alignment with Rail Baltica Synergies Priorities of Development of BEV Charging Infrastructure Synergy



Source: Synergies Study 2021-2022

3.3.3.4 Takeaways - Potential Benefits and Applicability to the Rail Baltica Case

- Promotion of electro-mobility as a tool to meet the de-carbonisation objectives of “Fit for 55”.
- Electric car chargers could be fed from:
    - Non-traction power supply system: installations such as medium voltage cable lines and MV/LV substations installed along the tracks
    - Traction power supply system: installations such as traction substations and autotransformer centres
- Support from CEF Transport through the Alternative Fuels Infrastructure Facility (AFIF)

The following table summarises the applicability of key recommendations and the synthesis of WP2.1-WP2.6 with respect to WP3.1 and WP3.2 regarding BEV charging infrastructure synergetic action.

Table 17: Synergetic Action Synthesis of BEV Charging Infrastructure

	Development of BEV Charging Infrastructure:
	Future technical functionalities and related developments of synergy action The synergy involves capturing the electrical energy from the electric infrastructure to supply electric car chargers. The Installation of these charger points throughout the 3 Baltic states with the objective of create a BEV charging infrastructure. There are different options to feed this charging point, the most viable are: • feed from direct current or alternating current traction substations • feed from transformation centres (substations MV/LV, medium voltage / low voltage) in stations
Benefits that maximise of the value of the Rail Baltica global project from the "Dig Once" perspective	This BEV charging infrastructure will promote electro-mobility meeting the de-carbonisation objectives of "Fit for 55" that requires EU Member States to ensure sufficient recharging stations for BEV. The European regulation also includes requirements such as the maximum distance between charging stations, which should not exceed 60 km. In addition, RB will obtain benefits by renting these charging points or by selling energy to recharge BEV from the energy purchased in high voltage at a lower price to obtain benefits.
Contribution to the achievement of objectives of CEF sectors	Transport ☒ Energy ☒
Synergy components of relevant European funding programmes	The main sectors that contribute to the achievement of objectives of CEF are transport and energy. <u>Transport:</u> Article 3.2.a of the CEF I. to contribute to the development of projects of common interest relating to efficient, interconnected and multimodal networks and infrastructure for smart, interoperable, sustainable, inclusive, accessible, safe and secure mobility in accordance with the objectives of Regulation (EU) No 1315/2013. <u>Energy:</u> Article 3.2.b of the CEF I. to contribute to the development of projects of common interest relating to further integration of an efficient and competitive internal energy market, interoperability of networks across borders and sectors, facilitating de-carbonisation of the economy, promoting energy efficiency and ensuring security of supply. II. to facilitate cross-border cooperation in the area of energy, including renewable energy.
Compatibility with Design Guidelines and Rail Baltica work programme	Railway Energy. Part 1: Traction Power System and Railway Energy: Part 3: Non-traction Power Supply. Both guidelines do not include supplying power to BEV chargers, since those are high demanding power consumers they should be included. Considering the construction in the design phase, it is possible to minimise the impact on the project´s timeline. Power supply systems should be dimensioned for transporting the demanded power by BEV charging equipment from the design stages.
Best practices and lessons learned	**ADIF BEV Charging Infrastructure. "***Installation of 400 charging points in stations"*

Source: Rail Baltica Global Project Synergies Study (2022)

3.3.4 DEVELOPMENT OF FUEL CELL ELECTRICAL VEHICLE (FCEV) INFRASTRUCTURE

3.3.4.1 Compatibility with CEF Funding Priorities

The development of FCEV charging infrastructure that interconnects the three Baltic states and communicating their main population areas means de-carbonising the road transport and promoting sustainable and accessible mobility for most of the population. It is an alternative that pretend mitigate pollution from vehicles that run on fossil fuel combustion engines.

In addition, this synergy is a cross-border action because it allows FCEVs from other European countries to use Rail Baltica installations on their journey.

