European Commission

MOTORWAYS OF THE SEA

DETAILED IMPLEMENTATION PLAN

BASED ON THREE KEY PILLARS

Environment ✓

The integration of maritime transport in the logistics chain ✓

Safety, human element and traffic management ✓

Connecting Europe Facility

Investing in Europe's growth

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CONNECTING EUROPE

Mobility and Transport

Foreword

I am proud to present the Detailed Implementation Plan for Motorways of the Sea.

It is my first work programme outlining the vision for future of Motorways of the Sea (MoS) concept as part of the maritime dimension of the Trans-European Transport Network.

Maritime transport contributes to international trade. Improving transport connectivity within the EU and with the neighbouring countries is a major EU transport policy goal, and removal of cross-border bottlenecks and missing links is a main priority in that context.

Motorways of the Sea aim at green, viable and efficient sea-based transport links that are well integrated in the entire EU transport chain and exploit the huge potential of maritime transport as the backbone of international trade. The policy is supported by the Connecting Europe Facility (CEF), a dedicated tool for infrastructure financing. The European Fund for Strategic Investments can also provide significant support.

Motorways of the Sea have evolved over time. Nevertheless, its core consists of short-sea routes, investments in ports, associated maritime infrastructure, equipment, facilities as well as introduction of simplified administrative formalities enabling short sea shipping between at least two maritime ports, including hinterland connections.

My Detailed Implementation Plan is built within the three development pillars that I consider as key priorities for shipping and ports and integral part of my work plan:

- Environment (maritime green solutions)
- Integration of maritime transport in the logistics chain
- Safety, Human Element and Traffic Management.

My ultimate objective is to create a European Maritime Transport Space without Barriers, connect Core Network Corridors by integrating the maritime leg and facilitate maritime freight transport within the EU's Internal Market with neighbouring as well as third countries.

Motorways of the Sea should lead to the increase of cargo flows to be carried by maritime traffic, development of efficient ports and better port hinterland infrastructure as well as connectivity. All this with the aim to facilitate a smooth traffic flow in Europe, as well as to contribute decisively to the decarbonisation of transport.

The Detailed Implementation Plan will constitute a comprehensive work programme for the Motorways of the Sea, providing an integrated approach with the other work plans for the nine strategic Core Corridor Networks.

This document is only the beginning, accordingly I would like to invite Members of the European Parliament, Member States as well as industry stakeholders to further contribute to this document. Once consultation with the European Parliament and Member States has taken place, the Detailed Implementation Plan will constitute a clear and precise guidance for the future orientation of the MoS policy. It is my intention to come up with an updated version in June 2017.

Motorways of the Sea have the ambition to re-balance the EU transport system.

I invite all readers to work together with the European Commission towards a Motorways of the Sea program that effectively contribute to a more competitive and sustainable transport system.

Brian Simpson OBE
The European Coordinator for Motorways of the Sea.

Methodology

This report represents the opinion of the European Coordinator and does not prejudice the official position of the European Commission.

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LIST OF ABBREVIATIONS

AIS	Automatic Identification System
ATD	Actual Time of Departure
CAPEX	Capital Expenditure
CCTV	Closed-circuit Television
CDM	Collaborative Decision Making
CEF	Connection Europe Facility
CNC	Core Network Corridors
COP	Conference of the Parties
CPMR	Conference of Peripheral Maritime Regions
DIP	Detailed Implementation Plan
DTLF	Digital Transport Logistics Forum
EC	European Commission
ECSA	European Community Shipowners' Association
ECA	Emission Control Area
ECMOS	European Coordinator for Motorways of the Sea
EEDI	Energy Efficiency Design Index
EFSI	European Fund for Strategic Investment
EIB	European Investment Bank
EMSA	European Maritime Safety Agency
ESP	Europa Ship Plan
ESSF	European Sustainable Shipping Forum
EU	European Union
ETD	Estimated Time of Departure
EV	Europa Venture
GRT	Gross Register Tonnage
ICT	Information and Communication Technology
IGC Code	International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
IGF Code	International Code of Safety for Ships using Gases or Other Low Flashpoint Fuels
INEA	Innovation and Networks Executive Agency (European Commission)
IMF	International Monetary Fund
IMO	International Maritime Organization
IMP	Integrated Maritime Policy
ISL	Institute of Shipping Economics and Logistics
ISPS Code	International Ship and Port Facility Security Code
ITS	Intelligent Transport Systems
JIP	Joint Industry Project
LGTT	Loan Guarantee Instrument for Trans-European Transport

LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LSFO	Low Sulphur Fuel Oil
MARPOL Convention	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee (IMO)
MGO	Marine Gas Oil
MoS	Motorways of the Sea
MPA	Marine Protected Area
MSC	Maritime Safety Committee (IMO)
MSP	Maritime Spatial Planning
NSR	Nordic Sea Route
NSW	National Single Window
OECD	Organisation for Economic Cooperation and Development
OPEX	Operational Expenditure
PCS	Port Community System
R&D	Research and Development
RIS	River Information System
Ro-Ro	Roll-on/ Roll-off
RTMS	Rail Traffic Management Systems
SCR	Selective Catalytic Reduction
SECA	Sulphur Emission Control Area
SEEMP	Ship Energy Efficiency Management Plan
SOx	Sulphur emissions
SSS	Short Sea Shipping
STCW	Standards of Training, Certification, and Watchkeeping
STM	Sea Traffic Management
TEN-T	Trans-European Transport Network
TEU	Twenty Feet Equivalent Unit
TSS	Traffic Separation Scheme
TTIP	Transatlantic Trade and Investment Partnership
UCC	Union Customs Code
UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development
VHF	Very High Frequency
VTS	Vessel Traffic Service
VTMS	Vessel Traffic Management Systems
ZVT	Zero Vision Tool

I. Executive Summary

1- Introduction

There is no doubt over the importance of shipping as the backbone supporting world trade. In Europe, the shipping sector holds 40% of global shipping and European ships trade on all oceans, serving many markets all over the world. In addition, shipping is a central part of the intra-European transport system with ports, ferries, barges and various other operators moving goods and people by sea. Sea transport leads to decongestion on land-based networks, eases pressure on logistics chains and provides clear environmental and climate benefits. With its geography, Europe also has the advantage that its seas span the Arctic winter areas as well as the warmer climate areas which leads to an unparalleled experience with shipping operations in different conditions. Continuing to build on Europe's maritime dimension will strengthen the EU's global competitiveness, increase the number of job opportunities and promote leadership and international excellence in maritime R&D.

The concept of The Motorways of the Sea (MoS) is legally described in Article 21 of the TEN-T Regulation 1315/2013, where it is stated that MoS, inter alia:

> *(1) …shall contribute towards the achievement of a European maritime transport space without barriers. They shall consist of short-sea routes, ports, associated maritime infrastructure and equipment, and facilities as well as simplified administrative formalities enabling short-sea shipping or sea-river services to operate between at least two ports, including hinterland connections*
> […]
> *(3) Projects of common interest* […] *may also include activities that have wider benefits and are not linked to specific ports, such as services and actions to support the mobility of persons and goods, activities for improving environmental performance* […] *and*
> *(4) Within two years after being designated in accordance with Article 45, the European Coordinator for motorways of the sea shall present a detailed implementation plan for the motorways of the sea based on experiences and developments relating to Union maritime transport as well as the forecast traffic on the motorways of the sea.*

The delivery of the MoS Coordinator's Detailed Implementation Plan fulfills the obligation set out in the TEN-T Regulation and presents concrete recommendations for development priorities under the MoS programme.

The Detailed Implementation Plan (DIP) has been built around three thematic pillars that were identified by MoS Coordinator Brian Simpson in his 2015 Work Programme. These are:

- the Environment,
- the Integration of maritime transport in the global logistics chain,
- Safety, Traffic Management and the Human Element.

The DIP methodology is based on:

1) An analysis of MoS Data (overview of shipping operations, MoS qualitative assessment, MoS maps and traffic data), and
2) An analysis of MoS Content (the development of priorities based on identified gaps, Member State and industry needs according to the above three pillars.

The first element relies on a large-scale data collection on the status of the Motorways of the Sea today. The focus is on data that is available in a reliable and comparable format as only such data allows for meaningful conclusions to be drawn on the status quo of the MoS. The data collected concerns maritime links (e.g. characteristics of the ships used on regular services) and ports (cargo volumes by type, infrastructure, maritime and hinterland connections). Once the level of adequacy is determined by comparing the status quo with the established objective, the data analysis could support the identification of those areas that can serve as horizontal priorities for the Detailed Implementation Plan. It is the objective of the DIP to identify areas where there is still a large potential for improvement.

The second element, based on existing information generated over several years, led to a full array of development priorities, along the lines of the three pillars. The knowledge generated by the 80 existing MoS projects, representing no less than €2.5 billion of investments, combined with the institutional and professional stakeholders' know-how led to a clear vision of development priorities for MoS, which have received many additional, valuable contributions as well as validation from a large number of stakeholders (more than 300 stakeholders have been invited to contribute).

To gather stakeholders input for the DIP, three Fora were organized in Brussels along the following key priorities: Pillar 1: Environment (March 15, 2016)[1], Pillar 2: Logistics

[1] http://www.onthemosway.eu/the-first-mos-forum-on-environment-in-brussels-video-agenda/

Integration of Maritime Transport in the Global Logistics Chain (May 17, 2016)[2], Pillar 3: Safety, Traffic Management, and the Human Element (May 18, 2016)[3]. The stakeholder consultation has thus reached far and wide to gather the thoughts and contributions of the industry's and Member States' best experts.

The DIP hereby presents all these data and content, and concludes with clear development priorities. Furthermore, the reader will find in the DIP a number of annexes, including the full set of MoS data and maps, a dedicated section on the three MoS Fora and projects co-financed through MoS over the last five years.

This is Europe's maritime space!

More than 800 regular ro-ro and container services are the heartbeat of European maritime transport. They call in more than 400 different EU ports and connect them with hundreds of ports worldwide. They comprise a large variety of different links from short-distance ro-ro ferries crossing straits to round-the-world container liner services between the Far East, Europe and the Americas. (The map illustrates the extent of Europe's maritime dimension. It shows all the major European sea routes and their connection with intercontinental trades, based on AIS data. (Source: ISL).

In 2014, ports in the EU-28 handled 3.8 billion tonnes of cargo. According to estimates, around three billion tonnes are hinterland traffic, i.e. traffic that needs pre-/post-carriage by truck, rail or barge. Hence, the connections of terminals and ports with the hinterland infrastructure are vital for the success of maritime transport. The 79 maritime ports situated on the core network corridors (CNCs) of the TEN-T accounted for two thirds of the total European port traffic, i.e. 2.5 billion tonnes in 2014. Here, the ports of the Hamburg-Le Havre range– are situated in an area where five CNCs intersect – account for 1.1 billion tonnes, alone.

[2] http://www.onthemosway.eu/the-second-mos-forum-on-logistic-agenda-and-presentations/
[3] http://www.onthemosway.eu/the-second-mos-forum-on-safety-and-human-element-agenda-and-presentations/

Despite the importance of maritime transport in Europe, the TEN-T Core Network Corridors contain only very few maritime links. The corridors are conceived as land-based corridors that start or end in ports however given the mix of needs in European ports, it is inconceivable to develop a one-size-fits-all approach for the Detailed Implementation Plan.

2- The three pillars of MoS and Development Priorities

1. Environment (Pillar 1)

The environment is a key area of development for MoS. The introduction of stricter emissions standards in general, and of the Sulphur emission control areas (SECA) in particular, produced an immediate need for new ship technologies, operational processes, new infrastructure, and new tools for financing environmental upgrades in the period from 2010 onwards.
There are also other drivers in addition, such as new environmental and regulatory developments relevant for European maritime transport. They impact especially short sea shipping routes at regional level, e.g:

- new NOx emission control areas expected in the Baltic Sea and the North Sea from 2021;
- the total ban on untreated sewage discharge from passenger ships in the Baltic Sea from June 2019,
- the Ballast Water Management Convention which will enter into force in September 2017.

The global climate agreement reached at the UN climate change conference COP 21 in Paris last December ("the Paris Agreement") is seen as an historic and landmark instrument in climate action. Though formally lacking wording on international maritime transport, many expected the maritime sector to play its part. Therefore, climate remains high on the MoS agenda. Various other processes are driving environmental standards, such as air quality, operational pollution, and accidental pollution, integrated use of marine resources, environmental compensation measures and financing mechanisms for green shipping.

In total there have been 20 projects financed under the TEN-T that related to the environment in the period from 2010-2013. These have generated just over EUR 655 million of investments of which the EU has contributed EUR 174.9 million. In addition to these, the number of environment/sustainable shipping projects financed under CEF so far has been 21, adding an investment of EUR 468.5 million of which the EU total contribution has been EUR 173.2 million. These projects were mainly LNG or scrubber-related reflecting the ECA-compliance preparations in the Baltic and North Sea/English Channel areas, extending the project networks across Europe and the Mediterranean as knowledge and know-how grew. Other projects however, included areas such as alternative fuels (methanol), electric vessels, on-shore power supply, waste water reception facilities, and SECA compliance monitoring.

The First MoS Forum organized on 15th March, gathered the industry's best experts to share their experiences, either on MoS flagship environmental projects, or from their areas of operation in general. The recommendations given in the Detailed Implementation Plan reflect what the industry and Member States see as development priorities on Climate, Air emissions, Operational and Accidental Pollution, on the Integrated use of marine resources, Environmental compensation measures and Financing tools for green shipping. Below are some examples of environment related development priorities (the full list is available in the DIP):

- Continue the current evolution of hybrids and battery use
- Further the development of LNG and methanol use including lowering LNG storage and logistic costs.
- Continue to encourage the uptake of cold ironing technologies
- Support new financial instruments through risk reduction mechanisms
- Support further new alternative and innovative solutions.

2. Logistics and Integration of Maritime in the Global Logistics Chain (Pillar 2)

The quest for ever-increasing efficiency in shipping and port operations is driven by the need to improve competitiveness of EU industries. Transport is a derived demand and hence for the transport sector to serve trade, transport costs must be kept at a minimum. Maximising efficiency on seaside and in ports is important to reduce transport costs and contribute to the competitiveness of EU traded goods and of related EU industrial sectors.

MoS is the maritime dimension of the EU but it is also the means for connecting the ports and their hinterlands and as such, it is the only priority project covering the entire EU economic and transport space. Issues such as last-mile connections, connectivity of the regions with particular and special characteristics, including the nine outermost regions and islands, are important considerations in a very complex connectivity network.

