Position paper on multimodal and interoperable supply chains

Work Package 2 | Activity 3

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#BSRAccess

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Abbreviations

AFI	Alternative Fuels Infrastructure
AGV	Automated guided vehicle
CCNR	Central Commission for the Navigation of the Rhine
CEF	Connecting Europe Facility
CNC	Core Network Corridors
CT	Combined transport
DG	Directorate-General
EBU	European Barge Union
EFIP	European Federation of Inland Ports
EU COM	European Commission
EUSBSR	European Strategy for the Baltic Sea Region
eFTI	Electronic Freight Transport Information Regulation
EGDP	European Gross Domestic Product
EU	European Union
ECA	European Court of Auditors
ERSTU	European River-Sea-Transport Union
ESO	European Skipper's Organization
GHG	Greenhouse gas emissions
ICT	Information and communication technology
INE	Inland Navigation Europe
ITT	Inter Terminal Transportation
IWT	Inland waterway transport
MTS	Multi-trailer systems

OLE	Overhead line electrification
RIS	River Information Services
RRT	Rail-road terminal
RSS	River-sea shipping
SSS	Short-sea shipping
TEN-T	Trans-European Transport Networks
TFI	Transport Flagship Infrastructure
UIRR	International Union of combined Road-Rail transport companies
WSV	German Federal Waterways and Shipping Administration

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About the project platform

The platform **BSR Access** facilitates innovative and sustainable transport by creating linkages between traditional infrastructure nodes and smart transport solutions to further develop the TEN-T Core Network Corridors and contribute to sustainable growth in the region. BSR Access combines expertise from Interreg Baltic Sea Region projects **NSB CoRe**, **TENTacle**, **EMMA** and **Scandria®2Act** as well as **E12 Atlantica Transport** of Interreg Botnia-Atlantica, **FinEst Link** of Interreg Central Baltic, and **Green Regions with Alternative Fuels for Transport**, funded by the EU Connecting Europe Facility.

On the one hand, BSR Access communicates and highlights more environmentally friendly transport modes as competitive alternatives to conventional lorry transport and showcase smart transport solutions (e.g. River Information Services in inland waterway transport). On the other hand, a special focus lies on clean fuel deployment along transport corridors and their catchment areas. The latter referring to first mile and urban nodes, including their different challenges and incentives in the Baltic Sea Region. A multi-fuel approach will be considered as a starting point for a realistic recommendation on future policy.

For more information please visit: www.bsraccess.eu

Purpose of the position paper

This position paper illustrates best practice examples of interoperability and integration of multimodal transport in supply chains, with a focus on untapped potential ensuring a better modal choice for business decisions.
The business success stories attend the Issue Papers' (IPs) desire to create durable, streamlined, and capitalized actions and illustrate potentials to optimize interoperable and intermodal transports as part of the supply chain. In addition, this position paper features input from inland waterway transport (IWT), short sea shipping (SSS) and rail transport.

Thus, the target group of this paper are decision-makers from the public and business sector from the Baltic Sea Region. Especially the European TEN-T Coordinators, national administrations and regional development agencies, regional and local authorities as well as transport associations.

1. Transport in Transition – Towards zero emission

Climate change and environmental degradation are an existential threat to Europe and the world. To overcome these challenges, the European Commission (EU COM) presented the **European Green Deal** – a set of policies to make the European Union's (EU) economy more sustainable. As a new growth strategy, the European Green Deal aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient, and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use.[1]

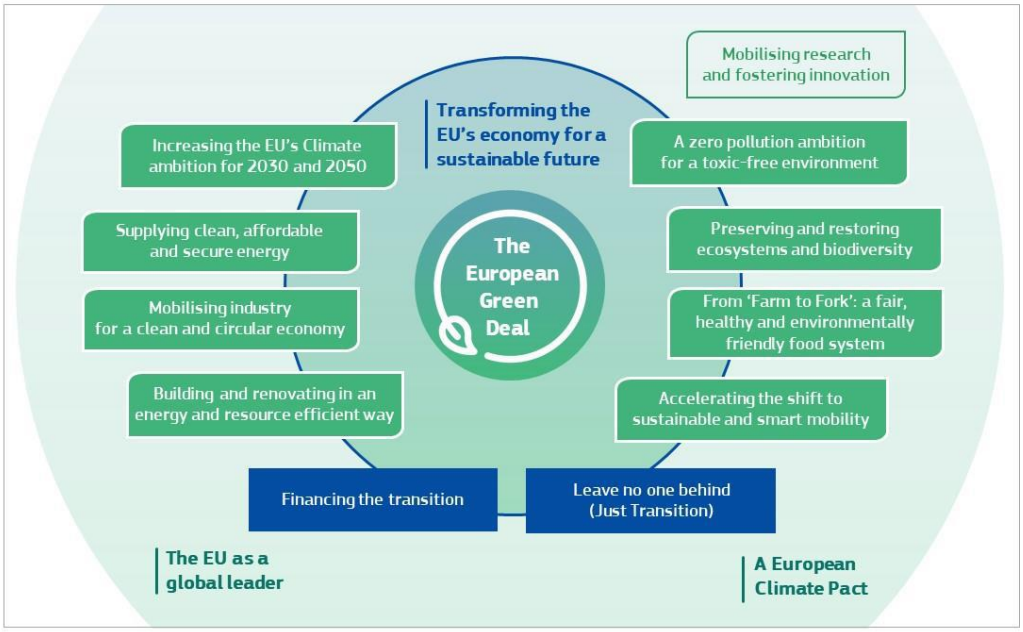

Figure 1: Elements of the Green Deal[2]

The main goal of the EU regarding the European Green Deal is to reduce emissions from all sectors by 80 % below levels until 2050. Between 1990 and 2018, greenhouse gas emissions were reduced by 23 %, while the economy grew by 61 %. However, current policies are projected to only reduce greenhouse gas emissions by 60 % by 2050.[3] The EU's

[1] European Comission: The European Green Deal
[2] European Comission: The European Green Deal, p. 3
[3] Ibid., p. 4f

overarching goal of climate neutrality is constantly being updated and modernized so that the European economy sets a good example in terms of climate protection worldwide.

The transport sector is currently the second largest producer of greenhouse gas emissions (GHG) in the EU. Freight transport continues to grow and specifically road freight is projected to increase by around 40 % by 2030 and by just over 80 % by 2050 (compared to 2005). Thus, in the coming years there is a need to develop measures to reduce GHG emissions from freight transport and at the same time handle the expected growth in transport volume to meet the targets set by the Green Deal.

At the end of 2020, exactly one year after the initial publication, the EU COM has launched a follow-up on the EU Green Deal. On 9 December 2020, the **EU Strategy on Sustainable & Smart Mobility** was published. This document outlines very first practical steps in the upcoming transition, which importance is clearly evident in the milestones listed below:

- By 2030, rail and waterborne-based intermodal transport will be able to compete on equal footing with road-only transport in the EU.
- Rail freight traffic will increase by 50 % by 2050.
- Transport by inland waterways and short sea shipping will increase by 25 % by 2030 and by 50 % by 2050.[4]

The strategy is based on three pillars for further actions under ten flagship actions:

- make all transport modes more sustainable,
- make sustainable alternatives widely available in a multimodal transport system and
- put in place the right incentives to drive the transition.

European land freight transport is an important economic sector with a massive impact on environment and society. The figure below shows that in 2015 the transport performance of the sector has reached 2,385 billion tkm² or 19 billion tons of goods transported, representing about 6 % of European Gross Domestic Product (GDP). Despite an increase in freight volumes, the modal share for road, rail and inland waterway freight transport remained substantially unchanged between 1996 and 2016. The vast majority of transport, 75% in total (in tkm), was carried out by 4.2 million trucks on European roads. 18% of transport (in tkm) was carried out by rail with a fleet of 40,000 locomotives and 880,000 wagons, while 7 % of about 15,000 barges were used on European inland waterways.

[4] European Commission: Sustainable and Smart Mobility Strategy – putting European transport on track for the future

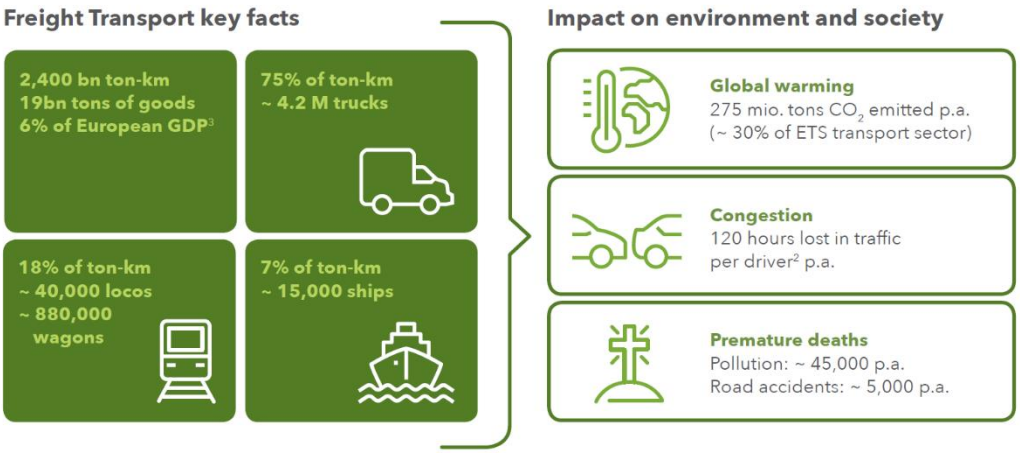

Figure 2: European land freight transport facts and impact, 2015[5]

Furthermore, a strategy for sustainable and intelligent mobility has been developed by the EU COM highlighting the importance of multimodal transport. The Commission explains that, as a matter of priority, a substantial part of the 75 % share of internal freight traffic currently carried by road should be shifted to rail and inland waterways.

Key objectives such as decarbonization and decongestion require a sustainable transport policy. However, the current transport policy cannot fully meet these requirements in view of the expected growth. It is unmistakable that environmental concerns have become much more important in recent years, but according to judgements made on transport prices, they remain a secondary criterion in decision-making.

The European Green is the latest, and most ambitious plan, of the Commission in greening the transport sector. Already in 2011, the **Transport White Paper** (COM/2011/144 final) stated examples of notable key elements and countermeasures regarding the climate neutrality. Here, the EU formulated benchmarks for a competitive and resource-efficient transport system and for achieving the then 60 % GHG emission reduction target:

- Developing and deploying new and sustainable fuels and propulsion systems
- Optimizing the performance of multimodal logistic chains, including by making greater use of more energy-efficient modes
- Strengthening of rail and inland waterborne transport (30 % of road traffic to be shifted by 2030 and more than 50 % by 2050) facilitated by efficient and green freight corridors

[5] Rail Freight Forward: 30 by 2030 Rail Freight strategy to boost modal shift

- A fully functional and EU-wide multimodal **TEN-T core network** shall be attained by 2030, with a high-quality and capacity network[6]
- A European multimodal transport information, management, and payment system because of the increase in efficiency of transport and of infrastructure use with information systems and market-based incentives

The different **Core network corridors** (CNCs) are fundamental and guiding for the successful implementation of the TEN-T dimensions, which were written into the guidelines in 2013. The corridors act as a powerful tool not only to encourage investments but also to promote and demonstrate the achievement of the EU's wider transport policy objectives. All corridors offer numerous opportunities to promote overarching transport solutions. The overall aim of infrastructure development along the corridors and on the core network is to provide unhindered and uninterrupted connections in the common interest of efficient, future-oriented and high-quality transport services for citizens and economic operators. All CNCs have set themselves the common goal that emissions will be lowered by developing the corridors through harmonized TEN-T standards, increased share of a stable dominant position of inland waterway transport, modal shift from road to rail and further deployment of alternative fuels infrastructure. The implementation of the TEN-T core network is expected to reduce transport-related CO_2 emissions significantly.[7] At the moment (10/2020), the Commission undertakes a review of the current guidelines for the TEN-T to revise the regulation by 2021. This revision aims to ensure cross-border infrastructure networks and the transport system are ready for the Green Deal objectives of carbon neutrality and climate resilience. The revision will also look at how to prepare the network for smart and connected mobility.

To meet the targets set by the Transport White Paper and the Green Deal, it is of enormous importance that the transport sector shifts to sustainable modes of transport such as railways, inland waterways, and river/sea shipping. This can ensure environmentally friendly, safe, and congestion-free transport and logistics, while at the same time upgrading the existing infrastructure and fleet. It is also essential for the transport sector to make efficient use of an integrated and intelligent multimodal network. Especially inland navigation and river-sea shipping (RSS) will hardly develop further without the political willingness and support to create same terms and conditions for all transport modes. At the same time they have a lot of potential to substantially contribute to greening transport chains.

[6] Moreover, all core network airports shall be connected to the rail network by 2050, preferably high-speed. This ensures that all core seaports are sufficiently connected to the rail freight and, where possible, inland waterway system.
[7] Euopean Comission: The impact of TEN-T completion on growth, jobs and the environment, p. 19

This policy paper provides input to future discussions on by illustrating best practice examples of interoperability and integration of multimodal transport in supply chains, with a focus on untapped potential ensuring a better modal choice for business decisions.

2. Highlighting the potential of less dominant transport modes

In the text, goods transport involving more than one mode is classified according to the following definitions:

- Multimodal transport: Goods transportation that employs more than one mode of transport.
- Intermodal transport: Multimodal goods transportation where the cargo is carried in an intermodal loading unit throughout the entire journey.
- Combined transport (CT): Intermodal goods transportation where the road legs of the journey are kept to a minimum, while the longest possible section of the distance is covered by non-road modes of surface transport.