Therefore, it is an eligible action because it complies with the CEF objectives of its overall financial envelope to climate objectives, based, on the following coefficients: (i) 100 % for expenditure relating to railway infrastructure, charging infrastructure, alternative and sustainable fuels, CO2 transport and renewable energy; (ii) 40 % multimodal transport provided that it enables the use of renewable hydrogen or bio-methane to be increased.

As already commented an important objective of the CEF is to deliver increased synergies and complementarity between the transport, energy and digital sectors. For that purpose, the CEF should provide for the adoption of work programmes that address specific intervention areas, for instance connected and automated mobility or sustainable alternative fuels.

The case study is aligned with the “Fit for 55” regulation, which promotes the rollout of hydrogen refuelling stations at a maximum distance of 150 km in-between stations with the geographical scope extended along with the Trans European Network for Transport (TEN-T) core network and urban nodes.

Hydrogen can help tackle various critical energy challenges. It offers ways to de-carbonise a range of sectors (including intensive and long-haul transport, chemicals, and iron and steel) where it is proving difficult to meaningfully reduce emissions. It can also help improve air quality and strengthen energy security. In addition, it increases flexibility in power systems.

3.3.4.2 Impact on Project Guidelines, Timeline and Costs

At present, the design guidelines do not incorporate aspects related to this system.

When this case is considered from the initial design phase, its implementation with the rest of the infrastructure is simpler and does not imply any change in the timeline.

For hydrogen transport, the requirements for the transport of dangerous goods specified in the Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods and the associated obligations of those involved apply.

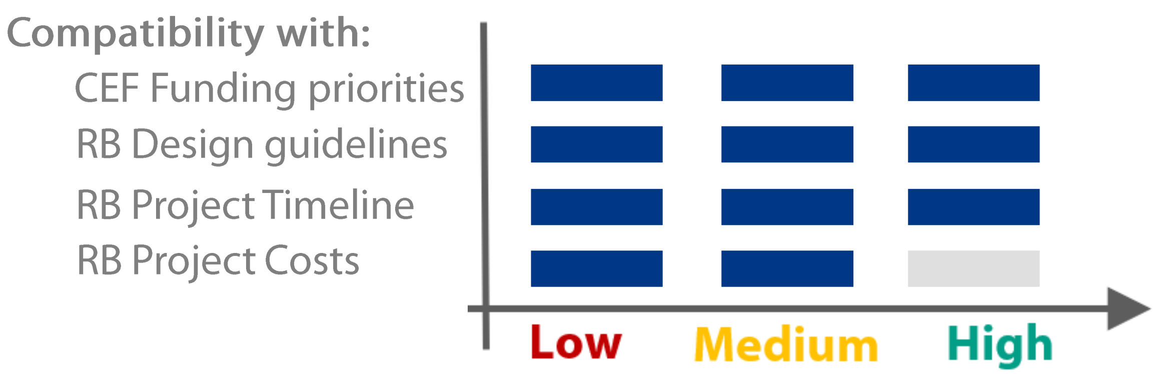
In principle, there are no regulatory quantity restrictions for rail transport for dangerous goods, provided that the transport of the substance is permitted. Furthermore, individual deviations from possible axle loads, freight train lengths and tunnel restrictions can restrict the maximum amount of hydrogen that can be transported on individual sections. The route must be checked before each new route with regard to individual restrictions.

When focusing on safety and interoperability of hydrogen transport by train, tunnels, underpasses, bridges, stations with roofs, over-track stations, train workshops and other enclosed areas where trains would be present are of relevance. Essentially, any area where hydrogen could potentially become trapped and be ignited would need examination.

The design and construction of FCEV charging infrastructure around terminal and intermodal areas could be carried out parallel to the construction of the Rail Baltica network with no impact on the project timeline.

FCEV charging infrastructure would not affect the foreseen costs of the Rail Baltica network, except for when some specific rail diversions to feed railway rolling stock would be installed.