Improving last-mile connections by rail and inland waterways is essential for MoS to become integrated in the door-to-door logistics chain. This involves not only constructing physical infrastructure to connect ports via rail and with barge terminals to their hinterlands but also improving info-structure (and the related ICT solutions/platforms) to connect the different modes of transport present at a port.

MoS is also the way to connect short-sea links and maritime transport services with the Core Network Corridors (CNCs) and MoS links are the junctions allowing the connection of different CNCs. This concept is clearly presented in a map in the Detailed Implementation Plan showing Europe's most favourable logistics locations, the European SSS routes and the 9 Core Network Corridors.

Lastly, efficient cargo clearance procedures are highly relevant for the competitiveness of short-sea services. In addition to contributing to a European space without borders, initiatives now also need to consider port security including cyber-security.

In total there have been 21 projects financed under TEN-T that related to the integration of the maritime transport in the logistics chains in the period from 2008-2013. These have generated just over EUR 759.6 million of investments of which the EU has contributed EUR 167.3 million in the TEN-T. A total investment of EUR 163.7 million of which the EU total contribution has been EUR 55.7 million in the CEF.

With the background gained through existing MoS projects, plus the Second MoS Forum and the Issue Paper, recommendations made for the development priorities on Logistics and Integration of Maritime in the Global Logistics Chain (Pillar 2) contain the following as examples (the full list is available in the DIP):

- Further develop flow management services to support onshore organisations and ships in optimising overall traffic flow
- Develop a unique single window for trade and transport comprising all modes
- Further harmonise relevant administrative procedures
- Encourage better connections between MoS and short-sea shipping with blue growth and maritime spatial planning
- Strengthen EU territorial cohesion by improving the connection of ports with hinterland, improve adequacy of ports infrastructure and link better peripheral and outermost regions to the rest of the EU and to the world.

3. Safety, Traffic Management and Human Element (Pillar 3)

The EU generally has an excellent record as regards maritime safety and traffic management. The IMO and EU legislation implemented in the last decade have ensured a high level of safety for freight, crew and passenger transport. Symptomatically, safety, traffic management and human element have not featured heavily on the MoS agenda to date. Indeed, one would find a comparatively higher number of projects related to the environment and logistics, than projects specifically related to safety, traffic management or human element.

Nevertheless, in total there have been 6 projects so far financed under TEN-T and CEF. The projects generated a total investment of over EUR 131.7 million, of which the EU has contributed over EUR 60.8 million. While the analysis covers the projects identified by INEA as belonging to Pillar 3, it is important to note that many other environmental and logistics projects that belong to Pillar 1 and 2 also included activities contributing to the enhancement of maritime safety and the further development of traffic management and the human element.

When it comes to the Human Element, two projects were funded under TEN-T and CEF, for a total investment of more than EUR 8.1 million. The EU contributed approximately EUR 4 million in total. These projects aimed at developing adequate training schemes for smooth and efficient freight transport by sea, i.a. by establishing the content of a modular MSc/Post Graduate Diploma/Certificate/Continuing professional development (CPD) programme and by starting the accreditation process.

Development priorities for Safety, Traffic Management and the Human Element (Pillar 3) contain the following as examples (the full list is available in the DIP):

- Safe handling and storage of alternative fuels
- R&D for simplification of ship designs and autonomous ship
- Migration: search and rescue, preparedness, management
- LNG safety guidelines, safe storage and handling of alternative fuels
- Further development of ICT, route planning
- Information sharing platforms to efficiently use and analyse big data in sea traffic management
- Support better training (for soft skills, digital skills, new technologies, LNG safety, security and cybersecurity

Motorways of the Sea constitute a fundamental contribution to the TEN-T network bringing the right complementarity required to the development of core network corridors.

The Detailed Implementation Plan proposes the further development of MoS built around three priority pillars following numerous recommendations from institutional and industrial stakeholders.

II. Introduction

The European transport system faces a difficult challenge: *to support the continued development of the largest trading block in the world, by simultaneously catering for the overseas trade and for the needs of the internal market.* In Europe, the challenge is to reconcile the comprehensiveness of the connections within the internal market with the flexibility to accommodate large trade flows from Asia and the Americas – being carried through the (improved) Suez and Panama Canals or the South Atlantic.

The numbers show that, in 2011, the value of EU seaborne external trade was growing up to €1693.7 billion (from (€1452.3 in 2010) whilst Shipping and Ports handled up to 90% (in ton km) of EU external trade and 40% (in tonnes) of intra-EU freight exchanges. In 2010, European maritime transport and ports handled slightly under 400 million passengers. Furthermore, European ports are directly linked to over 800,000 enterprises, generating in total the direct and indirect employment of about 3 million people. These impressive figures portray the relevance for Europe of its Maritime Transport System.

In times like this, when economic growth is essential, the role of maritime transport and ports is particularly important and thus needs to be adequately reflected and supported in the European transport system/ TEN-T network hence in the Motorways of the Sea (MoS).

By improving shipping and ports operations, MoS develops the underlying foundation of Europe's foreign trade whilst at the same time pursuing cohesion and accessibility within the European regions. As a funding (policy and financing) framework, MoS improve port infrastructure, develop interoperable port-ship interfaces and efficient port–hinterland connections, link ports and integrate origins and destinations and finally develop sustainable transport solutions to bridge gaps in and between different trade and transport corridors.

MoS provides a shrewd platform, using sophisticated information systems to integrate important assets, such as ports, shipping and know-how, tackle transport efficiency problems and endeavour to properly integrate maritime transport in the global logistics chain. For example, port single windows – single points of contact between ships, cargoes, authorities and logistics operators - will pave the way for a smooth transit of cargo through the necessary customs and phytosanitary controls, saving literally hundreds of millions of euros by eradicating obsolete and cumbersome procedures.

In parallel, MoS supports the development of highly efficient shipping operations guaranteeing the smooth flow of large quantities of goods and efficient intermodal connection with the hinterland of ports such as Gothenburg-Friederikshaven, Trelleborg-Rostock, Dover-Calais. Leixoes-Brest-Liverpool, Helsinki-Tallinn, London-Bilbao, Zeebrugge-Ejsberg or Barcelona-Civitavechia and Valencia-Livorno, finally connecting regions such as within the Gulf of Bothnia or the North Adriatic rim (e.g. Venice and Koper) and Mediterranean ports: such as Haifa and Igoumenitsa.

MoS supports safety and protection of the environment, including the development of sustainable maritime operations and the respect of environmental targets. This is particularly important on the Sulphur Emission Control Areas where MoS activities involve countries, ports and ship operators in the Baltic and North Seas addressing the implementation of remedial tools such as the use of Liquefied Natural Gas (LNG), Methanol or scrubbers, as such MoS is supporting the retrofitting of ships and re-fuelling barges as well as the deployment of re-fuelling facilities in ports (e.g. Rotterdam-Gothenburg project). MoS also supports projects producing new and updated hydrographical surveys, which help ships sail safely and avoid grounding as well as more dynamic Sea traffic control to prevent collisions and other accidents. The results of full scale pilots in this area are being applied already since 2015. MoS is also exploring the economic use of LNG as a geostrategically relevant fuel for the Atlantic, Mediterranean and Black Sea areas.

Finally, MoS favours the creation of a knowledge network – building on local knowledge to tackle global problems. This initially started as a network of universities linked to MoS industrial stakeholders, promoting the integration of remotely dispersed experts and multidisciplinary expertise and making it available for education and professional training. The projects have been giving results in particular on the training for efficient Corridor Logistics on the use of LNG in ports and ship operations.

There are already many practical results in this area resulting from the more of 80 projects already developed or under development under MoS.

This explains the setting of the European Coordinator's (ECMOS) strategic development objectives:

1 - The Environment

2 - The integration of Maritime Transport in the Global Transport Chain

3 - Safety, Traffic Management and the Human Element

As well as his method of meeting the European parliament's request, enshrined in the TEN-T regulation: delivering a Motorways of the Sea Deployment Implementation Plan (MoS DIP).

The ECMOS has promoted three dedicated Fora, addressing each one of the priorities. More than 250 stakeholders (industrial and institutional) participated in the three Fora defining a comprehensive basis for the analysis of the challenges and opportunities in each one of the priorities – a comprehensive report was produced for each one of the Conferences and its technical results integrating the findings of more than 80 MoS projects (either developed or under development), were validated by the stakeholders.

Additionally, an important work of "data gathering" provides comprehensive insight in the characteristics of the infrastructure and operations of Maritime Transport in Europe – this will allow for the definition of Key Performance Indicators(KPIs) and consequently for a proper assessment of priorities for development both for MoS and for the Core Network Corridors connection to the Sea.

TEN-T is trying to optimise use of Europe's large maritime operations capacity, its technical expertise and European ports. The aim is to efficiently use and fully interconnect the over 100 ports in the Core Network and the more than 300 ports in the Comprehensive Network to the global logistics chain i.e. to Maritime and Land transport corridors.

The development of Motorways of the Sea (MoS) will provide a framework for the deployment of high-level standards for efficient, safe and environmentally friendly maritime transport operations which can be fully integrated in a door-to-door transport chain.
MoS, whilst ultimately aiming at the increase of cargo flows to be carried by maritime traffic, aims primarily at the development of efficient ports and better port hinterland infrastructure and connectivity which will facilitate a smooth traffic flow. This development will help to mitigate traffic congestion and land transport deficient links between regions which are detrimental to cohesion and a dynamic internal market as well as to Europe as the largest trading platform in the world.

III. Overview of the shipping operations

1- Introduction And Overall Data On Maritime Transport And Ports

Maritime transport plays an important role in transport between the EU and third countries as well as in transport between EU Member States. This concerns, of course, islands like Ireland, Malta or Cyprus, but also transport between countries which are connected by land.

Major European sea routes and their connection with intercontinental trades (based on AIS data)

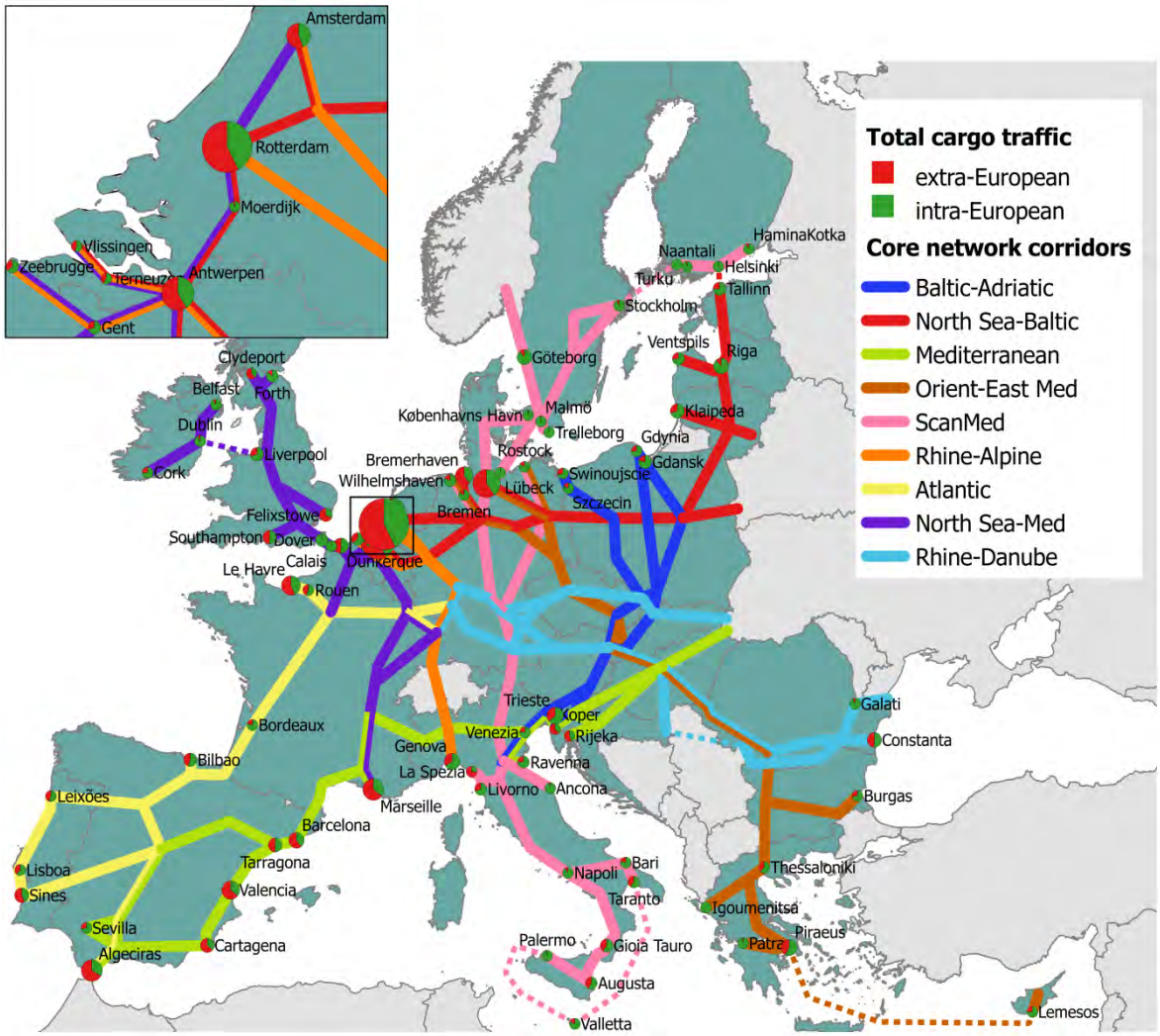
Source: ISL

More than 800 regular ro-ro and container services are the heartbeat of European maritime transport. They call in more than 400 different EU ports and connect them with hundreds of ports worldwide. They comprise a large variety of different links from short-distance ro-ro ferries crossing straits to round-the-world container liner services between the Far East, Europe and the Americas.

Motorways of the Sea carry billions of tonnes each year. However, in order to function properly, they need efficient ports and hinterland connections. Moreover, Motorways of the Sea must be fully integrated into overall logistics chains as the ports are most often neither the source nor the ultimate destination of freight flows.

In 2014, ports in the EU-28 handled 3.8 billion tonnes of cargo. According to estimates, around three billion tonnes are hinterland traffic, i.e. traffic that needs pre-/post-carriage by truck, rail or barge. Hence, the connections of terminals and ports with the hinterland infrastructure are vital for the success of maritime transport.