Multimodal logistics refers to when freight is moved by combining two or more transport modes. Today, multimodal freight transport plays a significant role in the overall supply and distribution chain. The advantage of multimodal transport lies in the ability to utilize the most efficient combination of multiple means of transport. The combination of these should also result in increased environmental sustainability. The contribution of multimodal mobility is relevant also for passengers, who can benefit of quicker and improved connections, especially at urban level and within specific transit nodes.[8]

Rail

The EU has an ideal size for rail freight services and already has the densest rail infrastructure in the world and a dynamic economy. According to the International Union of combined Road-Rail transport companies (UIRR), there are two main reasons which emphasize the attractiveness of rail freight transport in multimodal supply chains. On the one hand, freight trains dominate cross-border rail traffic, with international traffic making up 50 % of the total rail traffic volume. These dimensions justify the need for a coherent and comprehensive European rail network to support rail freight transport. On the other hand, rail freight transport currently provides the most optimal solution to existing environmental problems, both in terms of energy-efficient mobility and lower emissions.[9]

[8] European Parliament: Research for TRAN Committee - Modal shift in European transport: a way forward Policy, p. 46
[9] UIRR: European Road-Rail Combined Transport 2018-19, p. 8

The European rail freight market has been growing significantly since 2012. Moreover, the years 2017 and 2018 saw noticeable increases in rail freight transport performance (+3.2% and +3.4%), which reached a peak after the economic crisis at 430-million-ton kilometers.[10] The railroad sector in Europe consists of state-owned rail infrastructure managers and railroad companies, some of which are partly state-owned, while others are privately managed. These two actors are complemented by train path allocation bodies, rail freight corridors, regulatory and safety authorities, and managers of rail service facilities to form the sector.

UIRR is the European industry association of CT. The association binds together CT Operators, transhipment terminal Managers, technology providers and various associations committed to coordinate the development of intermodal freight transport in Europe. UIRR also builds numerous bridges towards shippers, stakeholders of related transport modes and operators of different types of transport infrastructure. UIRR actively promotes CT, primarily towards European decision-makers and facilitates the enhancement of the sector, while also supporting the daily functioning of this ecologically and economically sustainable mode of long(er) distance freight transport.

Challenges

However, when looking at the development of rail infrastructure in the BSR, there is a vast gap in the different countries. In some, such as Finland, Lithuania and the BSR parts of Germany the length of the railway network increased in the recent years. Unfortunately, all other countries saw a decrease in the operational network. Poland and Latvia, for instance, saw a significant number of tracks taken out of the network. Additionally, a major part of rail infrastructure in the BSR does not allow the operation of high-speed trains and non-modernized tracks, outdated signaling techniques and rolling stock lead to slow and often unreliable services.[11]

A cargo flow analysis conducted by the INTERREG BSR project **COMBINE** found that transport in the BSR is predominantly organized on road for several reasons: the region is to a large extent rurally coined with a correspondingly low population density, meaning that the last mile is longer than in other areas of Europe. Although several large ports located in urban centers can be

The project COMBINE (Interreg BSR 2014-2020) aims at enhancing the share of combined transport in the BSR to make transport more efficient and environmentally friendly. It follows a comprehensive approach to strengthen all parts of the transport chain: main leg, terminal handling, and last mile. New technologies regarding these different parts of the transport chain as well as modern and efficient transport organization are opportunities for the Baltic Sea Region. To inhibit pure road transport, it is vital to use the benefits of each transport mode and to optimize each part of the transport chain where appropriate.

[10] Eurostat: Railway freight transport statistics, URL: https://bit.ly/3n0qLEp
[11] VASAB: Accessibility of the Baltic Sea Region Past and future dynamics, p. 8

found along the coastline of the Baltic Sea, Hinterland traffic is mainly organized in trucks and semi-trailers.[12]

Another issue is the still partly uncoordinated access to infrastructure. A railway undertaking must ask for track access to different national infrastructure managers. Tracks are often congested (particularly around large transport hubs) and time-sensitive passenger services are always given priority. The track access rights granted in the different countries are not always coordinated, and any incident can have a major impact, as all the track access rights must be reconfigured. Consequently, freight trains are often delayed because they are waiting for track access rights.

A level playing field needs to be achieved between the road and rail as mode of transport to be able to shift cargo to the more environmentally friendly transport mode. To make the intermodal/multimodal transport chain more attractive, easy availability and accessibility need to be guaranteed as well. Rail Baltica, as a green field development, crosses several national borders in relatively short distances (in terms of multimodal transport 'standards').[13]

Inland waterway transport (IWT)

Choosing inland navigation and river-sea shipping is another way to shift transport of goods from road to waterways in future. The navigable inland waterway network within the EU exceeds 40,000 km and covers all important economic areas in Central Europe. Many industrial and population centers are located along inland waterways. Half of Europe's population lives close to the coast or to inland waterways and most European industrial centers can be reached by inland navigation and river-sea shipping.

[12] COMBINE: Overview of the combined transport market in the BSR, p. 13

[13] The railway and infrastructure project Rail Baltica is a large transnational project developed by states of Estonia, Latvia, and Lithuania, and co-financed by the EU. Besides the project owners, Rail Baltica has many interested stakeholders along the NSB TEN-T corridor. The mission of Interreg BSR project NSB CoRe has been to bring stakeholders' perspectives on Rail Baltica from the viewpoint of accessibility and regional growth (see chapter 3.2).

Figure 3: Important economic areas connected to inland waterways[14]

Inland navigation has many advantages that have not been sufficiently exploited so far. Even small inland waterway vessels are generally able to carry up to 500 tons of cargo, while medium and large vessels can easily carry up to 3,000 tons of cargo. In addition, a push convoy with two barges can transport over 7,000 tons of goods. To put this into perspective, the masses can be transported by 175 railway wagons with a payload of 40 tons each or 280 trucks with 25 tons each. The largest inland vessels are nowadays able to load over 400 TEU. Due to the fact, that the volume of transports is constantly increasing, it makes sense to bundle large transports and the resulting volumes by a conscious policy. This should be

[14] Via Donau, 2013 EMMA project 2018. Remark for Sweden: Inland navigation is time being allowed in Lake Mälaren and Lake Vänern including Göta River

driven forward in particular by digitalization and be based on sustainability aspects (e.g. better use of plant and land capacity, decarbonization, lower energy consumption). Furthermore, the use of clean modular inland vessels with a higher frequency would be a useful addition to the European waterway network, for example for smaller rivers. As a result, inland waterway and river-sea shipping could save external costs, reduce emissions, and reduce the burden on roads and railways.

In 2018, the inland waterway transport performance in the European Union was 135 billion tkm (railway freight transport 430 billion tkm, road freight transport nearly two trillion). This transport performance is currently handled by a relatively small fleet of about 17,000 inland waterway vessels.[15] Specialized vessel types make it possible to adapt to inhomogeneous needs of European waterway systems. Other vessels can operate on large parts of European waterways and thus, are able to transport between different waterway systems and member states. In both cases, most of the vessels can transport any kind of goods.

Challenges

While Poland and Germany have a dense waterway network (though the former is in a dilapidated condition), in Finland, Sweden and Lithuania it is only concentrated in a few regions but offers enough potential for shifting cargo from road to waterways. Scandinavian waterways include lake areas, connected by canals. That is why there are fewer draught restrictions, but the winter conditions are tougher in Scandinavia than for example in North-West Europe. This requires different characteristics on ships' hull (ice-classed vessels) to extend operation season and profitability of waterway-based logistic solutions.

However, a cohesive BSR and European strategy is missing to boost inland navigation on rivers, canals and lakes that still have free capacities. Specialized ship tonnage for less deep fairways or wintertime is existing. However, framework conditions and regulations need to be harmonized and set accordingly to complete the single market for shipping.

The next logical step would be the linkage of the western and central European waterway system with the Russian waterway system to form a pan-European inland navigation market.[16] Unfortunately, as of today cargo owners, multimodal terminals and logistics service providers experience high transaction costs when doing business with barge operators. This relates to finding, contracting, and booking a suitable IWT transport service compared to other modes of transport. Especially in multimodal (containerized) operations it is important

[15] EMMA: Strengthening inland navigation and river-sea-shipping in Europe and the Baltic Sea Region, p. 7
[16] Ibid., chapter 3

to have a good visibility on services and their availabilities and to be able to manage the service efficiently.[17]

River-sea shipping also plays a very decisive role as a less dominant mode of transport. River-sea transport consists in a transport operation partly by inland waterways and partly by sea, without transhipment. River-sea transport must therefore not be confused with transport operations combining inland and maritime transport and requiring transhipment operations between the two. River-sea transport can be performed by a seagoing ship or an inland vessel meeting SOLAS regulations. River-sea shipping takes place on all major rivers in Europe that have a connection to the open sea. In the EU, this type of river-sea transport can especially be found in Sweden, Finland, the United Kingdom (UK), the Netherlands, Germany, France, Belgium, Portugal, and Romania. Outside the EU, it is well developed in Russia and Ukraine. In total, almost 64 million tons of goods are currently transported by river-sea shipping in the European Union.[18]

River-sea shipping is a transport mode that combines advantages from short sea shipping and inland navigation by allowing transports on maritime and inland waterways use the same special type of ship: river-sea ships. River-sea shipping takes place on all major rivers in Europe having a connection to the open sea, the Russian Federation, and the Baltic Sea as well.

Advantages of river-sea shipping include removal of transhipment costs in seaports (time and cost savings) and quality benefits since the goods are no longer transhipped in seaports and thus possible damage in reloading processes is excluded.

New vessels are often characterised by lower draught, and therefore can expand their operation area further inland making use of the inland waterways via river mouths.

Finnish stakeholders refer to **lake-sea shipping**, which is in context to this document a synonym for river-sea shipping**.**

The term **Inland Waterway Transport (IWT)** is used in this document and shall include all users of inland waterway infrastructure: river-sea shipping, lake-sea shipping, and inland navigation.

The main advantage of river-sea shipping lies in the absence of seaport transhipment. This results in lower transport costs, timesaving (avoiding possible congestion and related delays in a seaport), and a reduced risk of damage to goods resulting from additional transhipment and handling.

Challenges

River-sea ships must be adapted to navigate on inland waterways, and river-sea shipping is dependent on the state of inland navigation, the related infrastructure, and the water levels. The proper development and maintenance of inland waterway infrastructure (in particular the obsolescence of bridges and locks) and the waterways themselves is paramount for the good-functioning of river-sea transport. As is the case for pure IWT,

[17] EU COM: Digital Inland Waterway Area - Towards a Digital Inland Waterway Area and Digital Multimodal Nodes, p.47
[18] CCNR: Thematic Report. River-Sea Transport in Europe, p. 16

the lack of predictability (e.g. variation in freight rates) and reliability (delays, variation in water level) of river-sea transport can negatively influence demand for this kind of transport.

There is no harmonized data reporting in place at EU level on River-Sea shipping and Eurostat does not have a dedicated data collection. However, statistical data is essential to e.g. improve infrastructure or identify potentials. At the same time, both modes, inland navigation and river sea shipping are using the same infrastructure and partly same waterways. Thus, it could make sense to include river sea shipping perspectives while arguing for inland navigation matters.

Due to the highly divergent developments in the BSR, the geographical location and weather conditions resulting from the different climatic zones, the markets for inland waterway transport and river-sea shipping are different. It also can be said that lobbying structures in the different countries of the BSR vary a lot. The consequence of this is that the sector is often under-represented at the national and European level and is not given sufficient consideration.

Enhanced cooperation and common planning between the member states is needed to support river-sea shipping and inland navigation in the Baltic Sea Region. Ideally the aim should be the development of a common masterplan for enhancing inland navigation and river-sea shipping in the BSR. Such initiative might be driven and moderated by the Priority Area Coordinators Transport of the EU Strategy for the Baltic Sea Region (EUSBSR).[19]

3. Strengthening multimodal and interoperable transport solutions

3.1. Improved investment coordination among corridors

In terms of spatial development between corridors, the quality of transport infrastructure including capacity, connectivity, speed of travel etc. determines the competitive advantage of locations, which is usually referred to as accessibility. Investments in transport infrastructure lead to changes in the quality of different locations and can cause changes in spatial development patterns. In this context, geographical location, availability of infrastructure and

[19] EMMA: Strengthening inland navigation and river-sea-shipping in Europe and the Baltic Sea Region, chapter 2

economic strength are three important key elements that describe the pattern of general accessibility and connectivity in the EU.[20]

As stated in the 2011 White Paper, the TEN-T core network should be developed to ensure efficient multimodal connections, ports, airports, and key land border crossings – with a focus on completing missing links (e.g. cross-border sections, bottlenecks and bypasses). It states specifically, “for multimodal freight transport (i.e. E-freight), an appropriate framework for tracing goods in real time, ensuring intermodal liability and promoting clean freight transport can be put in practice through the concepts of “Single Window” and “one-stop-shop” by creating and deploying a single transport document in electronic form (electronic waybill).” [21]

The multimodal connectivity of the TEN-T core network can be drawn from the map below, which highlights the location of railways (freight), ports and rail-road terminals (RRTs) on the TEN-T CNCs in the EU Member States. The map provides an overall insight into multimodal connectivity throughout the EU and the BSR, where the network is less dense.