Figure 44: Impact Assessment and Risk Management of Development of FCEV Infrastructure Synergy



Source: Synergies Study 2021-2022

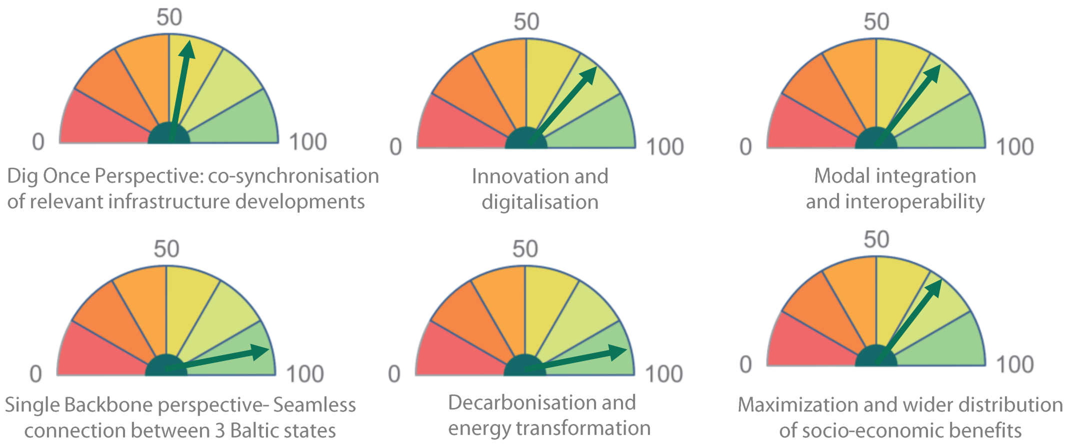
3.3.4.3 Alignment with Rail Baltica Synergies Priorities of application by Rail Baltica Stakeholders

As the FCEV charging infrastructure, the implementation of these chargers by itself is an innovation and a beginning for a more sustainable society, in addition, it will be possible to operate and know information remotely, thanks to the improvements in the measurement and protection devices. The charging infrastructure throughout the three Baltic states is generating a connection encouraging travel and routes through the Baltic countries.

With this approach the following goals of RB national policy framework could be achieved:

- promotion of the deployment of alternative hydrogen refuelling stations for railway public transport services
- facilitation of the deployment of charging stations for light-duty and heavy-duty vehicles at private locations that are not accessible to the public such as freight terminals
- promotion of alternative fuels infrastructure in urban nodes, in particular with respect to publicly accessible hydrogen recharging points
- necessary measures for ensuring that the deployment and operation of refuelling points contribute to the flexibility of the energy system and to the penetration of renewable electricity into the electric system
- measures to remove possible obstacles with regards to planning, to enabling and procuring of alternative fuels infrastructure
- a deployment plan for alternative fuels infrastructure in freight terminals close to ports, in particular for hydrogen, for port services as defined in Regulation (EU) 2017/352 of the European Parliament and Council

Figure 45: Alignment with Rail Baltica Synergies Priorities for Development of FCEV Infrastructure Synergy



Source: Synergies Study 2021-2022

3.3.4.4 Takeaways - Potential Benefits/Applicability to the Rail Baltica Case

The focus of hydrogen activities has evolved over the past two decades, with a shift from applications for the auto industry, to uses helping to de-carbonise sectors such as energy-intensive industries, trucks, aviation, shipping and heating applications.

Additionally, the fuel cell vehicle production costs will have to drop considerably from their current levels and the consumer understanding the technology and its benefits will have to improve for fuel cell vehicles in order to reach the mainstream market.

The following table summarises the applicability of key recommendations and the synthesis of WP2.1-WP2.6 with respect to WP3.1 and WP3.2 regarding FCEV charging infrastructure synergetic action.