Maritime Core Network Corridor Ports – Intra- and Extra-European Traffic 2014

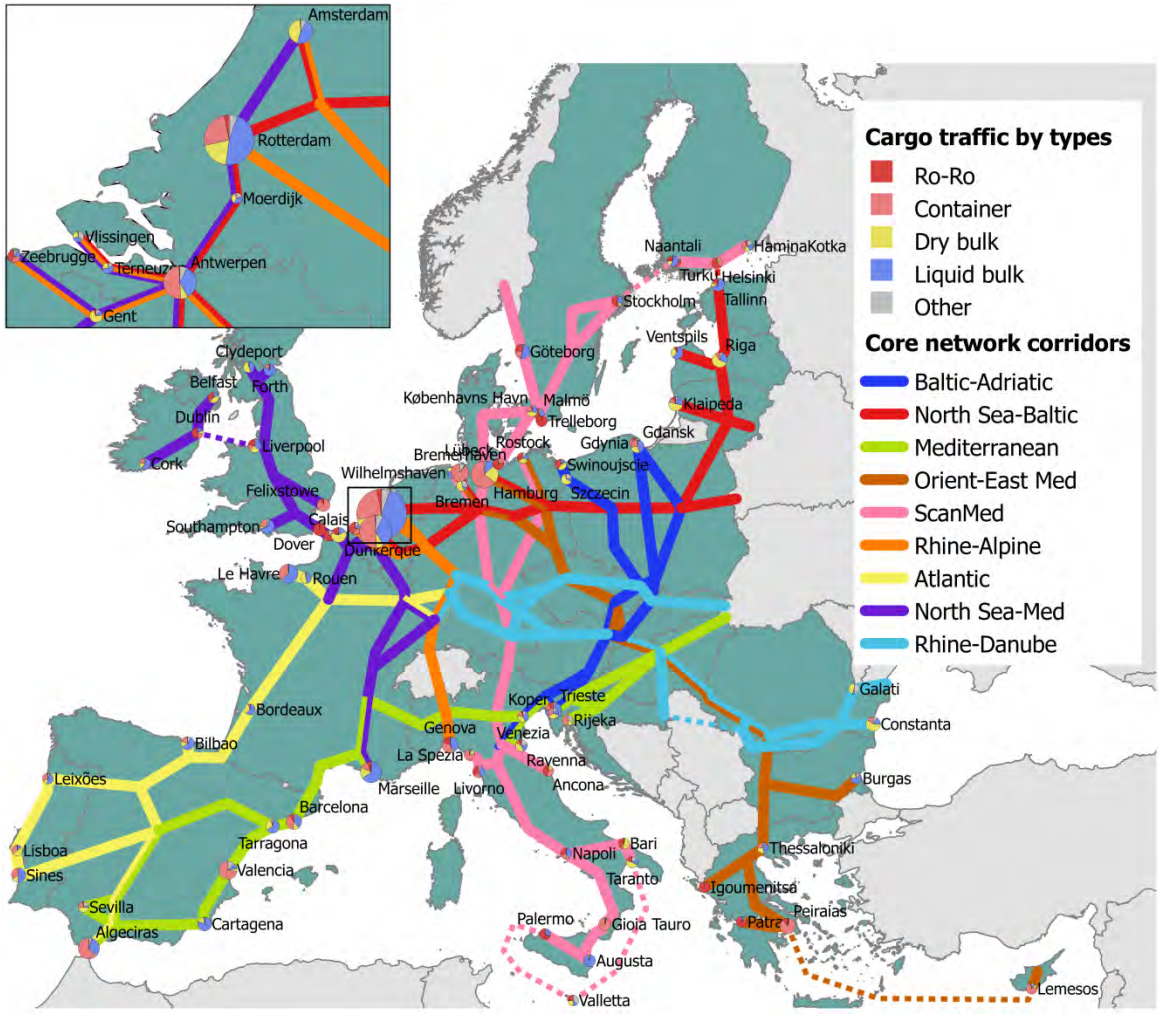


Source: ISL based on Eurostat

The 79 maritime ports situated on the core network corridors (CNCs) of the trans-European Transport Network (TEN-T) accounted for two thirds of the total European port traffic, i.e. 2.5 billion tonnes in 2014. Here, the ports of the Hamburg-Le Havre range– situated in an area where five CNCs intersect – account for 1.1 billion tonnes, alone.

There are considerable differences between ports regarding the cargo mix – both between different port regions and among ports within a region. There are universal ports handling all types of cargo, but also more specialized ports handling, for example, ro-ro traffic only.

Maritime Core Network Corridor Ports – Cargo Traffic by types 2014



Port types: Ro-Ro ports Container ports Universal ports

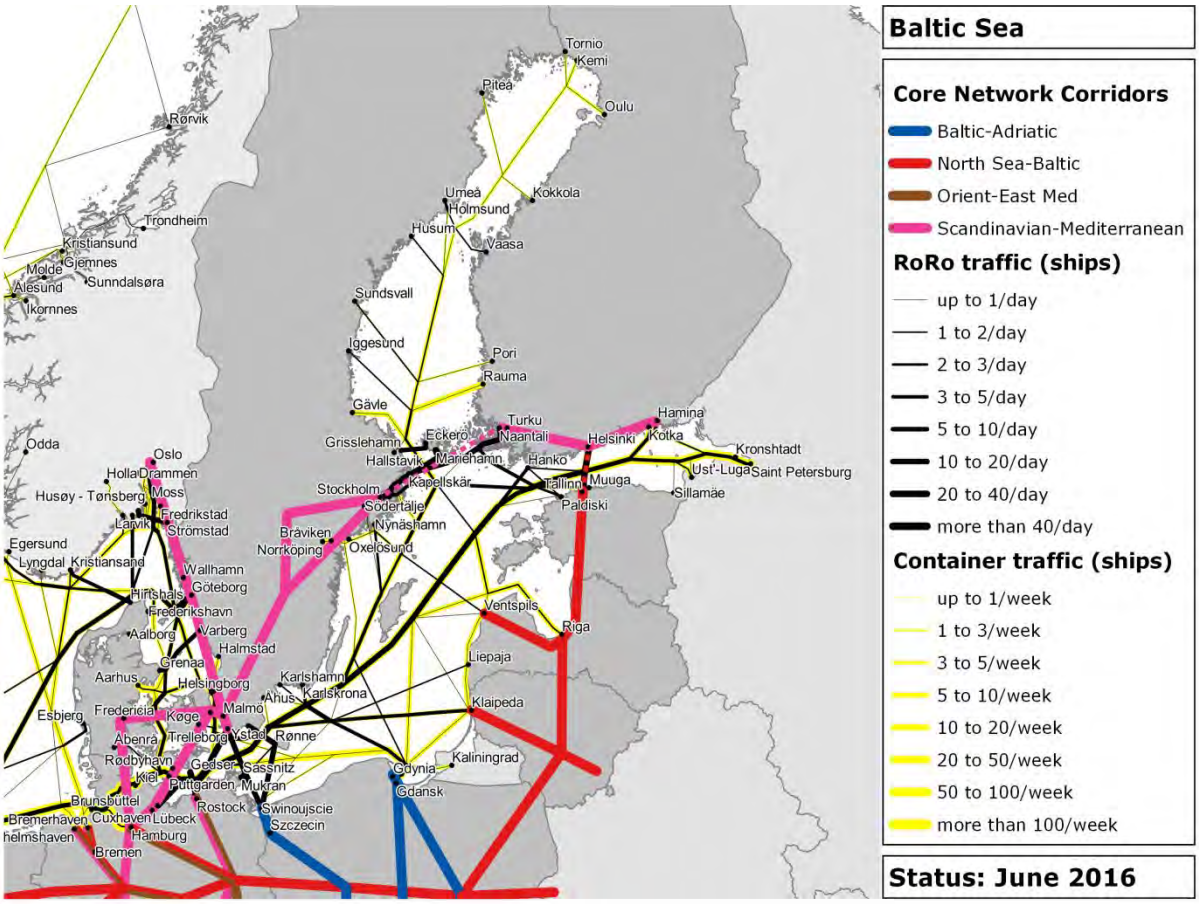
Source: ISL based on Eurostat

2- Motorways of the Sea and the TEN-T Core Network Corridors

Despite the importance of maritime transport in Europe, the TEN-T Core Network Corridors contain only very few maritime links. The corridors are conceptualised as land-based corridors that merely start or end in ports. However, a look at the existing regular ro-ro and container liner services shows that the maritime connections are manifold, connecting both ports within individual CNCs, between different CNCs and – of course – CNC ports with non-CNC ports in Europe and in the rest of the world. The diverse geography of these connections is illustrated for the different European Coastal areas below.

Baltic Sea

In the Baltic Sea, there is a high density of regular ro-ro and container services. There are two types of **ro-ro connections**: the short-distance links crossing the Baltic Sea, and the long-distance, often multi-stop services parallel to the costs. The most important international links in terms of cargo volumes are between Germany/Poland on the one hand and Denmark/Sweden on the other hand, but there are also high-frequency ferries connecting Sweden and Denmark as well as Finland with Sweden and with Estonia. The latter two links are part of the Scandinavian-Mediterranean and the North Sea-Baltic corridor, respectively. The long-distance traffic concentrates on the route between the Gulf of Finland and the Southern Baltic (and on to North Sea). The Swedish west coast has several links to the North Sea.



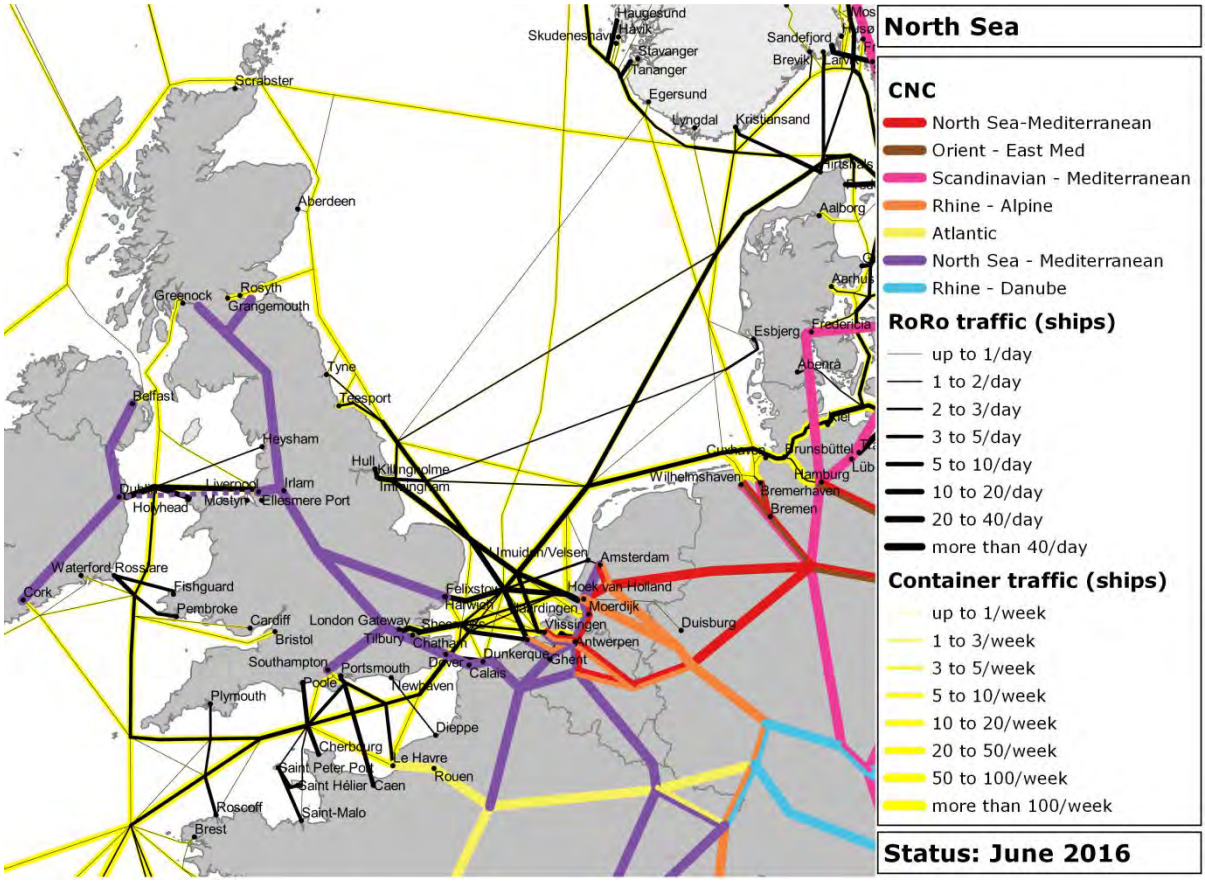
Note: Regular international services only; for more detail see 'Corridor Maps' in the Annex.
Source: ISL based on MDS Transmodal and AIS ship movement data

Container traffic concerns mostly traffic between North Range hub ports and Baltic Sea ports, most of it is passing through the Kiel Canal. This includes particularly feeder traffic from deep sea services calling the North Range, but also some short sea trade, i.e. trade

between the North Range ports hinterland and countries in the Baltic Sea. In addition, there are some deep sea liner services calling directly in Baltic Sea ports – including an Asia service with 18,000 TEU vessels. The volume of intra-Baltic container trade (i.e. excluding feeder traffic) is rather limited. Due to high handling costs for containers in the ports, this traffic is only economically viable on longer distances (e.g. between Germany and Finland) and where it is combined with rail or barge transport in the hinterland.

North Sea

As in the Baltic Sea, **ro-ro services** in the North Sea comprise long-distance routes along the coastlines and medium- to short-distance routes crossing the North Sea. While Calais-Dover is by far the most important link in terms of total cargo traffic and the shortest route between the UK and the continent, there numerous other links across the Channel. Moreover, there are also several ro-ro services between Great Britain and Ireland as well as between Great Britain and Norway/Sweden.