[20] European Parliament: Research for TRAN Committee - Modal shift in European transport, p. 46
[21] Ibid. p. 102

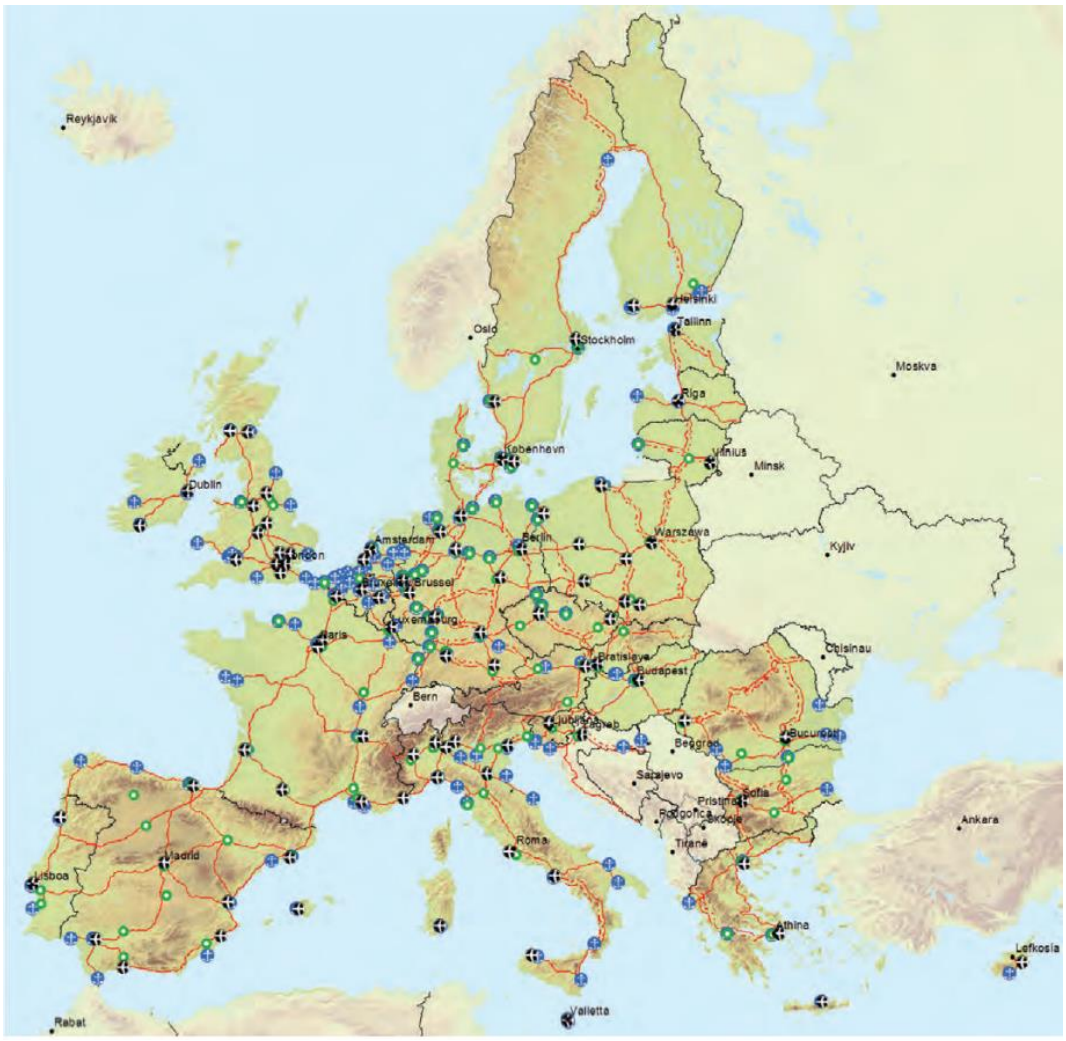

Figure 4: Railways (freight), ports and RRTs in the EU Member States (core network)[22]

The implementation of CNCs on the one hand brings substantial impact on the modal choice and accessibility to the functional transport system. Better commuting opportunities, extended labor markets and enhanced cross-border interoperability induces changes in the modal choice for passenger transport, provided the public transport operators ensure an adequate service offer. The better reliability, reduced time, and cost for freight transportation

[22] Ibid. p. 53

along the corridor correspondingly results in wider mode and route choice options for freight owners and forwarders in managing the supply chains. On the other hand, the implementation process for the CNCs faces several challenges, which may threaten the accomplishment of goals in the set time perspective (2030).

The figure below gives an overview of the progress in completing infrastructure on the core network by mode, according to information provided by the Member States in 2015.

Core network	Completed	Under construction/ Ongoing	Planned	Under study/Preparation
Road	75%	4%	19%	2%
IWW	89%	1%	10%	1%
Conventional Rail	73%	4%	22%	1%
High Speed Rail	61%	0%	39%	0%

Figure 5: Categorized TEN-T core network infrastructure (2015)[23] (no more recent data available)

Among the challenges are possible implementation delays for vital infrastructure projects on the corridors caused by weak cross-border coordination of investment planning and lower priorities assigned by the Member States in terms of national funding. Although cross-border projects usually demonstrate a high European added value, their direct economic effects might be less obvious – compared to purely national projects. The lack of a coherent approach in planning the corridor investments does not only manifest itself across the administrative borders. The Issues Papers[24] point at the still pre-dominant silo-thinking and low level of synergies with existing initiatives as a drawback in delivering the large infrastructure investments on corridors. The planning approach to TEN-T is, in the view of the European Coordinators, too supply-driven, while it should consider the actual needs of the freight transport market (demand-driven approach). This requires mobilization, cooperation, and coordination of relevant stakeholders.[25]

The European Court of Auditors (ECA) published a report this year confirming that the TEN-T network is unlikely to completed in the next ten years. The report analyzed six Transport

[23] European Commission: The Trans-European Transport Network: Common Progress Report of the European Coordinators, p. 55
[24] TEN-T Corridors: Forerunners of a forward-looking European Transport System. Issue Papers of the European Coordinators. The Papers should be understood as a first milestone of a process, as a door opener for further reflection and deeper analysis and as a catalyst for broader involvement and commitment.
[25] TENTacle: Realizing benefits from the TEN-T Core Network Corridors – how, where and by whom?, p. 7f

Flagship Infrastructures (TFIs), including three in the BSR: Rail Baltica, the Fehmarnbelt tunnel and the E59 railway line to ports in Poland.[26] After carefully analyzing the current development of these TFIs, the ECA concludes that:

> *"Since the TFIs and their access lines are key links in the core network corridors, it is therefore also unlikely that the connectivity of the EU core transport network will reach its full capacity by 2030, which implies that neither the EU transport network nor the expected network effects will be delivered by that time. Moreover, not all **rail TFIs** will be compliant with the minimum requirements of the TEN-T Regulation for rail freight by 2030."*[27]

Once completed, the Fehmarnbelt tunnel will be an important part of the ScanMed TEN-T corridor and effect the transport and logistics industry in northern Germany, southern Denmark, and southern Sweden. But the expected scale of changes in the international supply chains related to the tunnel is still difficult to assess due to the lack of progress in the last years. This makes it challenging for some stakeholders to respond to modal shift potentials and to adjust their business models or regional policies to benefit from the new infrastructure. The Fehmarnbelt Pilot Case of the Interreg BSR Project TENTacle compiled a guideline on how the construction of the tunnel will change transport structures and how the changes can act as a stimulus for regional development in the above-mentioned countries.

The project TENTacle (Interreg BSR 2014-2020) aims to improve the stakeholders' capacity to reap benefits of the TEN-T CNCs implementation for the prosperity, growth, and cohesion in the BSR. It delivered a package of policy and action measures to help public and market sector stakeholders to capitalize on the CNCs irrespective of the geographical location.

The traffic modelling performed by the Institute of Shipping Economics and Logistics (ISL) highlights which transport routes most likely will see an increase of traffic and which ones will see a decrease. This helps to identify changes in the flow of goods and by that the potential impact to different regions, transport stakeholders and modes of transport.[28]

[26] European Court of Auditors: EU transport infrastructures: more speed needed in megaproject implementation to deliver network effects on time, p. 13
[27] Ibid., p. 5
[28] TENTacle: Preparing the transport industry for the Fehmarnbelt Fixed Link, p. 7

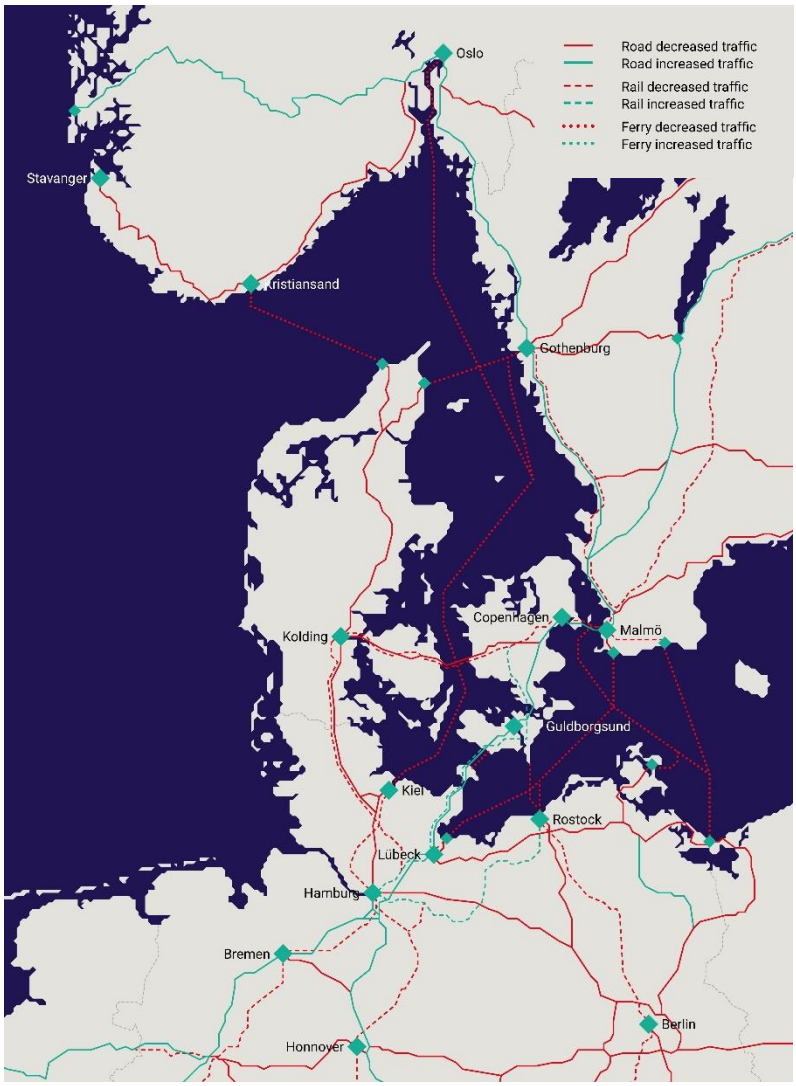

Figure 6: Traffic modelling performed by the ISL

The stakeholder interaction process carried out by the Fehmarnbelt Pilot Case assumes that business plans are more likely to be modulated once the tunnel is open and transport costs and other variables are calculable. The relatively low level of responses from surveys and individual exchanges indicates that more stakeholder involvement is necessary until the Fehmarnbelt tunnel is operational. Otherwise there could be a risk of short-sighted reactions and more transport on trucks than on more sustainable modes.

It is not enough to only invest in new infrastructure along the TEN-T CNCs to automatically shift more goods to rail/IWT as the Fehmarnbelt tunnel shows. Without knowing the final

price and actual opening of the tunnel, forwarding agents and shippers are unlikely to adapt their business model relying solely on truck or truck/ferry transport – especially given current bottlenecks and capacity issues in the railway infrastructure on the German side of the future tunnel.[29]

The TENTacle partners already examined possible scenarios for their region and business models (e.g. Port of Rostock, Guldburgsund Municipality, City of Kiel).[30] Most of the examples already explained above also conclude that the stakeholder interaction process should go beyond the final approval of the infrastructure construction. If stakeholder involvement is seen as a burdensome but necessary means of "enforcing" an infrastructure project, its true potential will not be realized.

Once must consider, that the CNC implementation generates diverse effects for the stakeholders, depending on their geographical location in relation to the corridor and the level they represent (national, regional, local). The changes induced by the new transport infrastructure are illustrated in another report by the TENTacle project in relative terms as they denote the comparative shift of the stakeholder's standing as compared with the other ones impacted by the investment. The grade of assessed impacts gives valuable input for how expedient the policy and action response should be to contain the challenge for prosperity and growth and to achieve the win-win situation, also for areas with foreseen negative impacts.[31]

Short recommendations from past projects and lobby organizations are:

- Continuously monitor and analyze CNC implementation and the need for complementary development measures
- Promote missing links or need for extension of the CNCs
- Ensure long-term and durable implementation by involving stakeholders early in the planning process
- Encourage bottom-up corridor governance initiatives (@Authorities at European, national and regional level)
- Analyze market opportunities, optimized business models, and logistic chains in the impact area of the CNC implementation (@Business stakeholders)

[29] For more information on this topic, please refer to Scanadria2Act: Fehmarnbelt / Øresund case study "Feasibility study for direct railway freight services between Hamburg and Scandinavia"
[30] TENTacle: Guidance Paper "How to use the Fehmarnbelt Fixed Link as impulse for regional growth", p. 19
[31] TENTacle Think Tank: Impacts of the TEN-T Core Network Corridors in BSR, p. 2

- Prepare adaptation strategies to the completed corridor investments, including possible opportunities for planning and managing multimodal supply chains (resulting, e.g. from shorter delivery times, better capacity, and interoperability between transport networks and between transport modes) (@Business stakeholders & regional authorities)

3.2. Improved connectivity by linking rail and inland waterways to multimodal hubs

One major aim of the TEN-T corridor development is to overcome capacity and bottleneck challenges in hinterland connections of ports. These have been analyzed by the Interreg BSR project NSB CoRe. The capacity and bottleneck challenges are tackled by shifting transport flows from road to the more environmentally friendly modes rail and inland waterways. The concept offers seaports the access to the hinterland market and increase the throughput without physical expansion, while at the same time being able to offer better services to shippers and transport operators.[32]

> The project NSB CoRe (Interreg BSR 2014-2020) enhances regional development in the BSR by improving internal and external accessibility of the region along the North Sea - Baltic TEN-T Core Network Corridor. The acronym NSB CoRe stands for 'North Sea Baltic Connector of Regions'.