Table 18: Synergetic Action Synthesis of FCEV Infrastructure

<table>
<tr><td>

5 FCEV charging infrastructure proposal under “Dig Once” perspective</td><td colspan="5">Development of FCEV Infrastructure

Future technical functionalities and related developments of synergy action

The synergy consists of the deployment of a significant part of the network of hydrogen vehicle charging infrastructure of the three Rail Baltic countries taking advantage of the “Dig Once” perspective of Rail Baltica Global Project. This charging network infrastructure is one of the main new requirements that will enter into effect with the amendment of DIRECTIVE 2014/94/EU on the deployment of alternative fuels infrastructure stating that Member States shall ensure that, in their territory, a minimum number of publicly accessible hydrogen refuelling stations are put in place by 31 December 2030.

In the proposal currently under negotiation, the requirement is that Member States shall ensure that accessible hydrogen refuelling stations with a minimum capacity of 2 t/day and equipped with at least a 700 bars dispenser are deployed with a maximum distance of 150 km in-between them along the TEN-T core and the TEN-T comprehensive network.

Members states shall ensure that by 31 December 2030, at least one publicly accessible hydrogen refuelling station is deployed in each urban node. An analysis on the best location shall be carried out for such refuelling stations that shall in particular consider the deployment of such stations in multimodal hubs where also other transport modes could be supplied.</td></tr>
<tr><td>Benefits that maximise of the value of the Rail Baltica global project from the “Dig Once” perspective</td><td colspan="5">The achievement of the “Fit for 55” goals and the European Green Deal is a clear way to boost intermodal national, regional and local mobility, including improved access to TEN-T and cross-border mobility, for hydrogen vehicles in rural and urban areas of the Rail Baltica economic corridor.
With this approach the following goals of RB national policy framework could be achieved:
• deployment of alternative hydrogen refuelling stations for railway public transport services
• deployment of recharging stations for light-duty and heavy-duty vehicles
• promotion of alternative fuels infrastructure in urban nodes
• promotion of a sufficient number of publicly accessible high power charging points
• removing possible obstacles with regards to planning, to enabling and procuring of alternative fuels infrastructure
• advancing a deployment plan for alternative fuels infrastructure near to ports particularly for hydrogen, and for port services as defined in Regulation (EU) 2017/352 of the European Parliament and Council
• advancing the infrastructure to support a deployment plan with targets, key milestones and financing needed for hydrogen trains on network segments that will not be electrified, if this deployment plan is co-synchronised with interchange gauge connections between RBGP and current national railway infrastructure</td></tr>
<tr><td>Contribution to the achievement of objectives of CEF sectors</td><td>Transport</td><td>☒</td><td>Energy</td><td>☒</td><td></td></tr>
<tr><td>Synergy components of relevant European funding programmes</td><td colspan="5">The article 3.1 of Regulation (EU) 2021/1153 establishes that the Connecting Europe Facility emphasis on facilitating the synergies among the transport, energy and digital sectors.

Transport
Article 3.c of Regulation (EU) 2021/1058 on the European Regional Development Fund and the Cohesion Fund propose a more connected Europe by enhancing mobility (PO 3) by developing</td></tr>
</table>