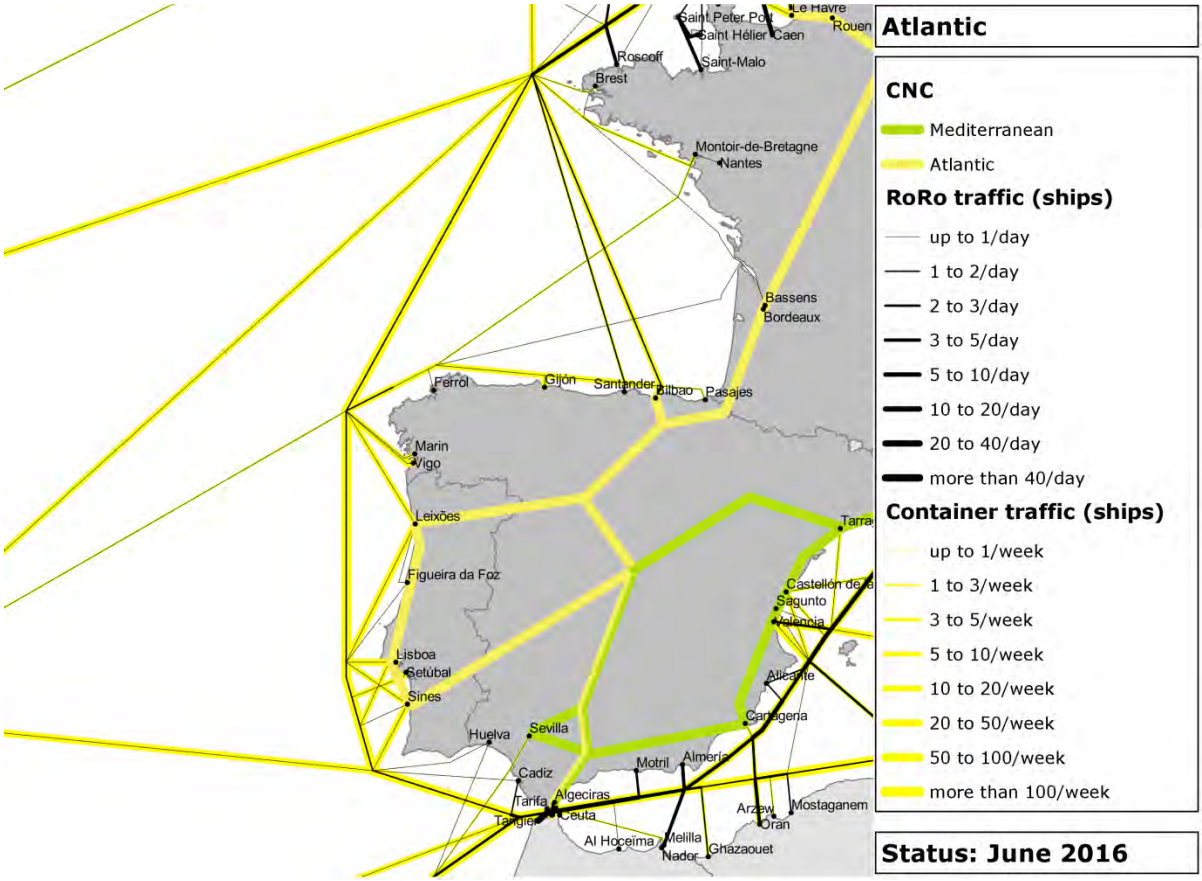
Note: Regular international services only; for more detail see 'Corridor Maps' in the Annex.
Source: ISL based on MDS Transmodal and AIS ship movement data

The major **container route** – one of the most important ones in the world – stretches from Hamburg along the German, Dutch and Belgian North Sea coast and through the Channel to the open sea. The North Range ports offer regular services to ports all over the world. Smaller ports are connected to the network via feeder services, but also through specialised deep sea services, most notably connecting Europe to Africa.

Atlantic coast

The Atlantic coast stands out among the European coastal areas because there are no real short-distance routes. Opposite to the European Atlantic coast is the North American Atlantic coast at a distance of several thousand nautical miles. There are, however, **ro-ro services** connecting the Atlantic coast ports among each other (e.g. France-Portugal) and with British ports.

While ro-ro traffic is hence less developed here than in the other European coastal areas, the Atlantic coast is strategically situated for **container traffic**. Three major intercontinental cross here: Americas to Europe, North Europe to Asia and Europe to Africa. Accordingly, ports along the Atlantic coast handle a large variety of deep sea services. Besides their role in intercontinental traffic, they are also the main correspondence ports on the European mainland for serving the Portuguese Acores and Madeira as well as the Spanish Canary Islands.

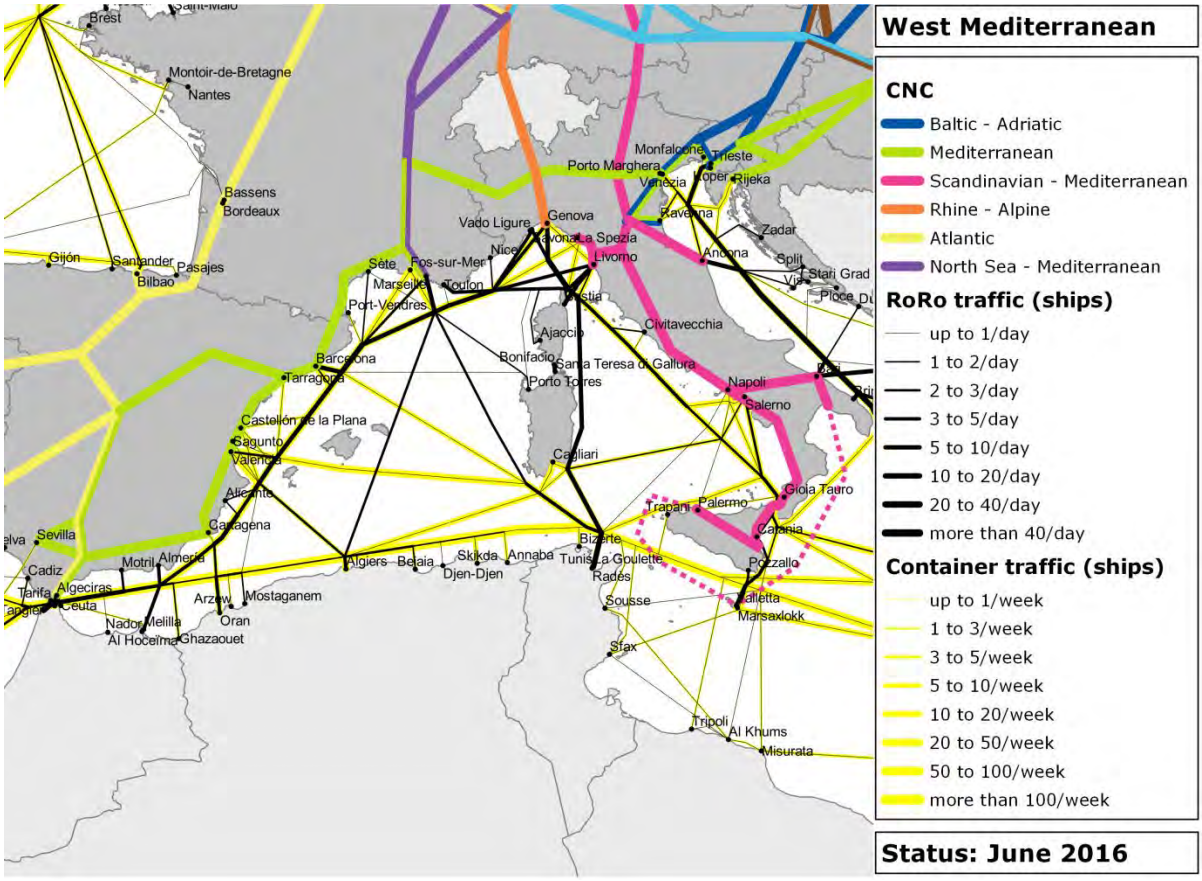


Note: Regular international services only; for more detail see 'Corridor Maps' in the Annex.
Source: ISL based on MDS Transmodal and AIS ship movement data

Western Mediterranean

Ro-ro traffic in the western Mediterranean is not limited to traffic between European ports but quite the contrary: the largest cargo traffic volumes are transported between the South of Spain and Morocco. Further to the East, ports in France and Italy also connect to North Africa through regular ro-ro lines. Still, there are also various intra-European services connecting Spain, France and Italy with each other – including direct connections of Corsica and Sardinia with neighbouring countries. Finally, Malta relies mostly on ro-ro connections with Southern European countries for intra-European trade.

As regards **container traffic**, there are several important hub ports in the Western Mediterranean that are directly connected to major Asia and Americas services. The smaller ports are mostly served by feeder vessels to and from these ports.

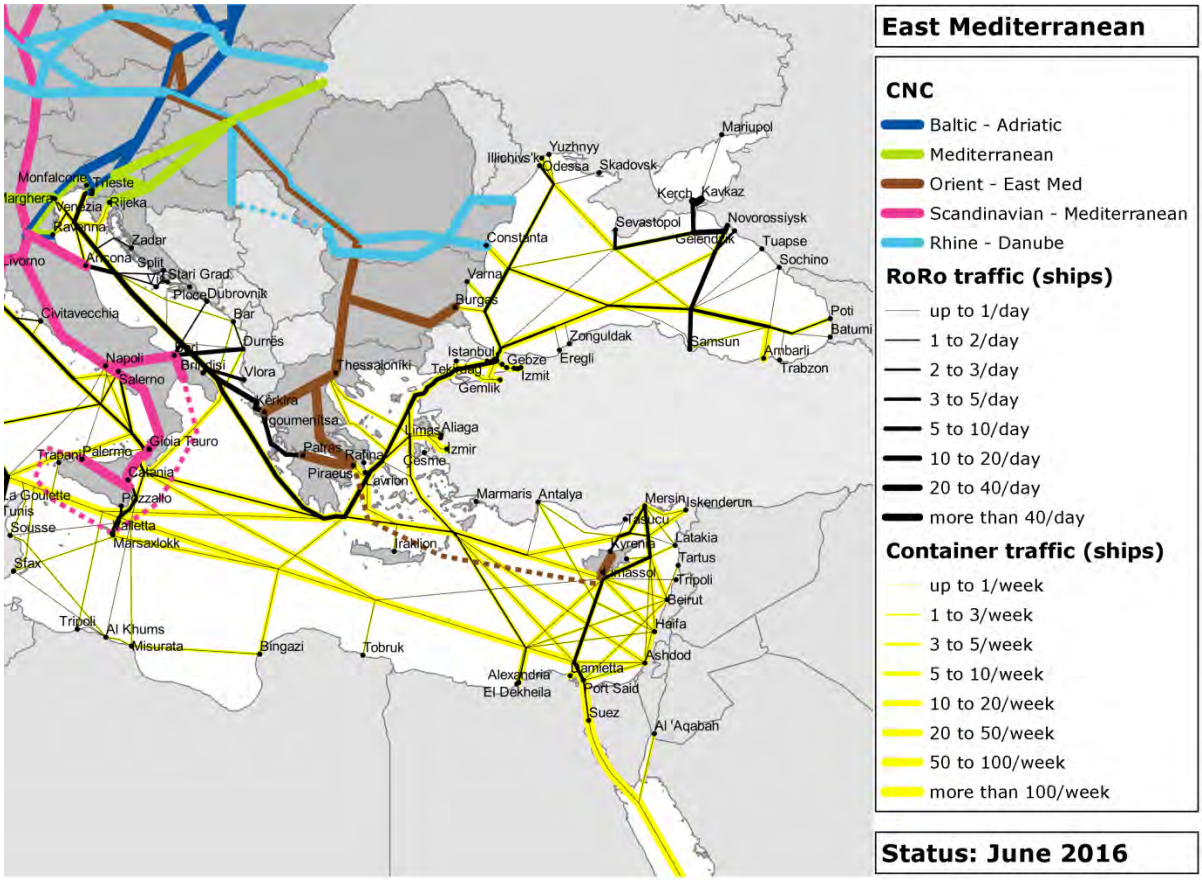


Note: Regular international services only; for more detail see 'Corridor Maps' in the Annex.
Source: ISL based on MDS Transmodal and AIS ship movement data

Eastern Mediterranean and Black Sea

In the Eastern Mediterranean, there are three major **ro-ro routes**: Adriatic Sea to Greece, Greece to Turkey and connections in the Near East (Egypt, Turkey and Cyprus). Ports in the Black Sea are connected among each other through various ro-ro services.

With regard to **container traffic**, many ports benefit from being close to the main Europe-Asia trade route through the Suez Canal. Some of them have established themselves as hub ports for transhipment. Direct Asia services now also call in the Black Sea where Constanta has developed into a regional hub port.



Note: Regular international services only; for more detail see 'Corridor Maps' in the Annex.
Source: ISL based on MDS Transmodal and AIS ship movement data

3- The Potential Of Motorways of the Sea

When looking into the future, the utilisation of Motorways of the Sea and their integration into multimodal logistics chains will depend on various factors. Here again, it is essential to differentiate between the different types of maritime transport.

For **intercontinental trade**, maritime transport will grow in parallel with market demand. With a few exceptions, there is simply no economic alternative for the transport of large volumes of cargo on long distances. Competition is not so much between sea routes and other transport modes, but rather among shipping lines – which is why DG Competition always monitors the development of alliances between container liner operators.

For **short-distance ferry routes** crossing straits like the Strait of Gibraltar or the English Channel or **links connecting islands**, it depends very much on whether there is an alternative to maritime transport. For example, the Eurotunnel is a direct competitor for the Calais-Dover ferry route, and so is the Oresund Bridge for the Helsingor-Helsingborg ferry

link. Therefore, the future share of seaborne transport will depend on the development of prices, but also on qualitative aspects such as the improvement of the digital dimension of the integration of Motorways of the Sea into the intermodal logistics chains. Where there is no fixed link, waterborne transport will grow in line with trade, though there may be shifts between, e.g., container and ro-ro transport or between accompanied trucks and unaccompanied trailers.

The attractiveness of many **intra-European long-distance routes** depends on its competitiveness vis-à-vis land-based transport. In many cases (e.g. Italy-Spain or Germany-Finland), the maritime route is the shortest distance between two markets, but freight potentials for maritime transport have not been fully used yet. Even where waterborne transport is the only economically viable option, shippers and forwarders can often choose between minimising and maximising the share of maritime transport. For trade between Morocco and France, for example, there are several alternatives: road transport between France and Algeciras and a short-distance ferry as a bridge function, a direct ferry service between France and Morocco or a container service. Increasing the attractiveness of maritime transport would hence foster a shift from road to sea. The success of waterborne transport on these trade routes has to be evaluated not in tonnes using maritime transport, but in tonne-miles. This is explored in more detail in the next section.

IV. Development of priorities for Pillar 1: Environment[4]

The environment is a key area of development for MoS.

The introduction of stricter emissions standards in general, and for the Sulphur emission control areas in particular, produced an immediate need for new ship technologies, operational processes, new infrastructure, and new tools for financing environmental upgrades in the period from 2010 onwards.