Aligned with the CNCs, **Rail Freight Corridors** (RFCs) are defined by Regulation (EU) No 913/201017, together with measures to ensure their interoperability and commercial development. RFCs are part of EU strategic policy to create a European rail network for competitive freight by means of cooperation between the rail infrastructure managers within

[32] A multimodal hub (or multimodal terminal) can similarly bundle traffic to terminal dedicated transport modes. One of the benefits of having multimodal hub is their ability to relieve the issues of storage and customs space that frequently plagues seaports. Another benefit is the ability of a multimodal hub to speed up the movement of cargo between ships and inland transportation systems that distribute the goods. This helps maintain multimodal hub as central distribution hubs for a massive amount of goods, as the import and expert of goods becomes quicker. Multimodal hubs also act as a cost-effective distribution channel between seaports and high-capacity rail. The entire process becomes more efficient, thanks to this link existing within the supply chain. Collection of the containers is simple and fast, allowing for goods to reach their final destinations quicker, mostly at a lower price. Finally, a multimodal hub can also bring empty units closer to the cargo. This reduces the positioning costs as well. To encourage combined (or intermodal-, multimodal transport), a logistics center should preferably offer the transport by a multitude of transport modes. To ensure synergies and commercial cooperation, the logistics centers should be managed by a single and neutral legal body. Preferably a public-private-partnership. The logistics centers furthermore must comply with European standards and offer a high-quality level to provide a commercial framework and to be able to offer sustainable transport solutions. The terminals are the interface between the different modes and the access key to intermodal services. It is therefore possible that logistics centers are part of freight villages (NSB CoRe: Intermodal Nodal Points enhancements requirements for better Interconnectivity, p. 20f)

the framework of each corridor.[33] They are tasked with the work to level the playing field compared to other modes of transport and set similar standards throughout the EU. The RFCs develop and publish joint guidelines and handbooks and offer exchange platforms across for different stakeholder groups.[34] Some RFCs already begun a closer cooperation between their members when traffic, capacity, and performance are concerned. At ScanMed RFC, a feasibility check on a Joint Coordination of Traffic and Capacity was carried out in 2020 and a Pilot Project is starting in 2021 on the Brenner axis.

Despite this effort, fragmentation in the European railway sector has not been overcome yet and there have been many calls for updating the already ten-year-old initiative. National infrastructure managers are still in charge of the coordination of their national railway systems. The RFSs are also not fully coordinated with the TEN-T network as they run under different legislations. In July 2020, the Community of European Railway and Infrastructure Companies (CER), and the European Rail Infrastructure Managers (EIM) have put their joint weight behind a qualified endorsement of Europe's RFCs. They agree on the relatively successful implementation, and now they are lobbying for a supportive program of flexible and enhanced European legislation to help realize the full potential of the RFCs.[35] At the 20th Florence Rail Forum in December 2020, it was discussed if the RFCs need a supranational entity to improve their performance and which functions a network manager could take on.[36]

Having a joint EU co-financed platform is of vital importance, since the relative cost competitiveness of road transport versus rail transport is likely to increase, driven by fast innovation cycles of the trucking original equipment manufacturers. Capacity increase, platooning and autonomous driving are expected to reduce the specific cost of road transport by substantial double-digit percentages by 2030. In rail, asset replacement cycles are up to ten times longer, which naturally limits the rate of innovation uptake, in the context of a relatively small rail freight supply market. Hence, its customers, the rail freight undertakings, need to drive innovation through their own programs, while only a few are currently earning enough to be able to reinvest in their fleets. Providing sustainable financing models for rail

[33] Each RFC has a dedicated governance structure to make the corridor functional, which is more complex than that of the CNCs. RFCs are integrated within the TEN-T CNCs and the European Railway Traffic Management System (ERTMS) framework. The routing of RFCs may differ from TEN-T corridors, as RFCs follow routes more appropriate for freight traffic, for instance avoiding urban nodes. (European Parliament: Research for TRAN Committee - Modal shift in European transport, p. 67). The Commission is currently in the process of finalizing its evaluation on the implementation of Regulation (EU) 913/2010, and a Staff Working Document on the results is expected by December 2020. The revision of the Regulation, as an important prerequisite for competitive freight and modal shift, is an opportunity to move away from a single corridor to a European RFC network approach.

[34] For more information on the individual corridors please visit: https://rne.eu/

35 For more information, please visit: https://bit.ly/3tJ5X7n

[36] For more information, please visit: https://bit.ly/32rp0H9

freight undertakings is currently not a priority for many national policy makers since they do not see rail as a backbone or important part of mobility.[37] Same applies to inland navigation where asset replacement cycles are even longer compared to rail.

Another important aspect is the improvement of information flow in several directions. A survey conducted by NSB CoRe shows that shippers, forwarding agents etc. have no knowledge about intermodal and multimodal transport. Many of them do not know about specific train schedules and opportunities to overcome the first / last mile and door-to-door solutions. This can be improved by marketing activities for logistic service providers or other intermodal transport stakeholders.[38]

The IWT sector needs a strong voice in Brussels, since the state of the waterway infrastructure is characterized by many years of underinvestment and the BSR is no exception.[39] The same gap in knowledge that can be observed for rail transport in multimodal supply chains can also be observed for IWT. Waterways are often not considered in the logistics chain because there is a lack of knowledge on the part of the decision-makers of logistics operators regarding the inland waterway vessel as a reliable means of transport. Therefore, new trainees should already be made aware of the waterway transport options during their apprenticeships. Similarly, corresponding continuing training and further education measures for forwarding and logistics agents should be offered.[40]

The European Platform for Inland Navigation was established in 2018 (financed by the reserve fund) and is supported by the existing inland waterway lobby organizations such as the European Barge Union (EBU), Inland Navigation Europe (INE) and European Federation of Inland Ports (EFIP). The platform creates a concentrated and bundled expertise that acts as a catalyst for the dissemination of strategies in the key areas of the future of inland navigation, such as greening and innovation, sustainability, education, and training, setting technical standards and infrastructure. In addition, there will be a support for innovation in

[37] In 2018, a coalition of European rail freight companies called Rail Freight Forward published their ambitious strategy to achieve 30 % modal share of rail freight in the EU by 2030. More best practices can be found here: Rail Freight Forward: 30 by 2030 Rail Freight strategy to boost modal shift, p. 9

[38] NSB CoRe: Interconnectivity and Interoperability Policy Paper, p. 35f

[39] In 2017, the EU Com for Mobility and Transport acknowledged themselves that while, in the past, this was predominantly due to insufficient investment, planning resources have proved to be the limiting factor in recent years, which meant that it was not possible to spend all funds despite the constraints on funding. Currently, various measures are being carried out to accelerate planning and construction and to thus increase investment turnover. This includes creating additional planning staff posts in the Federal Waterways and Shipping Administration. In the years 2014 to 2018, a total of 278.5 posts – predominately for engineers – and, in financial year 2019, another 161 posts were approved by parliament (EU COM: Digital Inland Waterway Area - Towards a Digital Inland Waterway Area and Digital Multimodal Nodes, p. 8)

[40] BMVI: Masterplan Binnenschifffahrt, p. 22 (German only)

vessels and their adaptation to technical progress regarding the environment, including all sustainability objectives at European level.[41]

Considering the challenges that the individual transport modes still face along the TEN-T corridors, it is also no surprise that the level of multimodal integration has not reached its full potential. The CNCs and the RFCs represent the main axes for the development of intramodality and multimodality across the EU and therefor the BSR. It is equally important that the whole EU territory is given the same opportunity to be connected by rail, following the principle of cohesion and accessibility policy. The distance that needs to be covered, and the associated costs, of the road haulage that occurs before and after transport on another mode are amongst the main barriers to multimodal transport. So called first mile corridor areas must be considered the same way as the last mile, since they feed freight (and passenger transport) flows into the CNCs through the corridor access infrastructure (secondary road, rail and/or inland waterway links, and regional airports) connecting to the nearest corridor hub/urban node. However, they are rarely considered in regional or national transport planning.[42]

Another study recently published by the project COMBINE examines definitions of unimodal, multimodal, intermodal, and combined transport and corresponding policies at the EU level regarding the implementation of combined freight transport. Their scenario-based projections show that a modal shift in freight transportation in the EU28 is not able to decrease total GHG emissions of the transport sector significantly. Even under very optimistic modal shift scenarios and constant total freight volumes, the emission reduction would only be 6.5 % in 2030 (compared to 2017). As a reduction of trade volumes seems unlikely, the remaining option would be to reduce the specific emissions of the transport modes. In turn, this requires the implementation of additional policies targeted at internalizing the social costs of emissions for companies in the transport sector. The debate on the appropriate instruments for this is still ongoing. In addition, policy measures need to be complemented by technological efforts to improve the relative cost effectiveness of multimodal transport.

A smooth transition between at least two modes of transportation is crucial for the efficient use of a multimodal transportation. For an easy Inter Terminal Transportation (ITT) between barge and rail or truck, the authors of the study for the COMBINE project give the following solutions:

[41] European Barge Union: Annual Report 2018-2019, p. 4
[42] For more information on first mile corridor areas, please visit the BSR Access website

- Install a network of non-public roads at ports, which allows using terminal equipment such as multi-trailer systems (MTS) and automated guided vehicles (AGV) more efficiently.
- A sophisticated data infrastructure to provide information about the container's location, destination, duration of stay at the terminal, and about the available modes and connections.[43]

The overall long-term European goal is to create an interconnected and interoperable rail system that connects Central- and Eastern Europe with Scandinavia, the Commonwealth of Independent States and China. Rail Baltica is one key project. Its effective connections to the wider 1520 mm railway network will help to create new industrial zones and communication nodes, to create conditions for emerging business opportunities, and will affect the development of distribution centers in national markets. A network of cooperating multimodal (or at least) intermodal terminals covering the CNCs should be designed, and an integrated and coordinated strategy for terminal development considered. This is possible only in close partnerships between public and private actors in transportation sector across national borders.[44]

3.3. Improved utilization of information and communication technology (ICT)

The efficiency and reliability of logistics processes of supply, production and distribution to a large stage depend on the speed and efficiency of information processing, which nowadays is determined primarily by the possibilities of modern IT technology. It is important that individual links in the supply chain are characterized by a high level of integration. This significantly influences the application possibilities of the chosen technology and facilitating contacts with business partners and clients. The development of new distribution channels and the creation of products along with the development of ICT technologies are becoming the driving force for creating more and more effective innovative solutions, thus determining comprehensive approaches to supply chain management. Increasing number of ICT tools providers, should be focus on offering, complex solutions, that allow efficient data exchange,

[43] The paper at hand discusses the different typologies of combined transportation in Europe. It shows that an improvement of handling infrastructure for combined transport can positively reduce environmental costs of trading between regions. However, the expected emission reduction effects are relatively small in comparison to the total emissions of the transport sector. This means that, to achieve a substantial reduction of emissions, combined transport initiatives need to be complemented by a reduction of the specific emissions of the relevant transport modes. The paper closes with an outlook towards the development of the combined transportation sector. (COMBINE: Combined Transport in Europe. Scenario-based Projections of Emission Saving Potentials, p.23)
[44] NSB Core: Growth Strategy, p. 18. The NSB Core analyses on logistics are summarized in Policy Paper on Interconnectivity and Interoperability.

and process integration, not only inside the enterprise, but also between members of the supply chain.[45]

IWT

In freight transport and logistics, digitalization has established itself predominately for the road and rail modes in recent years.[46] In 2018, the TRAN Committee already observed the lack of availability and the lack of transparency of information on freight flows, in combination with limited ICT facilities, as well as a lack of standards for communication and information exchange as the most important technical bottleneck to the IWT sector's interoperability. This inefficiency is mainly due to the costs to make the communication systems and planning tools interoperable between multiple actors along the multimodal transport chain.[47]

Digitalizing IWT and waterways must be a future priority in Europe to boost greening the entire transport sector. Some European initiatives are on the right track as the largest CEF funded project RIS-COMEX demonstrates. In the context of RIS-COMEX, the waterway administrations of the Member States involved in the respective TEN-T corridors ensure a seamless exchange of data for navigation, traffic management and logistics planning.[48] The project concentrates on the main European inland waterways, though. It does not include smaller waterways which offer big potentials as well when equipped with new technologies and better navigability.

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[45] NSB Core: Interconnectivity and Interoperability Policy Paper, p. 44

[46] Digitalization offers a lot of potential and benefits for the logistics and transport sector. It promotes cost reductions, utilization of resources and available infrastructure. Intelligent Transport Systems, often referred to as ITS - in a narrower sense, utilize modern ICT tools to enable better sustainability, efficiency, and competitiveness. The utilization of these ICT tools offers great potential to create a genuinely integrated transport system and at the same time support the EU's 'Roadmap to a Single European Transport Area'. The European Parliament therefore has provided the 'ITS Directive' as a legal framework. The Directive intends to ease the harmonized employment of ITS across Europe accordingly a C-ITS Platform was launched by the Commission in 2014 as a basis for this undertaking. The intention of the platform was to foster the emergence of a 'common vision' and a platform for exchanging knowledge. (NSB CoRe: Recommendations for information system developers, p.13)

[47] TRAN committee: Research for TRAN Committee - Modal shift in European transport, p. 78

[48] Platform for multimodality and logistics in inland ports: Position Paper, p. 16f. The waterway operators will exchange traffic data within the framework of RIS-COMEX to allow for better transport planning (e.g. lock planning). RIS-COMEX also is to improve the integration of inland waterway transport into digital logistics chains. The decision as to which data to share is to lie with the vessel operator. Setting up the services is expected to take until 2021. The Member States will decide which services they will offer along their corridor. Here, the specific framework conditions of the individual corridor will be considered. At the same time, a legal framework is to be established which allows for uniform digital cargo documentation throughout the EU, since almost all cross-border transport operations within the EU currently still require the use of paper documents. For more information please visit https://www.riscomex.eu/

Digitalization has focused so-far mostly on the provisioning of RIS by fairway authorities and their use by barge operators. Even though this provides a basis, further extensions are needed to address the gaps between the existing systems and the services data requirements of the various stakeholders (e.g. ETA, ETS projections and real-time notifications as well as slots for locking). Inland-AIS technically enables sharing of positioning and tracking data, however the protection of data (privacy and commercially sensitive data) is not yet solved in a transparent way. This limits the re-use possibilities of Inland-AIS as there is no sufficient governance mechanism and technical protection for the use of data for other purposes.