	and enhancing sustainable, climate resilient, intelligent and intermodal national, regional and local mobility, including improved access to TEN-T and cross-border mobility. Energy Article 3 of the CEF states to facilitate cross-border cooperation in the area of energy, including renewable energy. The Article 7.3 of CEF states that studies that aim to develop and identify cross-border projects in the field of renewable energy shall be eligible for funding. Art 7.4 highlights that cross-border projects in the field of renewable energy are eligible for Union funding if they meet the following additional criteria: a) the project specific cost-benefit analysis has been performed b) the applicant demonstrates that the project would not materialise in the absence of the grant or that the project cannot be commercially viable in the absence of the grant, which is the current situation for the deployment of a FCEV charging infrastructure Even though the EU law foresees a general prohibition of State Aid in the energy sector, the Commission will continue to support ongoing Member State efforts to design pan-European Important Projects of Common European Interest (IPCEI) that jointly overcome market failures by enabling breakthrough innovation and infrastructure investments in key green and digital priorities as this synergy action in the area of hydrogen development. The upcoming IPCEI State Aid Communication will further enhance the openness of IPCEIs to pool national and EU resources for this synergy action. State contributions are examined under the Guidelines on State Aid for environmental protection and energy (EEAG), and its ongoing revision, focuses on helping to reach the EU environmental and energy objectives in a cost-effective manner with minimum distortions of competition and trade. The EEAG includes criteria for supporting energy infrastructure, focusing on projects that improve cross-border energy flows and promote infrastructure in Europe's less developed regions.
Compatibility with Design Guidelines and Rail Baltica work programme	At present, the design guidelines do not incorporate aspects related to this system. When considered from the delivery phase, its implementation with the rest of the infrastructure is simpler and does not imply any change in the timeline.
Best practices and lessons learned	https://cutric-crituc.org/wp-content/uploads/2021/01/Rail-Innovation-in-Canada-Top-10-Technology-Areas-for-Passenger-and-Freight-Rail-2.0.pdf https://blog.lea-hessen.de/wp-content/uploads/2020/08/Potenzialbeschreibung-Wasserstofftransport-%C3%BCber-das-Schienennetz.pdf SP 20534 Special Permit to transport LNG by rail in DOT-113C120W rail tank car. https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/safe-transportation-energy-products/72911/environmental-assessment.pdf Fuel Cell Buses for Aberdeen, Scotland. Aberdeen City Council has implemented Europe's largest fleet of hydrogen fuel cell buses https://www.ballard.com/docs/default-source/motive-modules-documents/aberdeen-bus-case-study-website.pdf?sfvrsn=6151c280_8 FCEV Powered Trains: Coradia iLint Hydrogen Fuel Cell Powered Train, Alstom. Fuel cell trains will play a key role in the transition to a zero-emission economy. Hydrogen powered trains are poised to disrupt the rail industry as a cost-effective, high performing, zero-emission alternative to diesel, especially on a wide variety of routes without electrification and especially in protected areas, due to the absence of emissions. https://www.alstom.com/press-releases-news/2021/8/alstoms-coradia-ilint-hydrogen-train-runs-first-time-sweden

Source: Rail Baltica Global Project Synergies Study (2022)

3.4 LOCAL CONNECTIONS FOR INDUSTRIAL, DEFENCE AND LOGISTIC AREAS

3.4.1 COMPATIBILITY WITH CEF FUNDING PRIORITIES

The EU funding promotes the **modal shift to rail**, which is aligned with the construction of railway branches connecting industrial sidings or logistic/military areas to the RB network.

As described on section 2.1 in Annex 2, Article 9 of **Regulation (EU) 2021/1153** indicates several eligible actions for **CEF2 funding in the period 2021-2027** concerning railway branches and industrial sidings, such us actions relating to efficient, interconnected, interoperable and multimodal networks for the development of railway infrastructure, actions supporting sustainable freight transport services or actions promoting an increase in rail freight traffic.

Each **call for proposals under the Connecting Europe Facility (CEF) for transport funding** instrument will establish the specific requirements to apply for these funds. There is currently an open call[17] published on 16 September 2021 and with deadline date 19 January 2022 for the following actions:

- infrastructure projects on the core and comprehensive TEN-T (railways, inland waterways, maritime and inland ports, roads, rail-road terminals and multimodal logistics platforms)
- smart applications for transport (ERTMS, ITS, SESAR, RIS etc.)
- transport interoperability
- alternative fuels infrastructure (including electricity fast-charging and hydrogen refuelling infrastructure on the TEN-T road network)
- motorways of the sea
- multimodal passenger hubs
- reduction of rail freight noise
- safe and secure parking infrastructure
- road safety
- improvement of transport infrastructure resilience, in particular to climate change and natural disasters
- adaptation of transport infrastructure for union external border checks purposes
- adaptation of the TEN-T to civilian-defence dual-use (military mobility envelope)