1- Climate Change

1.1 Greenhouse gas, CO2 and fuel consumption

Greenhouse gas and CO2 reductions are associated with improved human health conditions and decreased impact on climate change. This can, and is often, therefore monetized to enable weighting between benefits and the cost for the society to reduce the emissions. When improving sea transport in this ongoing transition towards a more environmentally, climate and energy efficient transport mode this is naturally also taken into consideration, not only the benefits to the ship and business in itself. With standards established at the IMO, it is worth noting that the shipping industry is the only industry with global regulation for CO2 emissions.

1.2 Solutions

Vessel

Technological options such as ship sizes, hull and propeller optimisation, lighter materials, as well as optimized engines and low-resistance hull coatings[5] are some of the options to reduce the fuel consumption and greenhouse gases. The use of new fuel types including hybrids and full electric solutions are also ways forward. When assessing new alternative fuels the wheel to well approach should be used to get the full net effect of climate impact. All to reach a more energy and climate efficiency with lower, or none, fuel consumption.

[4] The Issue Paper from which this chapter is taken was compiled by Helén Jansson (Zero Vision Tool) and endorsed by MEP Miltiadis Kyrkos, Member of the European Parliament and Mr Juha Kytolä, VP Environmental Solutions, Wärtsilä. The full list of contributors is available in Annex 3

[5] http://balticseaposition.eu/

EU MoS co-funded Joint Industry Projects have been building and converting ships to run on LNG or Methanol. New ZVT projects are also looking into battery and hybrid solutions as well as other types of alternative fuels (i.a. biofuels, hydrogen).

Moving forward - vessel

- Continue the current evolution of hybrids and battery use
- Further the development of alternative fuel use
- Continue the optimisation of hull, propeller incl. development of light material and new design possibilities (energy efficient light-weight designs) and their interaction
- Further the development of LNG and methanol use
- Explore new fuel possibilities, such as hydrogen and biofuels
- Further developed closed loop scrubbers to take into account both the air and water impact

Infrastructure / operation

To re-charge the hybrid and electric vessels, the charging stations in port are being upgraded or built to contribute to even more climate efficient maritime links. Co-funded EU MoS projects in the North are piloting these. On-shore power supply is another solution where, while at berth, the vessel is connected to electricity instead of using its own engine to power up the vessel for loading, unloading etc.

In the South EU co-funded industry projects are looking into a LNG bunkering, supply and distribution chain where synergies with other LNG users are added value.

What type of ship, on what trade, at what speed - are very important factors to maximize the efficiency of the trade and thereby minimizing the emissions of GHG. The often land based decisions by traders or commercial managers is an important factor that has to be taken into account. By optimizing routing with the support of digital systems the efficiency may increase substantially.

Moving forward - infrastructure

- Continue the cold ironing implementation
- The implementation and use of charging stations for batteries and hybrids
- Digital support for route efficiency

Regulation

The global climate agreement reached at the UN climate change conference COP 21 in Paris last December ("the Paris Agreement") is seen as an historic and landmark instrument in climate action. Though formally lacking wording on international maritime transport, many

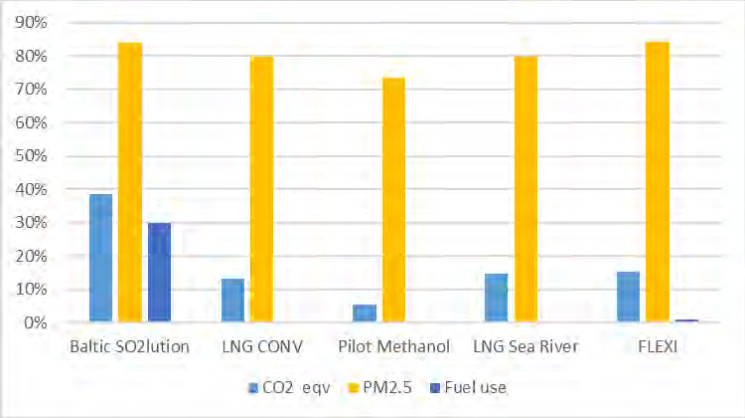
expect the sector to play its part. In 2011, the IMO adopted the Energy Efficiency Design Index (EEDI), which sets compulsory energy efficiency standards for new ships, and the Ship Energy Efficiency Management Plan (SEEMP), a management tool for ship owners. For both of these, EU MoS co-funded Joint Industry Projects have been supplying input when asked about routes and new technology choices. Two parallel processes are ongoing in regards to MRV (Monitoring, Reporting and Verification) within the EU and in IMO. The industry looks positively at the processes and hopes to gain one single global system for reporting.

Moving forward - regulation

- Stress that shipping is a global sector that needs to keep being regulated at a global level
- Predictability in the regulatory frameworks and collaboration

R&D

A Joint University Project[6], today comprising 10 universities and institutions, have studied the reduction of emissions for, among other things, the health and climate change reasons, and there is clear evidence of the socio-economic benefit when the industry invests in climate efficient solutions. The graph illustrates some of the Joint Industry Projects' reductions in percent of air pollutions compared to business as usual. In some of their cases business as usual means in this context using Marine Gas Oil (MGO), others MGO together with Selective Catalytic Reduction (SCR), yet others using 3% MGO as stated below.



- BalticSO2lution - LNG vessel newbuilding, dual-fuel engine and number of tech for improved fuel efficiency compared with MGO
- LNG CONV - LNG vessel conversion, dual-fuel engine compared with MGO
- Pilot Methanol – Methanol vessel conversion, dual-fuel engine and SCR compared with MGO
- LNG Sea River - LNG vessel newbuilding, dual-fuel engine compared with 3% MGO
- FLEXI – LNG bunker vessel newbuilding, dual-fuel engine compared with MGO

[6] http://www.zerovisiontool.com/news/032016/zvt-video-Zero8-assessing-and-verifying-the-benefits

Measured so far are CO2 and particulate matter (PM) reductions, and energy content in the fuel

The positive impact on climate and health can obviously not be assigned to one single point source of emissions, but the burden sharing of total air pollution impacts can easily be distributed among the sources following their relative contribution to air pollutant emissions. In other words, health impacts from the emissions of one single ship are impossible to verify but the health impacts from all the ships are, and one single ship's contribution to this impact is proportional to its relative share of emissions.

Moving forward – R&D

- Simplification of systems for safety (and further study into cost)
- Further research into renewable fuels and their impact/use in maritime transport, including cost consequences
- Develop joint KPIs, and benefits to society, to achieve common goals aiming at the reduction of the climate footprint of shipping

2- Air Quality/Emission Reductions/ ECA

2.1 Emission reduction

The industry in the North of Europe is situated, and works within an Emission Control Area, one of so far only two such areas in the world. As an adaptation to the IMO MARPOL Annex VI the EU Sulphur Directive[7] states that ships in EU SECA, both at berth in ports and sailing, are limited to 0.1% Sulphur emission. This Directive entered into force January 1 2015. From 2020 the rest of the EU waters will limit the Sulphur emissions to 0.5%. In turn this means that the industry in northern Europe, which is already taking measures to establish new infrastructures for a greener transport, have to deal with, and solve, a lot of unknown situations both with

[7] The IMO MARPOL Annex VI was adopted in 1997, a revised version entered into force in 2010 where significant tighter emissions limits were stated. 77 IMO Parties (approx. 95% of the world merchant shipping tonnage), and of those 24 EU Member States, have ratified the Annex VI. The EU Sulphur Directives 2005/33/EC and 2012/33/EU brought the EU legislation in line with MARPOL and a Commission Decision 2015/253 states inspections and sampling frequency.

regards to technology, regulations and financing. These measures address other emissions, too and not limited to SOx, but include NOx, Particulate Matter (PM) etc.

As the industry in the northern Europe done on a voluntary basis via the Zero Vision Tool, southern European industry is also taking measures to improve the air quality and comply with the forthcoming 0.5% Sulphur limit. Europa Venture (EV), acting as a multi-financing platform for the green compliance of the fleet, is implementing the Hellenic Shortsea Shipowners Association initiative, the Europa Ship Plan. This massive shipbuilding plan for dual fueled green vessels could substantially benefit the whole region significantly contributing to the reduction of CO2, NOx, SOx and PM emissions towards the 2020 environmental compliance. In parallel the platform is aiming at closing the financing gap for the general green and air quality compliance by applying state-of-the-art financing methodologies and tools blending EU incentives and commercial banks and funds traditional lending.

Encouraging multi-financing for the green compliance of the fleet and ports through the EU MoS programme should result in reducing the gap between planning and successful execution.

2.2 Solutions

Vessel

The switch to marine gas oil with 0.1% sulphur is the most common solution to meet the SECA rules. However, new solutions are also needed, some of the Joint Industry Projects, co-funded via EU MoS, are, or have already been, supplied:

- The first *ferry in the world* to be run on Methanol: Methanol is being tested as an alternative fuel that contains no sulphur and thus enables full compliance with the Sulphur Directive.
- The first *LNG bunker vessel in the world* of this type: The first vessel with fast, efficient and safe bunkering system for LNG bunkering on- and offshore is being built.
- The first *vessel converted* into an LNG fueled vessel.
- The first *dry bulk cargo vessel in the world* to be run by LNG: A cement carrier with LNG powered propulsion and without losing cargo carrying capacity.
- The first *installed light weight scrubber solution*: Innovative solution for equipping a vessel with the scrubber for cleaning of sulphur oxide exhaust fumes.

When these new solutions have been piloted in the North, one of the lessons learned is that there is need for followers. The conversion and building cost for these more climate and environmentally efficient ships is still 10-30% higher than traditional solutions. In addition,

the risks to invest in these new technologies, despite the pilot tests results are still high due to, i.a. delivery times, further development and customer demands. To continue the transition that has begun in the northern ECA area is vital, and therefore a risk sharing fund initiative is started (see further under headline 7. Financing of green shipping). Equally vital is that the South now is required to take huge steps towards vessels' green compliance. The recent voluntary initiation of the Europa Ship Plan will be an attractive solution forward as it is in parallel revitalizing the European shipbuilding and ship equipment manufacture industry. In this context, 6 pilot Europa Ship Class vessels have already been selected to be developed and more than 40 Mediterranean ship-owners are pooling together in order to achieve economies of scale in the ship building process. The process includes actions such as vessels retrofit for LNG as a marine fuel, scrubbers installation and newbuilding with green features. Considering this emerging needs currently prevailing, EV, provides invaluable financial support to these companies for their smooth adoption of the upcoming European legislation initiating in 2018 with the reporting of annual emissions of large vessels using every EU port and the implementation of the goals towards climate change in 2020. The innovative approach of EV, focuses on obtaining the best quotation for shipbuilding or ship retrofitting of vessels in EU shipyards, using EU equipment.

Moving forward - vessel

- Continue the current evolution of hybrids and battery use
- Further development of LNG and methanol use as well as exploring other new and innovative technological solutions
- Explore new fuel possibilities
- Further developed closed loop scrubbers need to take into account both the air and water impact
- Support the voluntary and proactive approach of shipowners through multi financing platforms
- Support vessels' green compliance while protecting competition via EU MoS, especially for the short sea shipping routes at regional level related to new maritime transport developments such as future European NECAs.

Infrastructure

- Joint Industry Projects, co-funded via EU MoS, are building LNG bunker ships to enable use of LNG as a fuel as well as support the traffic flow in and out of Ports so focus can be more on loading and unloading gods/passengers.
- The first hub for LNG bunkering in Scandinavia is established.

- The work in IMO Subcommittee Human Element, Training and Watchkeeping (HTW), previously Standards of Training and Watchkeeping (STW) concerns two courses: ”Model course on Advanced Training for Liquefied Gas Tanker Cargo Operations” where a drafting group is preparing basis and harmonizing with courses for Chemical and Oil Tanker Cargo Operations, and “Special Training requirements for seafarers on ships using gases or other low-flashpoint fuels” where Norway is preparing a proposed education plan. Both courses are being treated during HTW3 in Spring 2016. EU MoS co-funded Joint Industry Projects have contributed with training areas and suggestions on what is needed, based on experiences during actual implementations of the new fuel alternatives.
- 50% of the LNG consumer prices are due to storage and logistic costs which was found when looking into the small scale distribution model via Gainn.
- COSTA II (PoseidonMed) depicted that a simultaneous development of the critical supply and demand infrastructure is a prerequisite for a sustainable LNG bunkering system.

Moving forward - infrastructure

- Continue to look into ways of lowering LNG storage and logistics costs
- Promote synergies with other uses of LNG in road transportation and energy sector
- Development and harmonisation of training and education when handling and using new fuel types
- Facilitate further development of infrastructure for alternative fuels (the supply, port infrastructure, refueling vessels)
- Support the voluntary and proactive approach of ports and terminal operators through multi financing platforms, shared investment platforms
- Continue to support the uptake of cold ironing technologies via EU MoS.

Regulation

The new IGC Code (International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk) is scheduled to become effective on 1st July 2016, and the new IGF Code (International Code of Safety for Ships using Gases or Other Low Flashpoint Fuels) is scheduled to become effective 2016/2017. At IMO BLG17 it was also decided to include Methanol, Ethanol and Fuel Cells in the work with an extension of IGF Code.

Continued collaboration with industry and relevant agencies is needed to identify and cope with new situations that are found when implementing the new solutions for a more climate and environmentally efficient transport mode.

Moving forward - regulation

- Stable regulatory environment to facilitate and promote investments in green technologies for shipping.

R&D

The introduction of stricter sulphur legislation in the SECA from January 1, 2015 was probably the largest change introduced in the maritime sector in the Baltic Sea for decades. The industry in this area have always been ahead when it comes to clean transport, also in regards to shipping where the investments have been on a voluntary basis and in line with investment schedules. This time it was a forced deadline and with unknown situations as mentioned above.

Suggestions for the standardisation of the environmental construction process of new vessels, to reach multiple effects in several sector areas such as yard, equipment, naval engineers and so forth, are presented from Joint Industry Projects (JIPs) in the South of EU to continue what has been started in the North. The central concept is the standardisation of the construction process of new ships and ship equipment, along with the economies of scale that will incur as a result of a large-scale construction process. According to the principles of logistics, it is estimated that such a large-scale standard production process with improved economies of scale can lead to an average cost reduction of 15%.