In the project EMMA (Interreg BSR 2014-2020), waterway administrations, business support organisations and ports together with shipping companies, logistics businesses, and research organisations jointly raised inland waterway transportation higher on the political agendas in five countries (Germany, Sweden, Poland, Finland, and Lithuania) around the Baltic Sea.
The EMMA Extension Project (08/2019-01/2021) aims to enhance inland navigation in the BSR by supporting digitalization in IWT and by implementing new logistic concepts.

The partnership published a Service implementation guideline summarizing results and experiences of various stakeholders in the BSR: IWT best-practice cases, an overview on IWT affine in the industry and customer needs, new potential IWT services and a service set-up guideline. It demonstrates the potential IWT could play and aims at changing the way of thinking and acting by all stakeholders.

The Interreg BSR project EMMA, developed a prototype to overcome this challenge and by that support vessel masters, fleet- and cargo managers to demonstrate the feasibility of using modern information technology. This is achieved by collecting and aggregating different data sources from existing RIS. This data is then presented using an integrated web application called ELIAS. A particular advantage of this information technology is that no new specialized hardware or software is required. Furthermore, only a low-bandwidth Internet connection and a standard Internet browser are required. The central part of ELIAS is a map-based web application that displays relevant information about inland waterways.

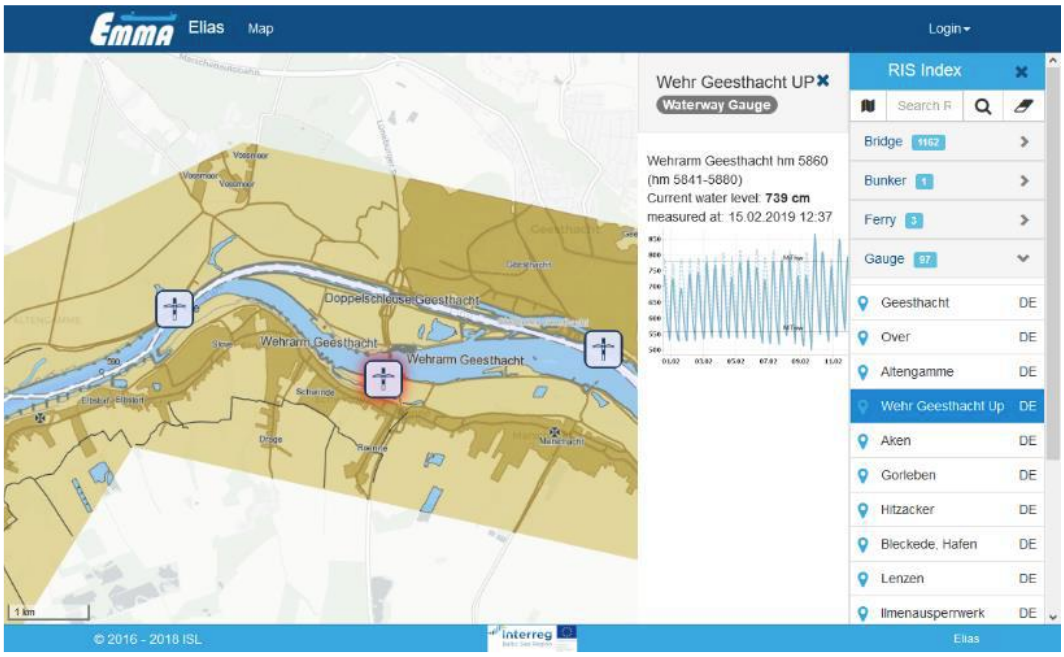

Figure 7: Screenshot of electronic navigational charts and water levels[49]

External information sources are directly integrated, e.g. available electronic navigational charts provided by the German Federal Waterways and Shipping Administration (WSV) via a standard web chart service. Current and predicted water levels at numerous gauges are available via another WSV service.[50]

ICT can also support administrations in lowering maintenance costs and at the same time increase traffic safety as a Finish pilot activity in EMMA Extension project highlights: Smart buoy technology has been installed in Saimaa on the fairway section between North Karelia and South Savo. Smart buoys deliver adjustable signal light intensity and allow accurate track and trace functionality. In bad weather conditions light intensity can be set to higher level by pilots on board or ship captains (via a smartphone app) to better support navigational aids. When weather is clear, signal intensity can be lowered again, resulting in longer battery operational lifetime. At the same time, the buoys' positions can be tracked online, and deviations detected in real time. Same applies to battery functionality. This brings more safety to shipping results in reduced maintenance costs for waterway authorities.

[49] Ibid. p. 42
[50] EMMA: Competitiveness Improvement Plan, p. 41

Control and inspection tours can be better planned in advance. Additional sensors could be installed to measure waive sizes, weather conditions, emissions etc.[51]

New manufacturing technologies and e-commerce processes are changing the supply chains of companies, resulting in new requirements for transport services. New modern logistics paradigms, such as synchro-modality and the Physical Internet, all rely on new underlying data infrastructures to bring together supply and demand for transport services. Synchronous modality manifests itself in strategic, tactical, and operational planning of transports and transport operations based on the real-time availability of available logistics services, data on the means of transport (e.g. the location of barges, trucks or wagons and their available capacities) and data on the infrastructure (e.g. expected delays). Sharing these data in a powerful way leads to an optimization of transport processes by all parties involved.[52]

Rail

Implementing the European Rail Traffic Management System (**ERTMS**) is still one of the overall goals to harmonise European rail networks. The slow technological innovation in the rail freight sector is an on-going barrier for long-lasting innovation. Whilst infrastructure managers may agree that there is a need for common standards, each wish to have his own standards implemented throughout the Union. The RFCs are of vital importance to streamline different interests within Europe and the BSR spanning several borders, industries, and business models.

> ERTMS aims to harmonize automatic train control and communication systems and ensure the interoperability of the entire rail system in Europe. Because of the many different national train control systems, which are the main barrier to a smooth interoperability of the European railroad system, the introduction of ERTMS will form the backbone of a digital, interconnected Single European Railway Area.

Besides the improvement of cross-border connections, ERTMS offers more safety and more capacity on existing infrastructure. However, the financing of this undertaking has caused the implementation to fall behind. There are still a few barriers of interoperability – such as: interaction with legacy systems in Member States, different engineering rules, or different interpretations of the ERTMS rules. By April 2020, the system was installed on only 78 percent of the routes for which delivery was scheduled for the end of 2019. The European

[51] EMMA Extension: Smart fairway in Saimaa contributes to safer shipping. URL: https://bit.ly/3cPqZtn The full report will be available shortly on the website of EMMA Extension.
[52] European Comission: Digital Inland Waterway Area: Towards a Digital Inland Waterway Area and Digital Multimodal Nodes, p. 9

implementation plan states that 15,682 kilometres of track should be ready by 2023. Only 38 percent of this has been realised now.

The EU COM has initiated the first steps towards a Single European Railway Area (SERA. With the legislative measures of railway package, the creation of RFCs that are corresponding to the TEN-T network, and the provision of various funding sources things have come a long way. However, there is still room for improvement to further the competitiveness and development of more efficient and up-to-date solutions to promote the railway sector and with that the intermodal transport sector. One of the most important areas for a single European railway network is that of data sharing. The 'chicken and egg' problem has been discussed for quite some time, but still hinders investments and cooperation between stakeholders. It furthermore also hinders the efficiency of multimodal logistics chains, as the tracing of cargo is not possible throughout the entire logistics chain within the customers' supply chain. A one-stop-shop offer development, which is currently offered in a fragmented manner for the differing transport modes at best, is also curbed through this.[53]

Although ERTMS is a leading solution for railroad signaling and control systems, it does not make sufficient use of the technologies available for intelligent transport systems. To exploit the existing potential even more efficiently and to drive innovation in the rail sector, the EU set up a joint-undertaking under Horizon 2020 in the form of a public-private partnership called Shift2Rail (S2R). This partnership provides a platform for cooperation and research and innovation will support EU efforts to create the SERA. The S2R research activities will for example: commit to reduce costs, increase capacity and improve reliability and punctuality.[54] Together with examples as the 'Digital Single Market' and the 'Digital Transport and Logistics Forum', these measures pave the way for e-documents[55], the 'Industrial

[53] NSB CoRe: Interconnectivity and Interoperability Policy Paper, p. 47f

[54] NSB CoRe: Recommendations for information system developers, p. 16. ICT has opened many new opportunities for companies along the supply chain. Not only in terms of new business opportunities, but also regarding more efficient logistics chains. For more information on the areas of Industry 4.0, Internet of Things and Industrial Internet of Things, Physical Internet, Cloud computing, Software as a Service, Platform as a Service, Infrastructure as a Service, Security Considerations of cloud computing, Big Data, Augmented Reality, Artificial Intelligence Blockchain technology, please refer to Ibid., Chapter 2: Future trends related with development of ICT tools technology

[55] There are various documents required in cross-border transportation. E-documents will enable to cut red-tape for all stakeholders involved and improve their power to compete and desirability of the different modes and their combination in intermodal transportation. In the maritime sector there is the European Maritime Single Window effort. The railway sector, like the road sector, also has a document that regulates various legal aspects related to international cargo transport by rail. The 'Contrat de transport international ferroviaire des marchandises' (CIM). There are some issues with the e-CIM at this stage: not all Member States recognize the e-CIM and digital signatures on e-CIM are not accepted by insurance companies, authorities, and courts. Furthermore, in the case of transporting dangerous goods, the e-CIM is not accepted in countries such as Germany.

Internet of Things' - or more transport related the 'Physical Internet', but also for Cloud Computing, Big Data and automated or autonomous driving in the transport and logistics sector.

The UIRR Interest Group on Digitalisation has developed the CT Digitalisation Roadmap adopted by UIRR's General Assembly in 2019. The Roadmap is a product of a broad sectoral collaboration. It lays out the structure of digital solutions to be developed by the various types of actors of the intermodal transport chain – reflecting on the initiatives pursued within the road and the railway sectors, as well as the Modernised Customs Code and the Electronic Freight Transport Information Regulation (eFTI).[56]

Digitalization has the potential to overcome some of the inefficiencies derived from the fragmentation of European rail freight and facilitate the monitoring of performance in each RFC, improve the management of capacity by better coordinating the allocation of existing capacity, and empower RFCs to manage traffic, both under regular conditions but also when disruptions emerge. However, while investment into digital innovation in the rail sector is essential to dramatically increase infrastructure capacity and improve efficiency, digitalization should also not be seen as a replacement of infrastructure investments. Considering the EU's modal shift objectives, while considering the congestion levels in large parts of the EU network today, one cannot realistically expect that digitalization alone will be the sole solution for congestion issues and that volumes will increase sufficiently. Investments into the maintenance of the existing rail network, especially on RFCs, will thus continue to be necessary.

Modal shift is a priority for the Green Deal and cannot do without multimodal transport management systems – this is the case for both waterborne and railway transport. Interoperability is the first condition for successful multimodal smart and connected transport. Standardisation is not enough as it leaves too many operational aspects untouched. Binding rules on interoperable standards between existing information systems across borders and modes would make the TEN-T Regulation much stronger by enabling the coherent

[56] UIRR: Report 2018-19, p. 13: The EU COM's proposed new Regulation for Electronic Freight Transport Information (eFTI) is an initiative that has the potential to propel the entire European transport and logistics sector into the 21st Century. The envisioned digitalisation will permit the abandoning of paper forms - considerably reducing the bureaucratic burden, while boosting the productivity of enforcement, thereby contributing towards fair and lawful daily operations. The adoption of the new Regulation will only be a beginning, as four critical delegated acts will need to be then drafted to lay out the roadmap towards implementing the desired digitalisation. Special care and prudence will be in order, as significant investments will be needed from both the market and the Member State government sides

deployment of digital technologies across the TEN-T network and boost synchro-modal transport.

The development of a common European mobility data space in full compliance with data protection rules and according to the highest standards for cybersecurity is very much welcomed to stimulate data accessibility, the use of data and demand for services enriched with data. All the synergies between transport and digital policies should be enhanced. To foster system innovation, the new common data spaces should not be isolated bubbles. For waterways and waterway transport as well as railway transport, there is a direct added value to develop connections between the common European data spaces for Mobility, Energy and Industry.

3.4. Improved utilization of decarbonation potential

The economic efficiency and commercial viability of multimodal transport are closely connected with the technological compatibility and the interoperability of the different modes of transport at international level. ICT tools support the communication between the stakeholders of a supply chain and can constitute a barrier, but also an opportunity for intermodal transport development. However, as the COMBINE project has shown, just shifting to a more sustainable mode of transport, or just implementing the right infrastructure or ICT tool is not enough anymore to hit the targets set by the Green Deal. Only by ensuring smooth cross-sectoral and cross-border cooperation as well as investing in clean fuel supply every step along the supply chain – from first-mile areas to upgrading the long leg covered by trains or barges to the last-mile delivery – there is a fighting chance in reducing emissions in the transport sector. Nonetheless, the overall picture is scattered when it comes to the deployment of clean fuel, even though the Alternative Fuels Infrastructure (AFI) Directive has been in place since 2014.

The next years will be crucial to develop and implement measures to reduce GHG emissions from freight transport and at the same time to handle the expected growth in transport volume to meet the targets set by the EU. Even though multimodal transport is recognized as one of the most environmentally friendly way to transport goods, the reduction of CO2 emissions alone is not an important motivation for companies to shift from solely road transport.[57] Many companies even do not measure the CO2 footprint of their transport

[57] The challenges of growing transport volumes are also addressed in the TENTacle THINK TANK paper that was developed in cooperation with the Swedish Transport Administration (Trafikverket). By promoting multimodality and shifting to more sustainable modes of transport, the gradual completion of the TEN-T network contributes to meeting these challenges in a more coherent and efficient way throughout the European Union. Completion of the TEN-T network will ensure an adequate coverage

operations. There is no legal requirement to do so and for instance many chemical companies already contribute to the Emission Trading System in the framework of their production processes, so there is no additional incentive.[58]

On a global scale, transport is highly (≈96 %) dependent on fossil fuels, finite resources that emit carbon dioxide and other greenhouse gases and pollutants into the atmosphere, contributing to the risk of severe climate change and deteriorated public health.[59] Hence, the primary directive dealing with alternative fuels in the EU is the AFI Directive. Therefore, the EU developed a strategy that focuses on electricity[60], gas, hydrogen, as well as liquid biofuels.[61] As stated in the first chapter, climate action is also at the heart of the Green Deal and first actions include:

- European Climate Law to enshrine the 2050 climate-neutrality objective into EU law
- European Climate Pact to engage citizens and all parts of society in climate action
- 2030 Climate Target Plan to further reduce net greenhouse gas emissions by at least 55% by 2030

The European Hydrogen Strategy is another important part of the long-term solution to meet the 2050 climate neutrality goal of the Green Deal. Hydrogen can be used as a feedstock, a fuel or an energy carrier and storage, and has many possible applications across industry, transport, power, and buildings sectors. Most importantly, it does not emit CO2 and does not pollute the air when used. Hydrogen can support the transition towards an energy system relying on renewable energy by balancing variable renewable energy. It offers a solution to decarbonize heavily emitting industry sectors relying on fossil fuels, where conversion to electricity is not an option. And it emits no CO2 and almost no air pollution.