[17] https://cinea.ec.europa.eu/calls-proposals/2021-cef-transport-call-proposals_en

3.4.2 IMPACT ON PROJECT GUIDELINES, TIMELINE AND COSTS

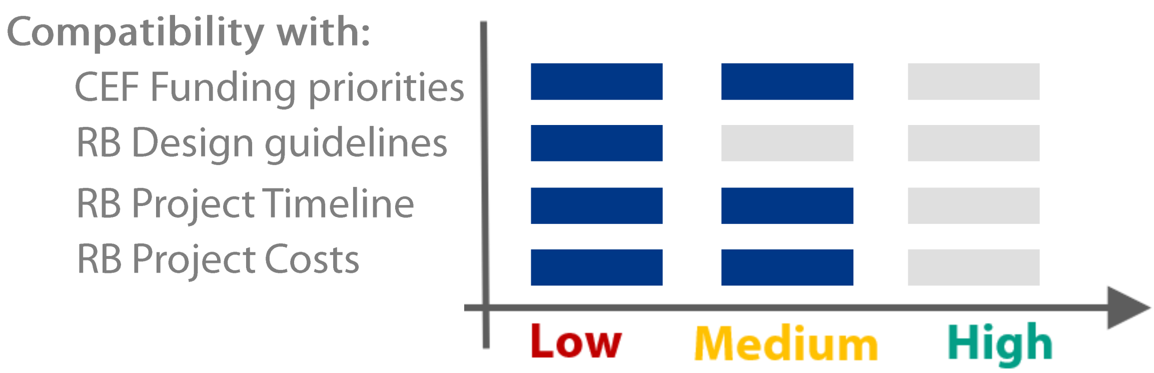
The design of railway branches from Rail Baltica network to industrial or logistic areas should **follow the existing Rail Baltica Design Guidelines and Rail Baltica Operational Plan**, although some **specific requirements** would be applied, preferable to be gathered in a dedicated guideline (see section 2.4.2 Review of Areas of the Rail Baltica Design Guidelines).

Regarding the impact on the timeline, the planning, design and construction of **railway branches and industrial sidings can be carried out parallel to the construction of the Rail Baltica network**, but it would be advisable to consider future connections in the RB layout for branches to important industrial areas for later implementation. As analysed in section 2.4.3 Impact on Project Timeline, the estimated time for the implementation of a rail connection from the RB network to an industrial area would be between 28 and 48 months.

Local connections for industrial areas would not have an impact on the estimated costs of the Rail Baltica network, except for the case that specific rail diversions for relevant connections are installed in advance. Despite the average costs mentioned in section 2.4.4 Impact on Cost, it is important to point out that **the assessment of costs for the construction of railway branches and industrial sidings is specific to each project design** and will have to be developed in accordance with the specific circumstances of each industrial area.

It is necessary to reach **agreements with national, regional and local authorities, including funding sources**: private funding, State Aid and EU support for “greening” and a modal shift to rail.

Figure 46: Impact Assessment and Risk Management of Local Connections for Industrial Areas Synergy