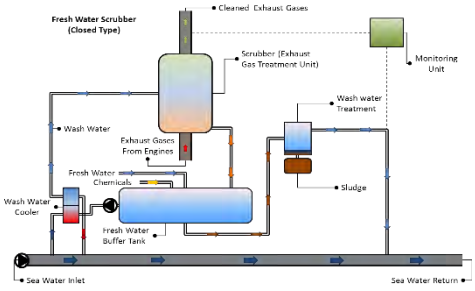
Moving forward – R&D

- Simplification of systems for safety (and further study into cost)
- Further research into renewable fuels and their impact/use in maritime transport, including cost consequences
- Joint KPIs, and benefits to society, to achieve common goals at aiming at the reduction of the environmental footprint of shipping
- Further harmonisation / standardisation of the green ship production

3- Operational Pollution

3.1 Cleaning, Reception and Modal Shift

There is a wide range of different scrubbers on the market.



Furthermore, following Finland's ratification, the Ballast Water Management Convention is due to enter into force in September 2017. The Convention will reduce the problem of invasive species, but again it represents a big challenge for the shipping industry not least to find certified solutions that can be combined with existing technologies.

In addition, a substantial contribution to the development of maritime transport was made by IMO in April 2016. MEPC 69 agreed to consider the draft amendments to MARPOL Annex IV regarding the Baltic Sea Special Area proposed by 28 EU Member States and Russia. According to this decision, the discharge of untreated sewage from passenger ships will be prohibited for new ships in the Baltic Sea from June 2019, and for existing ships in the Baltic Sea area from June 2021. This will bring new requirements both for ship owners regarding onboard sewage treatment plants and for ports regarding adequate port infrastructure to receive increased volumes of sewage without causing undue delay for ships.

Other developments related to the environment and the maritime transport in the EU that should be further considered are connected with Regulation (EC) No 1257/2013 of the European Parliament and of the Council of 20 November 2013 on ship recycling and amending Regulation (EC) No 1013/2006 and Directive 2009/16/EC.

When discussing operational pollution it is also important to include the pollution in regards to other transport modes. This not least since the EU strategies like to see a modal shift to sea to relieve the land infrastructure and to use a less costly mode where possible.

3.2 Solutions

Vessel

EC MoS co-funded Joint Industry Projects are implementing different kinds of scrubber solutions, and technical as well as environmental results are put forward, both to ESSF and to University Projects looking into the environmental effects (both emissions and discharge). Already today Joint Industry Projects include vessels with sewage treatment plants installed which clean the black and grey water. The plants are built according to set EU standards and certified to IMO MARPOL 73/78 Annex 4 Res. MEPC2(VI).

Other Joint Industry Projects implemented both in South (through the Europa Ship Plan) and North (through Zero Vision Tool) Europe are now looking into the implementation of a new BWT system, with the objective to make the vessel fully compliant with the requirements of the forthcoming Ballast Water Management Convention and the US type approval.

Route planning, together with hull cleaning, are also important contributions to lower negative impact from operational pollution.

Moving forward - vessel

- Further development and piloting of onboard treatment systems (e.g. ballast water, recycling, black/grey water)
- Pilot testing of monitoring equipment to find best speed and routing
- Financial support by MoS for the green compliance of vessels

Infrastructure

An infrastructure solution to black and grey water management, used by some of the Joint Industry Projects co-funded by EU MoS, is to use facilities available in Ports for receiving sewage waters. Vessels are also given the opportunity to offload black and grey water via tanker trucks or onto sewage water barges. Also this is done in Joint Industry Projects co-funded by EU MoS. An EU MoS co-funded Joint Industry Project has developed a safety data sheet after hazard identification where first aid measures, accidental release, handling and storage, exposure control and personal protection measures are specified when handling supply of scrubber additives and chemicals. They have also looked into, and identified, potential conflicts in handling of scrubber chemicals, cargo and bunkering.

Noise reduction, especially in ports, is another area that is on the agenda when looking into operational pollution.

Moving forward - infrastructure

- Further development of port reception facilities to prepare for support to new technologies
- Trials for noise reduction solutions
- Further development of port reception facilities co-funded by the MoS Programme to prepare for new or increased waste streams and support new technologies

Regulation

The discharge of sewage (Black water or mixed Black and Grey water) from ships is prohibited within 12 nautical miles of the nearest land in the Baltic Sea unless sewage has been comminuted and disinfected using an approved system and the distance from the nearest land is more than 3 nautical miles. In any case, when discharging from a sewage holding tank, the discharge must be at a moderate rate and the ship must be proceeding en route at a minimum speed of 4 knots. Only if a sewage treatment plant approved in

accordance with the requirements of IMO, is used onboard, can the discharge take place at any distance from the nearest land. Ships larger than 400 GRT are obliged to either empty their sewage in special reception facilities in port, or use an IMO certified sewage treatment plant.

Shipping is an important enabler of world and European trade and therefore also an important contributor to improved climate and environment. To find new industry technology standards that improve the climate and environment situation, they need to be tested in real operating conditions, not least to find them to also be safe and secure.

Moving forward - regulation

- In absence of binding regulations, new technologies should be given incentives, an opportunity to encourage best practice and find new industry standards

R&D

A Joint University Project assesses the consequences of different regulatory regimes for the base of the marine food web as represented by the pelagic microbial ecosystem (nanoflagellates, bacteria, phytoplankton, protozoa). They look into their global spread in air and also look into in their connection with scrubber technology use.

Moving forward – R&D

- Further scrubber bleed-off as well as other discharge and emission analyses for impact assessments when sailing through environmentally sensitive waters or within waterbodies under the water framework directives
- Further investigate smart vessels and autonomous safety systems

4- Accidental Pollution

4.1 Risk and safety

Depending on the routes the risk situations differs. Looking at this from a European financial and educational perspective we have the benefit of both covering Arctic winter areas as well as the warmer climate areas and the transport at sea, and its development, is dependent on the knowledge of both. If we can keep investing in, and being updated on, the development in both we will strengthen our global attraction, rise both the number of job opportunities and the knowledge level in Europa.

4.2 Solutions

Vessel

Double Hull to prevent leakage is in place since a long time. Other safety installments continue to be looked at and developed not least in the vessel development phase where simulators and other IT instruments can be used. Also crew education, safety planning and training are conducted regularly. Incident and accident sharing is of great importance, one existing system used by some of the EU MoS co-funded Joint Industry Projects is ForeSea, where solutions and knowledge are shared.

Moving forward – vessel

- Measures aimed at improving safety and education and training practices are still necessary in order to improve global safety levels and further alleviate and avoid accidental pollution
- Pilot testing of technology in Artic environments and compare with warmer climates can help defining risk specifics

Infrastructure

Traffic management and human element issues are key to avoiding the risk of errors and accidents. Traffic management can prevent collisions and groundings among other kinds of accidents. Improvements to the whole process can be achieved through better technologies and also, notably, digitalisation.

Moving forward – infrastructure

- Continued development of traffic management tools for collision and grounding avoidance
- Further investigation of how pilotage is used and improvements of routines
- Digital infrastructure to further simplify and reduce administrative burden

5- Integrated use of Marine resources

5.1 Planning and management

In July 2014 the EU adopted a legislation to create a common framework for Maritime Spatial Planning. While each EU country will be free to plan its own maritime activities, local, regional and national planning in shared seas are made more compatible through a set of minimum common requirements. Conflicting uses of the marine resources can lead to comparative disadvantage between sectors.

5.2 Solutions

Vessel

Passage planning and traffic management tools are to be used even more thoroughly onboard vessels. However important to remember is that the planning of new vessels need to have time enough to implement structures.

Moving forward – vessel

- Pilot testing of new solutions to function together with existing technologies is as important as implementing new ones

Infrastructure

HELCOM Marine Protected Areas (MPA) synchronize the collaboration around the Baltic Sea and North Sea area where some of the country priorities are;

- Germany is ahead regarding wind
- Norway is ahead within offshore and fishery
- The Netherlands is focused on spatial planning
- Sweden, as well as Poland, is looking into infrastructure and protected areas

EU MoS co-funded Joint Industry Projects contribute with data and information to the work in this group.

Moving forward – infrastructure

- This new discipline, spatial planning, is already underlined in the UNCLOS but it has not been effectively developed or used so far.

Regulation

Some of the countries working in the HELCOM MPA, including Sweden, also work further on the Marine Environment Directive and the Water Framework Directive.

Moving forward – regulation

- Develop tools to manage this complex process of Spatial Planning must be thought through by regulators, stimulating the use of tools to manage conflicting uses.

6- Environmental Compensation Measures

6.1 Do it together

The economic, environmental and social challenges include growing and concentrated traffic volumes; the cost of adaptation of port and port hinterland infrastructure measures; a changing marketplace as a result of increased alliances between shipping lines; national budget constraints limiting the possibilities of public funding for transport infrastructure; volatility in energy prices, the new energy landscape and the transition to alternative fuels; the entry into force of stricter sulphur limits (in, for example, IMO ECA countries); increasing societal and environmental pressure; and potential changes in shipping routes from new or enlarged international passage ways (UNCTAD review of Maritime Transport 2015).

6.2 Solutions

Infrastructure

Using natural resources for environmental compensation, and using compensation methods in the sea bed is a new and innovative way of thinking to mitigate environmental impacts provoked on the sea bed.

Moving forward – infrastructure

- There is a high potential for ports and port users to work together to share best practices and achieve cost-effective and efficient environmental compensation measures.

Finance and R&D

EU MoS co-funded Joint Industry Projects are involved in compiling data for an Environmental Performance Initiative (ZVT EPI). An important aspect is to find common ground on how and what to measure when identifying the compensation measures. There are Indexes on the market that have each developed great knowledge in their respective fields. The EPI aims at combining and/or if necessary developing this further to be used also beyond legislations, while keeping the joint vision of zero emissions, discharge and lowered energy use.

Providing incentives for the demand side of short sea shipping, supported both on European and regional levels are also a way forward to reach the set vision zero. An existing CEF project is looking into development of new shipping services. Another project is making use of this line of thinking where the most environmentally efficient choice of transport is supported.

Moving forward – finance and R&D

- Further development of support tools, such as Environmental Performance Indicators, to find joint KPIs and benefits to society and sea
- Further development of support systems to avoid modal backshifts and support new efficient routes

7- Financing Of Green Shipping

7.1 Grants and Loans

The EU TEN-T Motorways of the Sea grants have so far helped to start all the above, in many cases, unique solutions. To gain a broader transition into a safer and more environmentally, climate and energy efficient transport at sea, other forms of financing are also needed. The joint industry projects working in the North of Europe today need, and are willing, to invest approximately € 1 billion to reach the common vision zero. The same applies for South Europe, where a corresponding Mediterranean ship-owners pool are aiming at a plan of € 1.6 billion for ship building and green compliance through financial blending for meeting the set goals. The ESSF (European Sustainable Shipping Forum) subgroup Finance, which supports with consultative and technical processes, has found that a new green financial structure must be built. The ZVT and EV Europa Ship Plan (ESP) are joining forces towards this direction to facilitate the European Short Sea Shipping smooth adaptation. This is in line with what the stated industry needs are at present: a balance between CAPEX and OPEX, a risk sharing mechanism and some business cases to test the structure.

In parallel, the EIB (European Investment Bank) designs a sustainable, scalable business and financial instrument that provides a solution to accelerate investments in greener shipping. The Green Shipping Guarantee (EUR 750 million) intends to finance shipbuilding projects including new vessels as well as conversion and retrofitting of vessels. A pilot action is about to be launched with financial institutions in France, the Netherlands and Nordic countries.

Vessel

The very basic challenge is that a newbuilt vessel, using e.g. LNG as fuel, typically costs approximately 25% more compared to a standard designed vessel, but does not have a proportionately increased earning capacity. From a strictly financial perspective, the value of this LNG-vessel has not increased at all. The cost becomes 125%, whilst the value of the vessel from a financial perspective as collateral practically remains at only 100%. The

financing of the remaining 25% therefore becomes by far the most expensive. One of the lessons learned from the ongoing joint industry projects, run via ZVT in the North and Europa Ship Plan (ESP) in the South, is therefore the challenge to find competitive financing for the environmental part of the investment.

An important feature of the European Short Sea Shipping that should be taken into consideration is that the fleet is ageing. On a EU level, the average age of vessels operating in Short Sea is the 20 years, while the average age of vessels operating in Deep Sea is only 14 years. In South Europe, the average age of vessels operating in Short Sea is even higher, approximately 25 years. It is therefore quite adverse that the majority of these vessels have such a long life span and a technology incompatible with the available solutions.

Considering this, the retrofitting option becomes a non-feasible one for the vast majority of the fleet and the implementation of ESP in the Short Sea Fleet of South Europe through the shipbuilding of new innovative green vessels seems as the optimum and only possible solution. Although a renewal plan for south Short Sea Shipping is a first priority, the southern attempt for green compliance gives equal importance to the retrofit / re-engine of vessels and the installation of environmental equipment onboard vessels, therefore providing a complete solution.

Another factor is that the EU currently faces a major competition in shipbuilding by China, South Korea and Turkey. The costs, for the shipowner, to build the vessel are much lower than in Europe, in some cases also due to state support to the yard. One solution to this pricing problem is the approach of ordering a series of vessels from EU shipyards. This in combination with the EU incentives could provide an attractive “all EU package”. This could also potentially initiate the re-industrialization of the European Union and enhance its employment potential.

Moving forward – vessel

- New investments in environmentally efficient solutions should be supported by public investment incentives
- New financial instruments through risk reduction mechanisms can help the industry achieve a paradigm shift in the uptake of climate efficient technologies
- Promote common interest strategies of Shipowners pooling combined with EU incentives and EU reindustrialization

Infrastructure

In a broader and long term perspective, only a minor part of the port and shipping sector can be granted co-funding from the Commission, and at the same time it is clear that the Commission's ability to provide grants for environmental co-financing cannot continue indefinitely. Another important observation is that grants from the Commission cannot be used as pledge (collateral) for the required pre-financing needed to the shipyards or suppliers. This constitutes a problem in particular for the small and medium sized ports and shipping companies. The problem also relates to operations, as freight buyers are very rarely willing to pay a higher charter for an obviously more environmentally efficient vessel or a port with expensive equipment (or a connecting locomotive with expensive ERTMS equipment).

Moving forward – infrastructure

- Access and competitiveness of outermost regions remains an issue and requires the development of sustainable transport to guarantee cohesion
- Look into incentive systems where the transport buyer is encouraged to use climate efficient sea alternatives such as ECO bonus

Moving forward – regulation

- Regulatory incentives (carrots) are needed to encourage the industry to cope with the required changes and to do so on time

Finance and R&D

There is a clear need to find a way to cover risk for the voluntary group of already initiated projects to ascertain their progress, which is especially important not to discourage potential followers, and instead encourage possible followers.