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of the transport infrastructure, while encouraging the concentration of transnational traffic and long-distance flows. For more information please visit https://bit.ly/3mO3mG2 (TENTacle: Impacts of the TEN-T Core Network Corridors in BSR, p. 3)

[58] ChemMultimodal: Joint transnational strategy

[59] GREAT: GREAT Road Map: Final Report on Policy Measures, p. 5

[60] In direct comparison to road transport, rail freight has a six times lower specific energy consumption, mainly due to the inherent and enduring physical advantage of the low friction of steel wheels running on steel rails. As a positive consequence, the lower energy consumption leads to six times lower external costs compared to road, regardless of the energy source. In view of accelerating climate change, these benefits must become an eligible source of compensation for the existing direct cost disadvantages of rail versus road transport. Rail is already one of the most electrified modes of transport. Rising electricity use by rail in most regions can be met by various technologies including, but not limited to overhead line electrification (OLE) and can offer cost-effective means for reducing GHG and local pollutant emissions. (International Energy Agency: The Future of Rail: Opportunities for energy and environment, p.83)

[61] GREAT: GREAT Road Map, p. 9

Since the overall goal needs to be a transition to zero-emission fuels from renewable sources, short-term solutions need to be part of a clear long-term strategy, which is why the GREAT Road Map (part of the GREAT Project) was developed. This approach builds on a transport corridor concept spanning from Hamburg to Oslo/Stockholm, to support the exchange of knowhow and develop an example for transnational policy coordination in the field of alternative fuels. Another pillar of the GREAT project was to implement fast charging stations along the GREAT corridor and across national borders and by that showcase first steps to implement a long-term strategy.

Figure 8: GREAT Road Map[62]

It clearly showed that a useful approach to evaluating the environmental performance of various alternative fuels is the use of carbon dioxide equivalents (CO2e) as an indicator. In

[62] GREAT: GREAT Road Map, p. 4

addition, assessing energy consumption in a "well-to-wheel" perspective ensures that long-term sustainability is considered when determining the solutions to be implemented.[63]

The GREAT project also showed that communication activities are very important in the implementation of policy measures and to bring stakeholders together, share knowledge initiating pilot projects and implementing an infrastructure for alternative fuels regardless of the innovation sector.[64]

IWT

The IWT and RSS (also: Short Sea Shipping) sectors are challenged like all modes of transport to meet the 2050 zero emission goals and have play a significant role across transport corridors and industries if the climate targets are to be met. Due to road traffic congestion and climate-friendly waterways, the inland waterway sector already is an interesting alternative - also for combined transport. Various studies show that there is a lot of unused capacity and therefore room for growth, if the above-mentioned current bottlenecks are overcome. The EU COM already has taken the first steps to make shifting to IWT more attractive throughout Europe and the BSR: To this end, the Commission has developed an overarching program called NAIADES II, which aims to create the conditions for inland waterway transport to become a high-quality mode of transport and thus support the overall transport policy objective of shifting freight transport to waterways and rail. Specific measures include the review of technical requirements for ships and the assessment of obstacles to the further development of inland ports. Further measures will be taken in the sector of emission reduction and in educating the transport sector on IWT.[65]

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[63] Ibid. p. 41

[64] Ibid. The work of the GREAT project is continued in the BSR Access project platform. The “Clean fuel deployment Group of Activities” is led by the Capital Region of Denmark and aims at creating alignments in the clean fuels systems across the countries of the BSR building on the existing experiences and best practices with clean fuel deployment. In 2019, a review and assessment of Clean fuel deployment in the BSR was published on the BSR Access website. The report covers clean fuel policy, targets, ambitions, current market developments and successful supporting mechanism for its development. Some countries and regions can be considered as forerunners and there are a lot of good examples, initiatives and successful projects, but the overall picture in Europe and the BSR is highly scattered and not equipped for multiple users. In the beginning of 2021, the Position Paper on Clean Fuel Deployment in the BSR was published.

[65] European Comission: Digital Inland Waterway Area Towards a Digital Inland Waterway Area and Digital Multimodal Nodes, p. 10. NAIADES III is expected to be released in May 2021.

In November 2020, the acting German Federal Minister of Transport and Digital Infrastructure Andreas Scheuer, in cooperation with the European Barge Union EBU, invited the acting Commissioner for Transport Adina Vălean as well as his colleagues from many IWT countries to support the IWT industry, future modal shift and greening of the sector. All parties agreed that shipping is an indispensable component of the European economy. This is being confirmed also by the COVID-19 pandemic, which is seeing maritime shipping and IWT as well as the ports sector contributing significantly to maintaining the functioning of the transport system and avoiding supply shortages. The attending parties re-committed themselves to climate change mitigation and environmental protection objectives:

> The European Barge Union (EBU) is the European association representing the majority of the inland navigation freight and passenger carrying industry on a Pan-European level. Its members are the national associations of barge owners and barge operators as well as (international) associations in the field of inland navigation and related areas.

> "*We, EU Member States and EFTA States, will jointly work towards achieving these objectives - be it during the ongoing negotiations concerning the IMO initial strategy on the reduction of greenhouse gas emissions from sea-going ships, or the current work on the [Central Commission for the Navigation of the Rhine (CCNR)] roadmap for a zero-emission inland navigation sector.*"[66]

In their Declaration signed in Mannheim on 17 October 2018, the transport ministers of the Member States of the Central Commission for the Navigation of the Rhine (CCNR - Germany, Belgium, France, Netherlands, Switzerland) also reasserted the objective of largely eliminating greenhouse gases and other pollutants by 2050. To further improve the environmental sustainability of the navigation on the Rhine and inland waterways, the Mannheim Declaration tasked the CCNR to develop a roadmap to:

> The Central Commission for the Navigation of the Rhine (CCNR) is an international organization that exercises an essential regulatory role in the navigation of the Rhine. It is active in the technical, legal, economic, and environmental fields. In all its areas of action, its work is guided by the efficiency of transport on the Rhine, safety, social considerations, and respect for the environment. Many of the CCNR's activities now reach beyond the Rhine and are directly concerned with European navigable waterways more generally. The CCNR works closely with the European Commission as well as with the other river commissions and international organizations.

- reduce greenhouse gas emissions by 35% compared with 2015 by 2035,
- reduce pollutant emissions by at least 35% compared with 2015 by 2035, and

[66] Federal Ministry of Transport and Digital Infrastructure: Conferences of EU Transport ministers entitled "Triggering Greening and International Competitiveness of Shipping and Ports" and "Inland Waterway Transport – Key to the Green Deal" on 8 September and 20 November 2020, respectively. URL: https://bit.ly/3duKZDl

- largely eliminate greenhouse gases and other pollutants by 2050.

As of October 2020, several research questions have been performed and the results are available for publication. These results should be considered only as intermediate and will serve as a basis for the completion of the full research project by the Summer of 2021.[67]

Modernizing the engines of inland waterway- and SSS vessels makes sense in terms of environmental policy, but often not in terms of an operator's bottom line. Conversion of the IWT fleet to zero emission is a challenging task as inland ships have extremely long lifecycles. Technologies for near zero tank-to-wake emissions are theoretically available, but Technology Readiness Levels and costs do not favor short-term mass roll-out for most, (IWT, RSS & SSS) vessels and their operational profiles will require different solutions, as there is no 'one-size-fits-all approach', and to achieve ambitious emission reduction targets all available means (financial, regulatory, economic) must be deployed.

To speed up the deployment to reach the emission reduction goals in the IWT sector it is therefore of highest importance to provide the technical solutions, create and authorize specific aid schemes and fiscal incentives. The IWT sector therefore needs:

- Available and affordable technology to broadly deploy innovation in the sector
- Flexible goal based regulatory framework avoiding long term permission processes for innovative solutions
- Tailor made and dedicated funding combining national and EU funding schemes for:
    - Engine renewals;
    - Retrofitting of engines in existing vessels with electric drive or propulsion (to make the energy source exchangeable for future green solutions);
    - Innovative vessel design to reduce energy consumption and to make the fleet resilient towards climate change.[68]

The final aim is to achieve the possibility of clean onshore power and refueling along the network by 2030 to make significant progress towards climate neutrality on water and along shore. The clean energy transition is only starting, and it is not yet clear which alternative fuel will be the best solution. Most probably, the future is multi-fuel as well as multi-user and a technology and restriction to only one mode of transport lock-in should be avoided at all costs. The switch should be supported with appropriate technical regulations and the right taxation incentives. Binding targets for GHG and pollution across the whole transport sector

[67] The results of the CCNR studies on energy transition towards a zero-emission inland navigation sector can be found here: https://www.ccr-zkr.org/12080000-en.html
[68] Keynote given by Theresia Hacksteiner, Secretary General EBU, at the BSR Access online workshop on "Greening of Inland Navigation, Short Sea Shipping and River-Sea Shipping", summary and presentations available here: https://bit.ly/3edO9dZ

are needed to achieve a long-term shift and incentives to switch to greener fuels.[69] Power supply and fuel supply should gradually be made greener and more sustainable, decreasing the share of fossil fuels. Already underway to reach a substantial emission reduction by quick-win solutions like biofuels, the IWT sector is depending on the availability and market readiness of alternative fuels on a broad scale to cut its emissions in line with the policy aims of the Green Deal.[70]

Together with the European Federation of Inland Ports (EFIP), INE is lobbying for a stronger role of IWT in the Sustainable and Smart Transport Strategy of the Green Deal by proposing the following actions:

- The upcoming NAIADES action program should include an EU zero-emission transition pathway for IWT with binding intermediary goals to reduce its CO2 footprint by 40% in 2030, with full carbon neutrality achieved in 2050 through innovation-oriented and supporting regulation for clean fuels.
- A clear and feasible strategy should be put in place for alternative fuels infrastructure deployment. This strategy should include a corridor approach that outlines the availability of infrastructure based on demand, geography, and network characteristics. Roadmaps will be needed to break the 'chicken and egg' problem of investment between barge owners and infrastructure providers while providing clarity and transparency.
- Barriers for the carriage of alternative fuels by inland waterways should be removed and sustainable logistics of alternative fuels should be incentivized.[71]

Despite the challenges, there are already several regional initiatives to make the existing modes of transport even more sustainable. Since 2016, a German consortium has been pioneering the development of Elektra, the first hydrogen- fueled push-boat in the world. Elektra will not only enable an investigation of hydrogen's feasibility as an energy store but will also enable new charging infrastructure as well as the use of onshore electricity to be explored, as well as the creation of hydrogen for fuel cells.[72] ARKON Shipping and CMB – two European shipping companies with a focus on Short Sea trade, are greening their fleets

[69] INE: Annual Report 2019, p. 20
[70] Keynote given by Theresia Hacksteiner at the BSR Access online workshop on "Greening of Inland Navigation, Short Sea Shipping and River-Sea Shipping"
[71] Position of the European Federation of Inland Ports (EFIP) and Inland Navigation Europe (INE) on Sustainable and smart mobility strategy, URL: https://bit.ly/2P5hm2a
[72] With a total project volume of approx. €13 million, the project is being supported by the German with funding of approx. €8 million and is being supervised and coordinated the National Organization Hydrogen and Fuel Cell Technology (NOW GmbH). For more information please visit https://bit.ly/3sE2Hsz

by retrofitting their vessels with methanol or equipping them with hydrogen dual-fuel engines, respectively.[73]

Hydrogen trains have been deployed experimentally and are under further development. In 2015 the French train manufacturer Alstom and the Canadian producer of hydrogen generation, fuel cells and other similar technologies Hydrogenics established a partnership to develop a hydrogen train. In 2018, successful testing of the hydrogen fuel cell concept concluded, and two hydrogen trains entered operation along an approximately 100-kilometer regional conventional passenger train track in Lower Saxony, Germany. The plan is to expand to 14 trains by 2021.[74]

Long-distance freight transport by sustainable modes (rail/waterborne) presents particular challenges for last-mile deliveries within urban nodes. This requires stronger focus on relevant terminal infrastructure and their integration in the wider supply chain, in combination with enhanced urban logistics operations.[75] It is the basis for more efficient overall logistics chains and high-quality user services, developed in a strong partnership of all stakeholders (public and private) involved.[76]

4. Vision for a multimodal and interoperable supply chain

The transport market is very dynamic and increased competition in the market requires the companies to search for innovative solutions. This is especially true to support the supply chain and increase the level of customer services (value-added service to the customer) and differentiation possibility. The customer requirements (e.g. shipper's requirements) are

[73] CMB has an entire division (CMB.TECH) dedicated to hydrogen powered technology and infrastructure to produce and distribute the clean fuels of the future. Both companies took part in the BSR Access online workshop "Greening of Inland Navigation, Short Sea Shipping and River-Sea Shipping".
[74] International Energy Agency: The Future of Rail: Opportunities for energy and environment, p.83
[75] The City of Oslo provides a good example of implementing various infrastructure for alternative renewable fuels such as hydrogen, electricity, and biofuels. They have made significant efforts toward developing hydrogen, electricity, and biofuels (preferably biogas) as viable options for cars, vans, and trucks. Furthermore, they support supply by facilitating processes for establishing charging infrastructure, assure available land for energy stations. Focus lays in creating demand by being clear in the procurement of the City of Oslo's own services. By 2018, the City of Oslo operates 1 300 public chargers, and are installing around 1 500 additional public chargers by 2020. The City of Oslo also has a support scheme for charging infrastructure in housing companies. To ensure that targets are met, the City of Oslo's management system integrated Climate Budgets in 2017 (GREAT: GREAT Road Map: Final Report on Policy Measures, p. 23)
[76] TENTacle: Impacts of the TEN-T Core Network Corridors in BSR, p. 3

increasing – along with technological progress and complexity of supply chains in a globalized world. Although sustainability has been on the agenda for a while, its urgency was fueled by last year's publication of the European Green Deal. Regulations that require the transport sector to adhere to these new targets will present challenges as well as opportunities in logistics in the coming years.