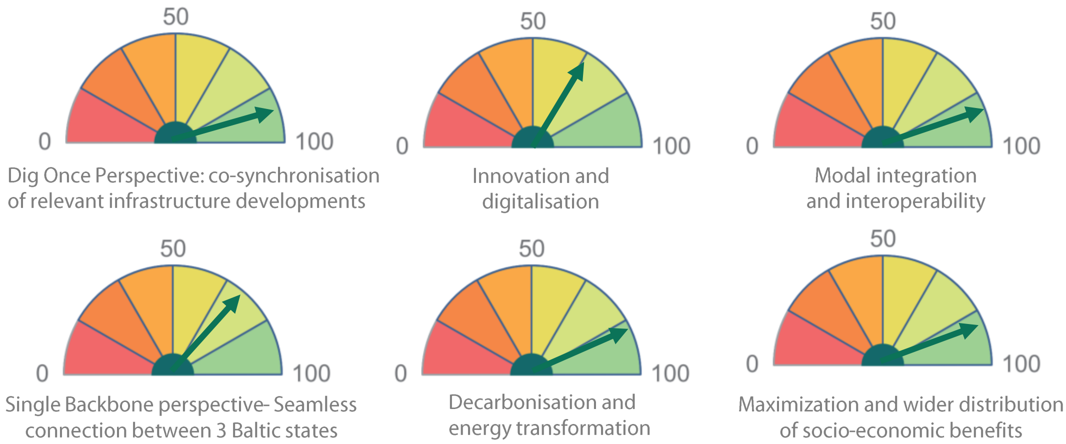
Source: Synergies Study 2021-2022

3.4.3 ALIGNMENT WITH RAIL BALTICA SYNERGIES PRIORITIES OF APPLICATION BY RAIL BALTICA STAKEHOLDERS

Local connections for industrial/logistics areas are aligned with the **RB Synergies priorities** as follows:

- "Dig Once" perspective: enablement of regional infrastructure development and industrial areas
- Innovation and digitalisation: new business opportunities
- Modal integration interoperability: mainly containers and bulk as type of freight, although other possible cargo types could be considered such as solid municipal waste or bulk hydrogen
- Single backbone perspective-seamless connection between the three Baltic states: rail freight transport expanded
- De-carbonisation and energy transformation: modal shift from road to rail
- Maximise trade and synergy opportunities in the corridor developing potential services/offerings: extended hinterland

Figure 47: Alignment with Rail B Synergies Priorities for Local Connections for Industrial Areas Synergy



Source: Synergies Study 2021-2022

3.4.4 TAKEAWAYS - POTENTIAL BENEFITS/APPLICABILITY TO THE RAIL BALTICA CASE

Railway branches with relevant freight hubs would enhance **new commercials opportunities related to both inner and international market**. The new infrastructure could provide an alternative way of freight transport, **transferring part of the goods currently transported by road to railway**.

The following **benefits** would be linked to the implementation of railway branches from RB network to relevant private industrial sidings or logistics/military areas:

- Synergies with private companies, improving the logistic supply chain
- New rail branches to industries will contribute to the deployment of 5G network and boost the eligibility of RB projects applying for CEF funds
- Increase of rail freight traffic in Rail Baltica project
- External costs saving from modal shift from road to rail
- Higher safety in freight transport
- Railway branches to military bases would allow for military mobility

The following table summarises the applicability of key recommendations and the synthesis of WP2.1-WP2.6 with respect to WP3.1 and WP3.2

Table 19: Synergetic action Synthesis of Local Connections for Industrial Areas

<table>
<tr>
<td></td>
<td></td>
<td colspan="3">Local Connections for Industrial, defence and logistic Areas

Future technical functionalities and related developments of synergy action:

Construction of dedicated railway branches in order to provide accessibility for relevant private industrial or logistics areas.

• Construction of railway branches to connect freight hubs with the Rail Baltica network

• Improvement of existing privately owned rail sidings, or construction of new ones, and their adaptation to the standard gauge.