- Another identified need in the ongoing ZVT projects, is that co-funding decisions granted by INEA are not accepted by the financial sector as collateral for loans (they are not “bankable”). This means that e.g. a shipping company ordering a new ship, and in possession of a positive decision on grants, cannot use this as collateral when arranging the necessary pre-financing to the yard. This has caused problems, especially for small and medium size actors in the sector.
- If project to retrofit or to build a new vessel (or terminal) is delayed, this causes the project severe problems since the grant will be reduced correspondingly to the delay.

It is important to create a solution that can complement the grants. A suggestion from Joint Industry Projects and Initiatives in the North and South is to create risk sharing funds

addressing the barrier to green investment in the sector. The objective of these financial instruments (FI) will be to (partially) de-risk commercial lenders on their financing of green investments and to calibrate FI resources and pricing on the external benefit of the investments using a consistent, independent and scientific measurement method of the external benefits. The interest rate and related conditions can then for the first time include a component of the overall benefit to the society and the sea. This to reach the paradigm shift where the shipping and financial industry's green investments will become "the new normal". So far an average of 1 million Euro per ship and year is calculated in benefits to society and sea. This when looking at the reduction of air emissions, other areas to be included in the calculations are discharge, risk/safety, noise, modal shift and European job opportunities.

Suggestions for moving forward can be found not only in the North but also in the South of Europe. Here the use of CEF grants or the cohesion funds that would increase greatly the bankability could be important. The cohesion Member States, could offer part of the cohesion funds for the building of the ships. The combination of low bankability, lack of funds and zero financial incentives deprives shipping companies from investing in new-builds or vessels retrofits with environmental equipment in order to be compatible with the environmental regulations. Through the ESP it has been pointed out how important it is to take advantage of a multi-financing platform for shipbuilding illustrating substantial cost reduction through economies of scales, compared to the building of just a single ship of this type, since this would create the feeling that mortgages have a much greater value than the capital they could lend, and also in case of liquidation they are secured.

Moving forward – finance and R&D

- Pilot testing of new mechanisms that consider both the capital expenditure (CAPEX) and the operational expenditure (OPEX)
- Attract beneficiary stakeholders such EU shipyards, engine and equipment manufactures in the risk sharing model
- Maritime investments should be further considered in the cohesion and other structural funds agenda

TEN-T Projects under Pillar 1

In total there were 20 projects financed under TEN-T that related to the environment in the period from 2010-2013. These have generated just over EUR 655 million of investments of which the EU has contributed EUR 174.9 million.

Of the 20 projects:

- 12 were LNG-related, which amounted to an overall investment of EUR 468.4 million (EU contribution of EUR 117 million)

  7 were scrubber-related and amounted to an overall investment investment of EUR 164.4 million (of which the EU contribution was EUR 46.6 million)

  1 was an action on alternative fuels (methanol) involving a ship retrofit.

Below is the list of all TEN-T sustainable shipping/environment-related projects.

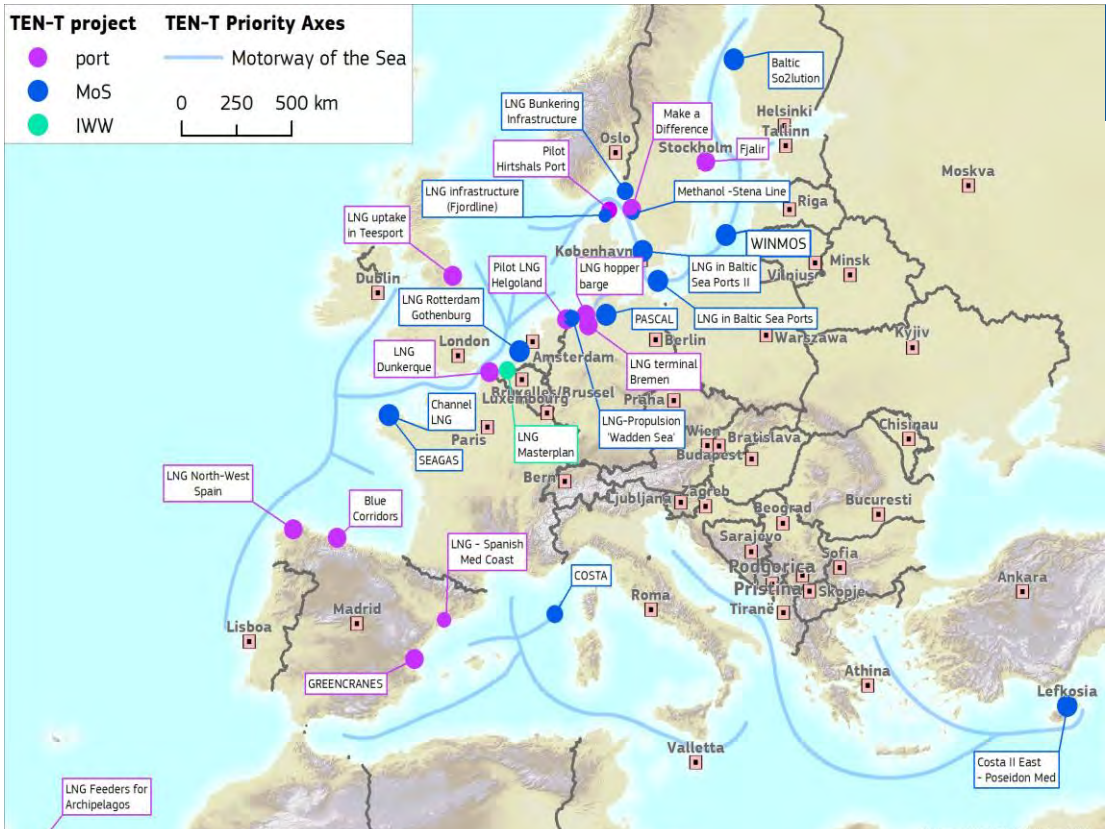
European Commission

TEN-T environment sustainable shipping projects

Project Code		Action type	Inital total costs (€ M)	TEN-T support (€ M)
2010-EU-21112-S	LNG infrastructure of filling stations and deployment in ships	Studies/Pilot	26.8	9.6
2011-EU-21005-S	LNG in Baltic Sea Ports	Studies	4.8	2.4
2011-EU-21007-S	COSTA	Studies	3.0	1.5
2011-EU-21010-M	Green Bridge on Nordic Corridor	Mixed (studies & works)	84.6	19.8
2012-EU-21003-P	LNG Rotterdam Gothenburg	Works	171.36	34.3
2012-EU-21008-M	WINMOS	Studies/Works	139.2	29.7
2012-EU-21026-S	SEAGAS	Studies	2.0	1.0
2012-EU-21009-M	LNG Bunkering Infrastructure Solution and Pilot actions for Ships operating on the Motorway of the Baltic Sea	Studies/Works	74.5	23.1
2012-EU-21010-S	PILOT SCRUBBER – New Generation Lightweight Pilot Scrubber Solution installed on a Ro-Ro Ship operating on the Motorway of the Baltic Sea	Studies/Pilot	13.5	6.7
2012-EU-21017-S	Methanol: The marine fuel of the future	Studies/Pilot	22.5	11.3
2012-EU-21023-S	Sustainable Traffic Machines - On the way to greener shipping	Studies/Pilot	12.9	6.4
2013-EU-21003-S	Into the future - Baltic So2lution	Studies/Pilot	7.3	3.6
2013-EU-21006-S	Deployment of next generation scrubber technology for clean and sustainable short sea shipping in the North Sea ECA	Studies/Pilot	10.3	5.1
2013-EU-21007-S	LNG in Baltic Sea Ports II	Studies	1.7	0.8
2013-EU-21005-P	Channel LNG	Works/pilot	26.6	5.3
2013-EU-21010-P	Sustainable Traffic Machines II – The green link between Scandinavia and Continental Europe	Works	11.4	2.3
2013-EU-21015-P	Sustainable Motorway of the Sea Ghent-Gothenburg through environmental upgrade and compliance while maintaining competitiveness of short sea shipping	Works	19.0	3.8
2013-EU-21016-P	Sustainable Motorway of the Sea Immingham-Gothenburg through environmental upgrade and compliance while maintaining competitiveness of short sea shipping	Works	12.7	2.5
2013-EU-21018-S	Pilot Implementation of a LNG-Propulsion System on a MoS Test Track in the Environmental Model Region 'Wadden Sea'	Studies/Pilot	6.1	3.1
2013-EU-21019-S	Costa II East - Poseidon Med	Studies	5.1	2.6
Total			655.3	174.9

Source: INEA

The geographic distribution for the TEN-T projects is depicted as follows, with the larger concentration of actions in the North Sea/Baltic area being explained by the introduction of the Sulphur emission control area (SECA).



Source: INEA

CEF projects under Pillar 1

In addition to the above, the number of environment/sustainable shipping projects financed under CEF so far has been 21, reaching a total investment of EUR 468.5 million. The EU total contribution to this has been EUR 173.2 million for these 21 Actions listed hereafter.

CEF environment – sustainable shipping

Project Code	Title	Action type	Inital total costs (€ M)	TEN-T support (€ M)
2014-EU-TM-0066-M	The Northern ScanMed Ports - Sustainable Maritime Links	Studies/Works	8.1	2.6
2014-EU-TM-0087-M	TWIN-PORT 2	Studies/Works	97.6	29.3
2014-EU-TM-0095-W	ReaLNG: Turning LNG as marine fuel into reality in the North Sea-Baltic region	Studies/Works	40.0	13.1
2014-EU-TM-0120-W	HEKLA - Helsingborg & Klaipeda LNG Infrastructure Facility Deployment	Studies/Works	28.7	10.2
2014-EU-TM-0379-M	Back from Black -Study and deployment of the affordable scrubber retro fitting technology for SME shipowners	Studies/Works	20.2	7.2
2014-EU-TM-0388-M	Environmental compliance and upgrade of the North Sea MoS Felixstowe-Vlaardingen	Works	4.3	1.3
2014-EU-TM-0391-M	Upgrading and sustaining the competitive core Baltic MoS link Helsinki-Lubeck	Works	26.0	7.8
2014-EU-TM-0396-M	Environmental compliance and upgrade of the North Sea MoS Esbjerg-Immingham	Works	1.5	3.2
2014-EU-TM-0428-M	Environmental compliance and service upgrade of the North Sea MoS Cuxhaven-Immingham	Works	5.3	1.6
2014-EU-TM-0437-M	Upgrading and sustaining competitive sea-based transport service on Baltic MoS Klaipeda-Karlshamn	Studies/Works	9.7	3.0
2014-EU-TM-0451-M	Scrubbers: Closing the loop	Studies/Works	24.6	7.7
2014-EU-TM-0487-M	Biscay Line - Multiple port Finland-Estonia-Belgium-Spain long distance MoS, relevant to many core network corridors	Works	15.8	4.7
2014-EU-TM-0489-S	Zero Emission Ferries - a green link across the Oresund	Studies	26.3	13.1
2014-EU-TM-0507-M	Upgrading and sustaining the competitive Baltic MoS link Germany-Finland (RoRo multiple ports loop)	Works	18.0	5.4
2014-EU-TM-0520-M	Motorway of the Sea Rostock-Gedser - Part 2	Works	21.1	6.3
2014-EU-TM-0546-S	Compliance monitoring pilot for Marpol Annex VI (CompMon)	Studies	4.2	2.1
2014-EU-TM-0673-S	Poseidon Med II	Studies	53.3	26.6
2014-EU-TM-0698-M	Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS)	Studies/Works	41.3	19.2
2014-EU-TMC-0708-S	Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS)	Studies/Works	1.5	1.3
2014-EU-TM-0723-M	Study and deployment of integrated gas & water cleaning system and biofuel-MGO blend for the upgrade of the Atlantic corridor	Studies/Works	6.6	3.2
2014-EU-TM-0724-W	Installation of gas & water cleaning system for the upgrade of the Atlantic Arch	Studies/Works	14.4	4.3
TOTAL			468.5	173.2

Source: INEA

Out of these,

- 6 actions were LNG Actions, with investments of EUR 262.4 million (EUR 99.7 million EU grants) as listed in the tables below.
- 13 Actions were scrubber projects with investments of EUR 175.6 million (EUR 58.3 million in EU grants) also listed in the tables below.
- There were 2 Actions in the area of electric vessels, on-shore power supply and waste water reception facilities, and 1 Action related to SECA compliance monitoring.

CEF- LNG related Actions

Project Code	Title	Action type	Inital total costs (€ M)	TEN-T support (€ M)
2014-EU-TM-0120-W	HEKLA - Helsingborg & Klaipeda LNG Infrastructure Facility Deployment	Studies/Works	28.7	10.2
2014-EU-TM-0087-M	TWIN-PORT 2	Studies/Works	97.6	29.3
2014-EU-TM-0095-W	ReaLNG: Turning LNG as marine fuel into reality in the North Sea-Baltic region	Studies/Works	40.0	13.1
2014-EU-TMC-0700-S	Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS)	Studies/Works	1.5	1.3
2014-EU-TM-0698-M	Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS)	Studies/Works	41.3	19.2
2014-EU-TM-0673-S	Poseidon Med II	Studies	53.3	26.6
Total			262.4	99.7

Source: INEA

CEF- Scrubbers related Actions

Project Code	Title	Action type	Inital total costs (€ M)	TEN-T support (€ M)
2014-EU-TM-0379-M	Back from Black -Study and deployment of the affordable scrubber retro fitting technology for SME shipowners	Studies/Works	20.2	7.2
2014-EU-TM-0385-M	Environmental compliance and upgrade of the North Sea MoS Felixstowe-Vlaardingen	Works	4.3	1.3
2014-EU-TM-0391-M	Upgrading and sustaining the competitive core Baltic MoS link Helsinki-Lubeck	Works	26.0	7.8
2014-EU-TM-0396-M	Environmental compliance and upgrade of the North Sea MoS Esbjerg-Immingham	Works	1.5	3.2
2014-EU-TM-0428-M	Environmental compliance and service upgrade of the North Sea MoS Cuxhaven-Immingham	Works	5.3	1.6
2014-EU-TM-0437-M	Upgrading and sustaining competitive sea-based transport service on Baltic MoS Klaipeda-Karlshamn	Studies/Works	9.7	3.0
2014-EU-TM-0451-M	Scrubbers: Closing the loop	Studies/Works	24.6	7.7
2014-EU-TM-0487-M	Biscay Line - Multiple port Finland-Estonia-Belgium-Spain long distance MoS, relevant to many core network corridors	Works	15.8	4.7
2014-EU-TM-0507-M	Upgrading and sustaining the competitive Baltic MoS link Germany-Finland (RoRo multiple ports loop)	Works	18.0	5.4
2014-EU-TM-0520-M	Motorway of the Sea Rostock-Gedser - Part 2	Works	21.1	6.3
2014-EU-TM-0723-M	Study and deployment of integrated gas & water cleaning system and biofuel-MGO blend for the upgrade of the Atlantic corridor	Studies/Works	6.6	3.2
2014-EU-TM-0724-W	Installation of gas & water cleaning system for the upgrade of the Atlantic Arch	Studies/Works	14.4	4.3
2014-EU-TM-0066-M	The Northern ScanMed Ports - Sustainable Maritime Links	Studies/Works	8.1	2.6
Total			175.6	58.3

Source: INEA

V. Development of Priorities for Pillar 2: Maritime transport integration in the global logistics chain[8]

1- Highlighting the role of MoS in efficient shipping and port operations. Optimising maritime transport operations

1.1. The struggle for ever-increasing efficiency

The quest for ever-increasing efficiency in shipping and port operations is driven by the need to improve competitiveness of EU industries. Transport is a derived demand and for the transport sector to serve trade, transport costs must be kept at a minimum. Maximising efficiency both at the sea side and in ports will reduce transport costs and contribute to increasing the competitiveness of EU traded goods and of EU industrial sectors.