An important factor in dealing with multimodal business models is that by combining modes of transport, another link is added to the supply chain and adding an extra link means extra cost. This extra cost can be linked to the handling cost when unloading and loading containers or pallets which requires time, manpower and the specialized handling equipment. Pre- and post-carriage on road for the first-/last mile should not be regarded as a competitive factor, but as an important connecting element to enable customers whose location is not in the immediate vicinity of a railroad line or inland waterway to connect to the rail/water network. [77] Many of the challenges in the multimodal sector today are due to the very complex and silo divided railway and waterway systems across Europe. Different standards for rail tracks and train systems create huge barriers for creating efficient and effective multimodal business models. The most feasible way of reducing costs and improving profits are for companies to create synergies and economies of scale making their supply chain as efficient as possible.[78] Further integration of waterways with other modes should not only be pursued more strongly for international and inter-regional flows, but also in urban environments where most of the negative externalities are generated. Together with sustainable urban mobility, sustainable urban logistics and proactive spatial planning is needed to allow inland ports to help supplying industries and cities as multimodal hubs and enablers of green logistics. Freight transport over short and medium distances (less than about 300 km) – which relies heavily on trucks right now – should be incorporated into multimodal supply chains. In an ideal situation, trucks running on clean fuels would only be needed for the first- and last mile. Making clean onshore power and refueling infrastructure available along waterways and railway tracks requires a network approach. Clean energy and refueling infrastructure need to be available and well accessible at berths along waterways, at major train hubs, in ports and dry port facilities. The European corridors (incl. RFCs and MoS) are the most suitable instrument to undertake coordinated planning in and between corridors using a smart mix of fixed and mobile facilities.

[77] Federal Ministry of Transport and Digital Infrastructure: Rail Freight Masterplan, p. 27
[78] Identifying the pros and cons of different business models in the multimodal transport sector has been part of the Interreg BSR project Scandria2Act. The report ""GoA Assessing Offers and Preconditions for Multimodal Freight Transport in the Scandria2Act Partner Regions"" presents different case studies, based on desktop research and in-depth semi-structured interviews with key stakeholders of different logistic companies from Hamburg, Örebro, Region Greater Copenhagen and Region Skåne

Figure 9: INE's vision for future Multimodality[79]

The future network must be equipped with fast mobile broadband coverage to sustain a smart digital infrastructure that is planned, managed, and organized by using open data. All modes of cross-border transport are paperless, and data are interoperable across transport modes on a “one record, once only” basis making railway transport and IWT easy-to-use in synchro-modal operations.

Multimodality can provide a sustainable solution in finding the right transport mix, with the additional option of integrating light rail and bus, walking and cycling. The EU COM has strongly promoted and will continue to promote the implementation of Sustainable Urban

[79] INE: Annual Report 2019, p.12f: INE and the EFIP is calling for call for the creation of a European Multimodal Area (EMA) that realizes the potential created by the Single European Railway Area, Road Transport legislation and NAIADES. Now is the time to connect them in a truly European way to make a great leap forward. The EMA should foresee the removal of legislative, administrative, cross-border and other obstacles and the creation of a multimodal expert group that should outline measures to support multimodal transport within the European economy.

Mobility Plans (SUMPs) as successful tools for sound policy coordination in the context of sustainable urban development. These plans are most effective when they integrate both passenger and freight mobility need into the broader urban and territorial development strategy. Another part of BSR Access looks at urban nodes in the BSR to identify challenges associated with their role as interface between urban transport and trans-European transport and to recommend measures to support urban nodes in developing the transport function accordingly to meet future mobility requirements.[80]

The European infrastructure policy should be considered the backbone of the common European transport policy that supports all modes of transport. As a result, the transport and infrastructure policy of the Member States should build on and reinforce the strategy developed at the European level. Only then a smooth and fully integrated European transport chain can be developed. Same applies to rail transport, inland navigation, and river-sea shipping, which can develop to their full potential if sufficient preconditions are set and implemented.

[80] Results of the responsible project partners will be available on the BSR Access website shortly. Urban nodes are a central element of the TEN-T Network. To better integrate urban nodes into CNCs, it is not only important to remove bottlenecks and missing links on TEN-T infrastructure. A stronger connection with SUMPs can contribute to improving first-/last mile connections for people and freight

ANNEX: Overview of surveyed best practices, reports & position paper

Category	Mode of transport	Titel	Author	Publishing Institution	Project	Funding programm	Year	Link
Action Plan	IWT	Masterplan Binnenschifffahrt	Federal Ministry of Transport and Digital Infrastructure	Federal Ministry of Transport and Digital Infrastructure			Mai 19	https://www.bmvi.de/SharedDocs/DE/Anlage/WS/masterplan-binnenschifffahrt-de.pdf?__blob=publicationFile
Action Plan	Rail	Rail Freight Masterplan	Pro-Rail Alliance, the Federation of German Industries (BDI), Deutsche Bahn AG, the Association of German Freight Forwarders and Logistics Operators (DSLV), the German Transport Forum (DVF), kombiverkehr, the Network of European Railways (NEE), the Research Association for Combined Transport (SGKV), the Association of Steel Producers, the German Railway Industry Association (VDB), the Association of German Transport Companies (VDV) and the Association of Freight Wagon Keepers (VPI)	Federal Ministry of Transport and Digital Infrastructure			Jun 17	https://www.bmvi.de/SharedDocs/EN/publications/rail-freight-masterplan.pdf?__blob=publicationFile
Action Plan	Rail	30 by 2030 Rail Freight strategy to boost modal shift	Rail Freight Forward	Rail Freight Forward			Jul 18	https://owln.eu/wp-content/uploads/2018

								/12/white-paper-30by2030-v7.pdf
Action Plan	Multimodal	EU COM European Green Deal	European Commission	European Commission			Dec 19	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019DC0640&from=EN
Input ongoing project	CT	Combined Transport in Europe: Scenario-based Projections of Emission Saving Potentials	Malte Jahn, Paul Schumacher, Jan Wedemeier, André Wolf	Hamburg Institute of International Economics	COMBINE	Interreg Baltic Sea Region	2020	https://www.hwwi.org/fileadmin/hwwi/Publikationen/Research/2020/HWWI_ResearchPaper_192.pdf
Input past project	Multimodal	ChemMultimodal Joint Transnational Study	Andreas Fiedler	Chem Multimodal	Chem Multimodal	Interreg Europe	Mar 18	https://www.interreg-central.eu/Content.Node/ChemMultimodal/D.T4.1.1-Joint-Transnational-Strategy.pdf
Input past project	CT	Overview of the combined transport market in the BSR	Clemens Bochynek, Johannes Michel, Eric Feyen, Mateusz Nowak	German Promotion Centre for Intermodal Transport, International Union for Road-Rail Combined Transport	COMBINE	Interreg Baltic Sea Region	Feb 20	https://www.combine-project.com/sites/default/files/content/resource/files/200228_combine_output_2.1_overview_of_the_ct_market_in_the_baltic_sea_region.pdf
Input past project	IWT	Strengthening Inland Navigation and River-Sea-Shipping in Europe and the Baltic Sea Region	Port of Hamburg Marketing Reg. Assoc.	Port of Hamburg Marketing Reg. Assoc.	EMMA	Interreg Baltic Sea Region	2018	https://projects.interreg-baltic.eu/projects/emma-20.html#output-67
Input past project	IWT	IWT Bottlenecks and Potentials in the BSR	Marcus Engler	Institute of Shipping Economics and Logistics/Port of	EMMA	Interreg Baltic Sea Region	Feb 19	http://www.project-emma.eu/sites/default/files/EMMA%20A2.1

				Hamburg Marketing Reg. Assoc.				%20Final%20Report_0.pdf
Input past project	IWT	Competiveness improvement plan - enhancing inland waterway transport	Institute of Shipping Economics and Logistics	Institute of Shipping Economics and Logistics/Port of Hamburg Marketing Reg. Assoc.	EMMA	Interreg Baltic Sea Region	2019	https://projects.interreg-baltic.eu/projects/emma-20.html#output-66
Input past project	IWT	Cost Benefit Analysis IWW Saimaa Socio-Economic Cost Related to Different Transport Scenarios	M4traffic AB	Port of Hamburg Marketing Reg. Assoc.	EMMA	Interreg Baltic Sea Region	2018	https://www.pohjois-karjala.fi/documents/33565/34589/CBA%20Saimaa%20Report%20EMMA.pdf/a4bd2fc7-7298-137a-be49-b6446e9a9586
Input past project	IWT	Business Plan - New inland navigation service in Sweden	AVATAR Logistics/Johan Lantz	Port of Hamburg Marketing Reg. Assoc.	EMMA	Interreg Baltic Sea Region	2018	https://www.project-emma.eu/content/43-business-plan-new-iwt-service-sweden
Input past project	IWT	Technical Improvements for increasing traffic	Matti Utriainen	Lahti Region Development/Ramboll FI	EMMA	Interreg Baltic Sea Region	Oct 18	https://www.project-emma.eu/sites/default/files/EMMA_A2-2%20Techical_Improvements_to_Increase_Traffic_Finland.pdf
Input past project	Multimodal	FinEst-Link Feasibility Study	FinEst link PPs	Helsinki-Uusimaa Regional Council	FinEst Link	Interreg Central Baltic		http://www.finestlink.fi/wp-content/uploads/2018/02/FinEst-link-REPORT-FINAL-7.2.2018.pdf
Input past project	Multimodal	FinEst-Link Feasibility Study – SEA report	FinEst Link PPs	Helsinki-Uusimaa Regional Council	FinEst Link	Interreg Central Baltic		http://finestlink.niili.net/wp-content/uploads/2015/12/pre-feasibility-study.pdf

Input past project	Multimodal	Annex 3 Finest-Link Cargo Volume Estimation	FinEst Link WP2	Helsinki-Uusimaa Regional Council	FinEst Link	Interreg Central Baltic		http://www.finestlink.fi/wp-content/uploads/2018/04/Annex-3_Finest-Link_Cargo-Volume-Estimation.pdf
Input past project	Multimodal	Annex 1 FinEst-Link Scenario-0	FinEst Link WP3	Helsinki-Uusimaa Regional Council	FinEst Link	Interreg Central Baltic		http://www.finestlink.fi/wp-content/uploads/2018/04/Annex-1_FinEst-Link_Scenario-0.pdf
Input past project	Decarbonisation	Great Road Map Final Report on Policy Measures	Region Skane, The Capital Region of Denmark	Region Skane, The Capital Region of Denmark	GREAT Project	Connecting Europe	Dec 18	https://great-region.org/wp-content/uploads/2019/03/GREAT_Activity5_Final_study_report_on_policy_measures_Milestone13.pdf
Input past project	Decarbonisation	Business Models Final Report from the Action GREAT	Region Skane, E.ON, FordonsGas, Ramböll	Region Skane	GREAT Project	Connecting Europe	Feb 19	https://great-region.org/wp-content/uploads/2019/03/GREAT_report_BusinessModels_2019.pdf
Input past project	Multimodal	Intermodal Nodal Points enhancements requirements for better Interconnectivity (Summarized in the linked document)	ILiM	Helsinki-Uusimaa Regional Council	NSB CoRe	Interreg Baltic Sea Region	Feb 19	https://www.uudenmaanliitto.fi/files/24664/NSB_CoRe_2.4_Policy_Paper_on_Interconnectivity_and_Interoperability.pdf
Input past project	Multimodal	Recommendations and Action Plan for Intermodal Nodal Point development	Johannes Betz	Port of Hamburg Marketing Reg. Assoc.	NSB CoRe	Interreg Baltic Sea Region	Feb 19	https://www.uudenmaanliitto.fi/files/24661/NSB_CoRe_2.2.5._Recommendations_and_Action_Plan_for_Intermodal_Nodal_Points.pdf

Input past project	Multimodal	Infrastructure Requirements Analysis (Summarized in the linked document)	Johannes Betz	Port of Hamburg Marketing Reg. Assoc.	NSB CoRe	Interreg Baltic Sea Region	Dec 18	https://www.uudenmaanliitto.fi/files/24661/NSB_CoRe_2.2.5._Recommendations_and_Action_Plan_for_Intermodal_Nodal_Points.pdf
Input past project	Multimodal	Recommendations for information system developers	Johannes Betz	Port of Hamburg Marketing Reg. Assoc.	NSB CoRe	Interreg Baltic Sea Region	Feb 19	https://www.uudenmaanliitto.fi/files/24662/NSB_CoRe_2.3._Recommendations_for_information_system_developers.pdf
Input past project	Multimodal	Logistics requirement of shippers and their commitment for intermodal supply chains on NSB Corridor	Sybille Rehse, Steffen Schlächter	Investor Center Ostbrandenburg GmbH	NSB CoRe	Interreg Baltic Sea Region	Feb 18	https://www.uudenmaanliitto.fi/files/24656/NSB_CoRe_2.1._Consolidation_Report.pdf
Input past project	Decarbonisation	E-mobility in city logistics - Technical Support Document	Philip Michalk, TH Wildau	TH Wildau and Skåne Association of Local Authorities	Scandria2Act	Interreg Baltic Sea Region	Oct 18	https://www.scandria-corridor.eu/index.php/de/e-mobility/category/42-results-clean-fuel-deployment?download=232:e-logistics
Input past project	Decarbonisation	Scandria Clean Fuel Deployment Strategy - Summary	German Energy Agency (dena)	German Energy Agency (dena)	Scandria2Act	Interreg Baltic Sea Region	Nov 18	https://www.scandria-corridor.eu/index.php/de/component/phocadownload/category/42-results-clean-fuel-deployment?download=273:scandria-2act-clean-fuel-deployment-strategy-summary