The selection of relevant industrial nodes close to Rail Baltica rail layout would allow increase the intermodal transport, as well as other kind of freight transportable by rail, such as bulk goods.</td>
</tr>
<tr>
<td>Benefits that maximise of the value of the Rail Baltica global project from the “Dig Once” perspective</td>
<td colspan="4">Railways branches with relevant freight hubs would enhance new commercials opportunities related to both, the domestic and international market. The new infrastructure could provide an alternative way of freight transport, transferring to railway part of the goods movements that take place by road.
• Synergies with private companies, improving the logistic supply chain
• New rail branches to industries will contribute to the deployment of 5G network and boost the eligibility of Rail Baltica projects applying for CEF funds
• Increase of rail freight traffic in Rail Baltica project
• External costs saving from modal shift from road to rail
• Higher safety of freight transport
• Railway branches to military bases would allow military mobility</td>
</tr>
<tr>
<td>Contribution to the achievement of objectives of CEF sectors</td>
<td colspan="2">Transport</td>
<td>☒</td>
<td></td>
</tr>
<tr>
<td>Synergy components of relevant European</td>
<td colspan="4">Article 9 of Regulation (EU) 2021/1153 indicates several eligible actions for CEF2 funding in the period 2021-2027 concerning railway branches and industrial sidings, such us actions relating to efficient, interconnected, interoperable and multimodal networks for the development of railway infrastructure, actions supporting sustainable freight transport services or actions promoting an increase in rail freight traffic.</td>
</tr>
</table>

funding programmes	The EU funding promotes the modal shift to rail, which is aligned with the construction of railway branches connecting industrial sidings or logistic/military areas to the Rail Baltica network.

Compatibility with Design Guidelines and Rail Baltica work programme	The design of railway branches from the RB network to industrial or logistic areas should follow the existing RB Design Guidelines and the RB Operational Plan, although some specific requirements to be applied, should preferable be gathered in a dedicated guideline.
	
	Specific requirements would be applied for the connection of industrial areas to the Rail Baltica corridor, should be preferable to be gathered in a dedicated guideline:
	• Maximum length of the rail branch from an industrial area to RB layout: 15 km
	• Minimum freight traffic: 5 trains/week (each way)
	• Design of industrial siding:
	  o Minimum number of loading/unloading tracks: 2
	  o Length of tracks: 1050 m (minimum of 750 m)
	  o Electrification of access to the siding
	
	In the case of existing industrial sidings or terminals that are currently connected to the conventional rail network (1520 mm) and considered relevant for the RB project, specific rail branches can be designed and built for connecting them to the Rail Baltica infrastructure (1435 mm), implementing a gauge changeover installation in this new branch in order not to interfere with traffic in both networks.
	
	Another possible solution for railway connections to industrial nodes with an existing access to 1520 mm rail network and with a significant volume of traffic between this node and a specific destination in standard gauge (through RB network) would be to establish a rolling highway (piggyback rail services) between these two points, including an interchange terminal between both networks where trucks (or semi-trailers using a tractor unit) could descend from one railway platform to get on the other in an efficient way. In this case truck drivers / fleet operators would not have to learn different processes / procedures for the different railways and automated tractor tugs could do transhipment between 1520 & 1435 rail networks, although specific investments and technical requirements should be considered as analysed in "Piggyback Transportation Services and Related Areas" study.
	
	As for military transport, operational conditions related to exceptional oversize rail services should apply, with special facilities for loading of military vehicles and a respectively aligned layout of the track systems, following the considerations regarding aspects of secrecy indicated in RB Operational Plan.
	
	RBR is currently in the process of developing a dedicated study on industrial connections. Its outputs is a concrete list of local connections that could be promoted taking into account the recommendations of this synergies study.

Best practices and lessons learned	**Europe** - National strategies for the promotion of rail freight and combined transport: • Germany: https://www.bmvi.de/SharedDocs/EN/publications/rail-freight-masterplan.html • France: https://www.ecologie.gouv.fr/sites/default/files/210909_Strategie_developpement_fret_ferroviaire.pdf • Spain: https://www.mitma.gob.es/ferrocarriles/mercancias-30 **US railroad companies -** UPRR, BNSF and CSX have dedicated sections on their websites, including documents describing the processes, defining the rules which apply to any private rail section: • UPRR: https://www.up.com/customers/ind-dev/index.htm • BNSF: https://www.bnsf.com/ship-with-bnsf/rail-development/build-rail-served-facility/ • CSX: https://www.csx.com/index.cfm/customers/industrial-development/build-or-expand-a-rail-served-facility/build-a-rail-served-facility/

Source: Rail Baltica Global Project Synergies Study (2022)