Input past project	Decarbonisation	Scandria Clean Fuel Deployment Strategy	German Energy Agency (dena)	German Energy Agency (dena)	Scandria2Act	Interreg Baltic Sea Region	Dec 18	https://www.scandria-corridor.eu/index.php/de/cfds/category/42-results-clean-fuel-deployment?download=262:cfds
Input past project	Multimodal	Multimodal Business Models	Luise Noring, Julie Jo Nygaard	Copenhagen Business School	Scandria2Act	Interreg Baltic Sea Region	Mar 18	https://www.scandria-corridor.eu/index.php/de/component/phocadownload/category/43-results-multimodal-transport?download=254:scandria2act-o3-2-multimodal-business-models
Input past project	Decarbonisation	Assessment of Clean Fuel Deployment and Market Access of Clean Fuels in the Northern Scandria®Corridor	Jan Carsten Gjerløw, Anna Cornander	Akershus County Council (ACC), Research Institutes of Sweden (RISE)	Scandria2Act	Interreg Baltic Sea Region	Apr 17	https://www.scandria-corridor.eu/index.php/de/component/phocadownload/category/42-results-clean-fuel-deployment?download=193:assessment-of-clean-fuel-deployment
Input past project	Multimodal	Existing multimodal freight offers in the Scandria®2Act partner regions	Lovisa Uhlin	Region Örebro county	Scandria2Act	Interreg Baltic Sea Region	Apr 17	https://www.scandria-corridor.eu/index.php/de/component/phocadownload/category/43-results-multimodal-transport?download=253:o3-2-multimodalfreightoffers
Input past project	Multimodal	Analysis of Potential Development for Strategic Freight Hubs	Helena Kyster-Hansen, MOE | Tetraplan	Region Skane	Scandria2Act	Interreg Baltic Sea Region	Sep 17	https://www.scandria-corridor.eu/index.php/de/component/phocadownload/category/43-results-multimodal-

								transport?download=252:o3-1-hubsskane
Input past project	Multimodal	Assessing offers and preconditions for multimodal freight transport in the Scandria®2Act partner regions	George Panagakos, Lovisa Uhlin, Tomi Solakivi, Thalis Zis, Harilaos N. Psaraftis, Luise Noring and Julie Jo Nygaard	Technical University of Denmark, Region Örebro County, University of Turku, Copenhagen Business School	Scandria2Act	Interreg Baltic Sea Region	Feb 19	https://www.scandria-corridor.eu/index.php/de/component/phocadownload/category/43-results-multimodal-transport?download=253:o3-2-multimodalfreightoffers
Input past project	Multimodal	Survey of road freight through RoRo-ports	Patrik Benrick, PLväu and Lina Wells, PLsyu	Trafikverket	Scandria2Act	Interreg Baltic Sea Region	Jun 18	https://www.scandria-corridor.eu/index.php/en/component/phocadownload/category/43-results-multimodal-transport?download=257:freight-flow-analysis-from-ports-and-hubs-in-southern-western-sweden-summary
Input past project	Decarbonisation	Cooperation between public and private partners in investment of clean fuel infrastructure	Anna Clark, Alexander Börefelt, Sebastian Fält (Trivector Traffic), Ola Mattisson (FEH, Lund University)	Region Skåne and Skåne Association of Local Authorities	Scandria2Act	Interreg Baltic Sea Region	Oct 18	https://www.scandria-corridor.eu/index.php/en/ppp/category/42-results-clean-fuel-deployment?download=233:clean-fuel-ppp
Input past project	Multimodal	Multimodal Corridor System Report	Lisa Hartmann, TH Wildau; Philip Michalk, TH Wildau	TH Wildau	Scandria2Act	Interreg Baltic Sea Region	Mar 19	https://www.scandria-corridor.eu/index.php/de/component/phocadownload/category/43-results-multimodal-transport?download=326:mcsr

Input past project	CT	Strengthening Örebro as an entry / exit hub to the northern Baltic Sea Region corridor	Anna Clark, Trivector Traffic	Region Örebro County	TENTacle	Interreg Baltic Sea Region	Sep 18	http://www.tentacle.eu/a/uploads/dokument/Report_on_freight_train_solution_TENTacle_final_1.0.pdf
Input past project	Multimodal	Baltic-Adriatic Corridor Freight Transport Logistics Action Plan	Michał Wolański, Wiktor Mrozowski, Mateusz Pieróg	Westpomeranian Region, Region Skåne	TENTacle	Interreg Baltic Sea Region	Jul 18	http://tentacle.eu/a/uploads/dokument/Baltic-Adriatic_Corridor_Freight_Transport_Logistics_Action_Plan_final.pdf
Input past project	Multimodal	Guidance Paper on how to use the Fehmarnbelt Fixed Link as impulse for regional growth	Inga Gurries, Sönke Maatsch, Mario Lembke, Frede Danborg	HHM, Rostock Port, ISL, Guldborgsund Municipalty	TENTacle	Interreg Baltic Sea Region	Oct 18	https://projects.interreg-baltic.eu/fileadmin/user_upload/Library/Outputs/TENTacle_Guidance_Paper_Fehmarnbelt_Fixed_Link.pdf
Input past project	Multimodal	Think Tank: Impacts of the TEN-T Core Network Corridors in BSR	Przemyslaw Myszka, Björn Hasslgren	Baltic Press Ltd ul., Trafikverket	TENTacle	Interreg Baltic Sea Region	Jan 18	http://tentacle.eu/a/uploads/dokument/Think_tank_Impacts__of_the_TEN_T.pdf
Input past project	Multimodal	Realising benefits from the TEN-T Core Network Corridors - how, where and by whom?	Maria Öberg, Luleå University of Technology + TENTacle PPs	TENTacle	TENTacle	Interreg Baltic Sea Region	Apr 18	https://projects.interreg-baltic.eu/fileadmin/user_upload/Library/Outputs/TENTacle_report_final.pdf
Input past project	Multimodal	Preparing the transport industry for the Fehmarnbelt Fixed Link	Inga Gurries	Port of Hamburg Marketing Reg. Assoc.	TENTacle	Interreg Baltic Sea Region	2018	http://www.tentacle.eu/a/uploads/dokument/TENTacle_Fehmarnbelt_Pilot_Case_brochure.pdf
Input past project	Multimodal	Traffic Strategy for the E12 Region 2018-2040	Jerker Sjögren (Jesjo Konsult HB), Karin Edenius (Sweco Management AB)	E12 Atlantica Transport		Interreg Botnia-Atlantica	Mar 18	

Position Paper	Multimodal	Position Paper_Platform for multimodality and logistics in inland ports_Short Paper	Platform for multimodality and logistics in inland ports	European Commission Mobility and Transport			Jul 15	https://ec.europa.eu/transport/sites/transport/files/modes/inland/doc/2015-07-logistics-inland-ports-platform-short-position-paper.pdf
Position Paper	Decarbonisation	Position paper on Clean Fuel Deployment in the BSR	Kia Madsen, Jerker Sjögren	Capital Region of Denmark	BSR Access	Interreg Baltic Sea Region	Jan 21	https://www.uudenmaanliitto.fi/files/25518/Clean_fuel_deployment_in_the_BSR_Position_paper.pdf
Special report	Multimodal	EU transport infrastructures: more speed needed in megaproject implementation to deliver network effects on time	Luc T'Joen, Thomas Obermayr, Guido Fara, Emmanuel Rauch, Katarzyna Solarek, Erki Must, Manja Ernst, Milan Smid,Richard Moore, Sabine Maur-Helmes, Oskar Herics Andras Feher	European Court of Auditors			2020	https://www.eca.europa.eu/Lists/ECADocuments/SR20_10/SR_Transport_Flagship_Infrastructures_EN.pdf
Strategy Paper	Decarbonisation	Communication from the Comission to European Parliament, the Council, the Euorpean Economics and Social Committee and the Committee of the Regions	European Comission	European Comission			2020	https://op.europa.eu/en/publication-detail/-/publication/ac9cd214-53c6-11ea-aece-01aa75ed71a1/language-en
Strategy Paper	Decarbonisation	Sustainable and smart mobility strategy	Turi Fiorito, Karin De Schepper	European Federation of Inland Ports, Inland Navigation Europe			2020	https://www.inlandports.eu/media/EFIP-INE%20Mobility%20statement_1.pdf

Study	CT	Gathering additional data on EU combined transport	TRT Trasporti e Territorio	European Commission			Feb 17	https://op.europa.eu/en/publication-detail/-/publication/e58e6253-fc01-11e7-b8f5-01aa75ed71a1
Study	CT	UIRR Report - European Road-rail combined transport 2018-2019	International Union for Road-Rail Combined Transport	International Union for Road-Rail Combined Transport			2019	http://www.uirr.com/en/media-centre/annual-reports/annual-reports/mediacentre/1188-uirr-annual-report-2018-19.html
Study	CT	Kombinierter Verkehr Berichtsjahr 2017	German Promotion Centre for Intermodal Transport	German Promotion Centre for Intermodal Transport			27.03. 2019	https://sgkv.de/wp-content/uploads/2020/04/SGKV_Zahlen_und_Fakten_2018.pdf
Study	Multimodal	Position Paper - Platform for multimodality and logistics in inland ports	Platform for multimodality and logistics in inland ports	European Commission Mobility and Transport			Jul 15	https://ec.europa.eu/transport/sites/transport/files/modes/inland/doc/2015-07-logistics-inland-ports-platform-long-position-paper.pdf
Study	IWT	Digital Inland Waterway Area - Towards a Digital Inland Waterway Area and Digital Multimodal Nodes	Ir. L.M. Punter (TNO), Dr. Ir. W.J. Hofman (TNO)	European Commission Mobility and Transport			Oct 17	https://ec.europa.eu/transport/sites/transport/files/studies/2017-10-dina.pdf
Study	IWT	Market Insight Inland Navigation in Europe	Central Commission for the Navigation of the Rhine	Central Commission for the Navigation of the Rhine			Apr 20	https://inland-navigation-market.org/wp-content/uploads/2020/09/CCNR_annual_report_EN_2020_BD.pdf
Study	IWT	EBU annual Report 2018-2019	European Broadcasting Union	European Broadcasting Union			Jun 19	https://www.ebu.ch/files/live/sites/ebu/files/codes/annual-

								report_2018-2019/index.htm
Study	CT	2018 Report on combined Transport in Europe	International union of railways, Railway Technical Publications	International union of railways, Railway Technical Publications			Jan 19	https://uic.org/IMG/pdf/2018_report_on_combined_transport_in_europe.pdf
Study	Multimodal	Research for TRAN Committee - Modal shift in European transport	TRT Trasporti e Territorio	TRAN committee Policy Department for Structural and Cohesion Policies			Nov 18	https://www.europarl.europa.eu/RegData/etudes/STUD/2018/629182/IPOL_STU(2018)629182_EN.pdf
Study	Rail	ERTMS business case on the 9 core network corridors – Second Release	INECO, Ernst & Young	European Commission			Jun 19	https://op.europa.eu/en/publication-detail/-/publication/a5c88a67-994f-11e9-9d01-01aa75ed71a1
Study	Rail	The Future of Rail Opportunities for energy and the environment	International Energy Agency (IEA), International union of railways	International Energy Agency (IEA), International union of railways			Jan 19	https://webstore.iea.org/the-future-of-rail
Study	Multimodal	Accessibility of the Baltic Sea Region Past and future dynamics	Tomasz Komornicki, Klaus Spiekermann	Vision & Strategies around the Baltic Sea			Nov 18	https://vasab.org/wp-content/uploads/2019/07/VASAB_Accessibilty_Report_2018.pdf
Study	Multimodal	The impact of Ten-T completion on growth, jobs and the environment	Francesca Fermi, Luca Bellodi, Angelo Martino, Silvia Maffii, Stefanie Schäfer	European Commission Mobility and Transport			2019	https://ec.europa.eu/transport/sites/transport/files/studies/ten-t-growth-and-jobs-synthesis.pdf
TEN-T	Multimodal	TEN-T Corridors: Forerunners of a forward-looking European Transport System_Issues Papers of European Coordinators	Péter Balázs, Pat Cox, Catherine Trautmann, Paweł Wojciechowski, Laurens-Jan Brinkhorst, Mathieu Grosch, Karla Peijs	European Commission – Directorate General for Mobility and Transport			2016	https://www.europarl.europa.eu/cmsdata/116220/tent-issues-papers.pdf

TEN-T		Scandinavian Mediterranean: Third Work Plan of the European Coordinator Pat Cox	Pat Cox	European Commission			Apr 18	https://ec.europa.eu/transport/sites/transport/files/180322_work_plan_wpiii_finalweb_0.pdf
TEN-T	Multimodal	Baltic Adriatic: Third Work Plan of the European Coordinator	Kurt Bodewig	European Commission			Apr 18	https://ec.europa.eu/transport/sites/transport/files/3rd_bac_work_plan_-_final_webversion.pdf
TEN-T	Multimodal	North Sea Baltic: Third Work Plan of the European Coordinator	Catherine Trautmann	European Commission			Apr 18	https://ec.europa.eu/transport/sites/transport/files/3rd_nsb_wp_28032018web_june2018.pdf
Thematic Report	IWT	Thematic Report. River-Sea Transport in Europe	Norbert Kriedel, Laure Roux, Lucie Fahrner, Sarah Meissner	Central Commission for the Navigation of the Rhine			Jan 20	https://www.ccr-zkr.org/files/documents/om/om19_IV_en.pdf