On the sea-side, cut-throat competition and overcapacity in most shipping segments is forcing carriers to define different strategies for them to be able to offer quality transport services at minimum prices. As a result, ocean carriers are investing in larger vessels to secure economies of scale to reduce the costs per unit transported; alliances are being formed; mergers and acquisitions continue to take place. Vertical integration is deemed necessary to control the transport chain and lock-in a minimum profit margin; slow steaming, investments in more efficient ship engines and a wide range of other eco-efficient solutions for vessels are making it possible to reduce fuel consumption per slot. International and European regulations are pressuring shipowners to define a strategy to reduce emissions (this topic has been presented and widely discussed on the 1st MoS Forum on the Environment so it will be mentioned but it will not be the main focus of the present paper).

On the land side, ports are urged to increase terminal handling productivity by several factors, such as growing and concentrated traffic volumes, potential changes in shipping routes for new and enlarged passage ways, continuously increasing ship size and the consequent need to reduce ship turnaround time at the port, growing concentration in the shipping market brought by mergers and acquisitions and the creation of ocean carriers' alliances, and vertical integration of sea carriers in the door-to-door transport chain.

[8] The Issue Paper from which this chapter is taken was compiled by Eva Pérez, (Director of Transport Economics, Fundación Valenciaport) supported by Gabriel Ferrús and Jorge Lara (Fundación Valenciaport) and Alexio Picco and Monica Grosso (Circle). The paper was endorsed by Gunter Klein (dbh Logistics IT AG), Michael Renz (Swedish Maritime Administration), Michael Sakellis (Association of Greek Passenger Shipping Companies), and Charalambos Simantonis (Hellenic Shortsea Shipping Association). The full list of contributors is available in Annex 4.

1.2. Solutions

1.2.1. Sea side

Sea Traffic Management efficiency can be improved by providing ships with the ability to see each other's planned routes and navigators get a more complete picture of how surrounding ships will influence their onward voyage. Using this data, other services are able to produce valuable information and offer advice to vessels on their routes, such as recommendations to avoid congestion in areas with high traffic, avoidance of environmentally sensitive areas, and maritime safety information. The information exchange between ship and port actors will improve planning and performance regarding arrivals, departures and turnaround times.

Within MoS co-funded Actions, the strengths and weaknesses of the current maritime ship- and transport systems, operations and interactions have been assessed and a target concept and key performance indicators for four strategic enablers have been defined:

1. Voyage Management services will provide support to individual ships in both the planning process and during a voyage, including route planning, route exchange and route optimisation services.
2. Flow Management services will support both onshore organisations and ships in optimising overall traffic flow through areas of dense traffic and areas with particular navigational challenges.
3. Port Collaborative Decision Making (Port CDM) services will increase the efficiency of port calls for all stakeholders through improved information sharing, situational awareness, optimised processes, and collaborative decision making during port calls.
4. SeaSWIM (System Wide Information Management) will facilitate data sharing using a common information environment and structure (e.g. the Maritime Cloud). This ensures interoperability of STM and other services.

A common technical protocol for route exchange has been developed and approved as an interoperable industrial standard in August 2015. This is a huge achievement and a prerequisite for further development and deployment of Sea Traffic Management, which is outlined in a master plan available at www.stmmasterplan.com.

More Joint Industry Projects, co-funded via the EU MoS Programme are making efficient shipping operations possible. A wide variety of these projects were presented in all the 3

MoS Fora that took place in Brussels. Presentations and conclusions of the event are available on www.onthemosway.eu/.

1.2.2. Land side

Port investments part of Joint Industry Projects (JIPs) co-funded via EU TEN-T and CEF Programme include:

- Equipment to increase terminal handling productivity and innovation to reduce equipment consumption;
- Automation of port and terminal gates
- Dredging of berths and canals to maintain safe navigation and to increase the size of target vessels;
- Railway connections to ports quays and terminals;
- Alternative fuel re-fuelling facilities for ships (e.g. LNG bunkering and low-sulphur biofuels bunkering);
- Reception facilities for scrubber sludge at ports;
- Shore-side power supply facilities

Additionally, MoS co-funded projects have proven the relevance of developing a governance structure between the sea carriers and the ports at both ends of the maritime link; and defining a collaborative network of ICT platforms for ports and MoS services to adapt to the needs of shippers and be able to attract transport demand in their catchment areas.

A discussion paper on port hinterland connectivity elaborated by the OECD in 2015 highlighted some port strategies that could effectively increase port productivity, such as truck appointment systems, incentives for off-peak traffic and extended gates and dry ports, namely cases where large amounts of containers and cargo can be grouped before being dispatched to individual destinations.

1.2.3. Research and Development

The remarkable economic growth before the global financial crisis and general growth of sea trade flows since 2011 have put pressure on ports for developing capacity and increasing productivity. However, some operational inefficiencies and bottlenecks still exist, resulting in higher-than-necessary energy consumption, thereby increasing port emissions and other externalities due to the increased use of fossil fuels at ports. Just considering port terminals with a yearly container throughput greater than 500,000 TEUs, approximately 1.5

million tonnes of CO_2 emissions are generated every year in the EU. Facilitating the transition of the existing port terminals European sector towards low carbon and even local zero emission operative models is a challenging goal that should be promoted in R&D projects.

Motorways of Sea has been and will continue to be instrumental for the shipping sector to meet the new challenges resulting from the coming into force of the SECA area and for the survival of open trust in the future. Since 2009 MoS funds and priorities have been there to back the ability to react and evolve that the shipping industry in Europe has shown. In order to monitor MoS development and foster its priorities, MoS demand (in tons and units) should also be considered, identifying and following over time the evolution of MoS services (their respective traffics), and the associated savings along the core corridors (alleviated road traffics in ton/km).

Horizon 2020 and CEF co-funded actions to pilot new types of port equipment that use alternative fuels and energy sources are fundamental to reduce technical risk, bridge the gap between research and commercialisation and increase market uptake. Some fields where further research is necessary include: more types of LNG engines for terminal tractors, dynamic lightning of ports and terminals, hybridisation of rubber tyred gantry cranes (RTGs), using hydrogen cells for port equipment, systems to store energy generated by train impact on the tracks, wave, wind and solar energy systems in the port environment, among others.

Further research on digitalisation of maritime transport, Sea Traffic Management and autonomous shipping are areas that needs to be further addressed in research and should be highlighted in the coming work programmes of Horizon 2020.

Making the shipping and port industry cleaner and more competitive is our collective responsibility for the next generations and MoS is creating the framework conditions to favour these developments.

2- MoS links: effective connections to the hinterland

2.1. Connecting ports with their hinterlands and with Core Network Corridors (CNCs)

According to Article 21 of the TEN-T Regulation 1315/2013: “Motorways of the sea, representing as they do the maritime dimension of the trans-European transport network, shall contribute towards the achievement of a European maritime transport space without

barriers. They shall consist of short-sea routes, ports, associated maritime infrastructure and equipment, and facilities as well as simplified administrative formalities enabling short-sea shipping or sea-river services to operate between at least two ports, including hinterland connections". Article 21. 1. b) states that MoS include port facilities, freight terminals, logistics platforms and freight villages located outside the port area but associated with the port operations, information and communication technologies (ICT) such as electronic logistics management systems, and safety and security and administrative and customs procedures in at least one Member State, and in 21.1.c) infrastructure for direct land and sea access. Moreover, according to the 2011 Transport White Paper (COM(2011) 144 final), attractive and sustainable MoS would contribute to modal shift / avoid modal back shift.

Therefore, the legal concept of MoS establishes clearly that MoS is not only short-sea shipping but also the connections of ports to their hinterlands so that integrated door-to-door transport solutions can be effectively provided to shippers. Given this context, efforts will be concentrated in fostering synchro-modality, improving last-mile connections to ports and thus to short-sea services, connecting TEN-T Corridors via MoS and promoting green corridors.

Synchro-modality[9] becomes crucial as an instrument to provide effective MoS connections to the hinterland as it would allow the decision on the mode of transport for the next part of the route to be much more flexible, the representative of the shipper being able to make last minute changes to the transport route based on reliable online real-time information. Synchro-modality would bring about routing flexibility, improved quality of MoS door-to-door transport services and sustainability. The main advantage of this approach is that it makes it possible for there to be seamless integration between cargo, infrastructure and transport management systems and providing of advanced track and trace systems for intelligent monitoring and control of the transport service and cargo transported becomes a possibility. Additionally, this solution helps small and medium size companies to break barriers of entry in certain transport segments and it increases the competitiveness of all modes of transport in the network.

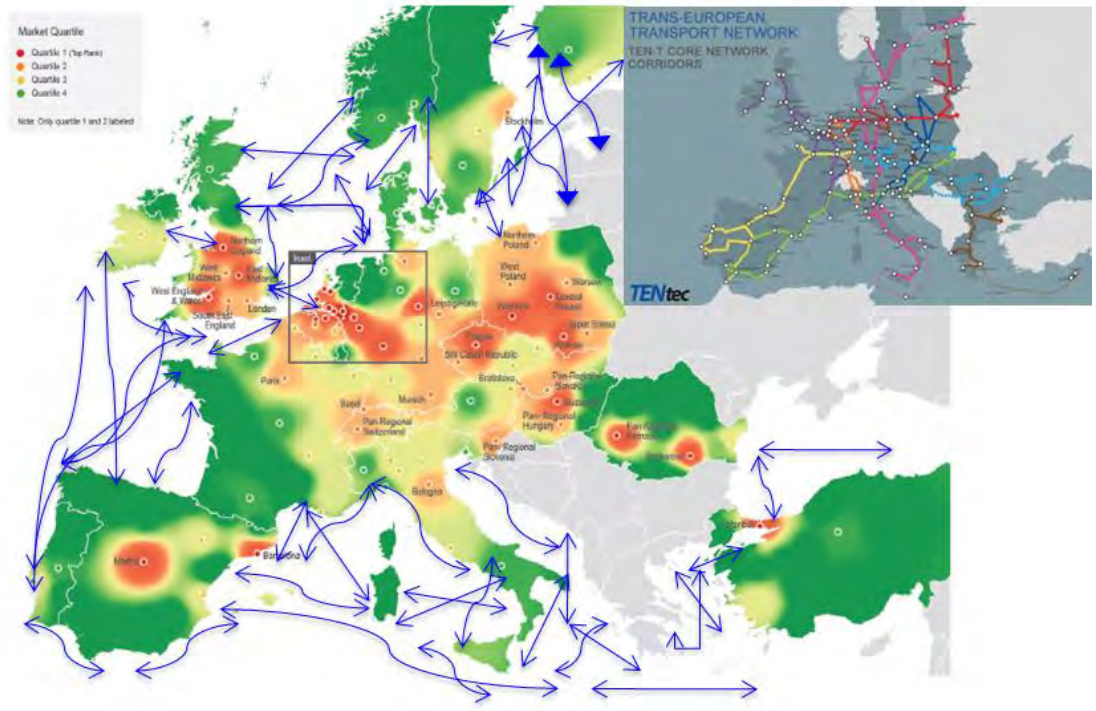
In this respect, efficient and strategically placed intermodal points should be developed and integrated with other local transport systems and international corridors.

[9] Synchromodality is a logistics method allowing dynamic interchangeability of transport modes at any point of the supply chain and at any given time during its execution. This means moving away from pre-defined routes and schedules, enabling logistics service providers to mix road, rail, air, and ocean to create a tailored solution for each client that is both more efficient and more environmentally friendly. Also, effective and efficient combination of intermodal means of transportation ensures that business and service requirements of key supply chain stakeholders are met.

Improving last-mile connections by rail and inland waterways is essential for MoS to integrate in the door-to-door logistics chain. This involves not only constructing physical infrastructure to connect ports via rail and with barge terminals to their hinterlands but also improving info-structure (and the related ICT solutions/platforms) to connect the different modes of transport to connect the different modes of transport present at a port.

MoS is also the way to connect short-sea links and maritime transport services with the Core Network Corridors (CNCs) and MoS links are the junctions allowing the connection of different CNCs. This concept is clear in the following map, showing the Europe's most favourable logistics locations, the European SSS routes and the 9 Core Network Corridors.

Map 1: European Logistics locations and SSS



Source: Presentation from Brigit Gijsbers – Director Maritime Affairs – NL Ministry Infrastructure and the Environment, MoS Forum 17 May 2016 – Brussels, based on Prologis Research 2016

Source: Presentation from Brigit Gijsbers – Director Maritime Affairs – NL Ministry Infrastructure and the Environment, MoS Forum 17 May 2016 – Brussels, based on Prologis Research 2016

MoS is the maritime dimension of the EU but it is also the means for connecting the ports and their hinterlands and as such, it is the only priority project covering the entire EU economic and transport space. MoS would therefore need to make sure that the TEN-T

Corridors project lists include all necessary last-mile connections to ports and extend the TEN-T Corridors project lists to ports of the comprehensive network, additionally complementing those project lists with projects related to the maritime dimension of the EU.

At the same time, MoS should also improve and provide all the necessary means for ensuring the connectivity of the regions with particular and special characteristics and needs acting as a vital part of a seamless logistics chain. EU counts nine outermost regions, while at least five member states have a wide number of islands connected to the hinterland through public service. For example, Greece is a Member State with a highly insular orientation, serving about 100 islands, 46 of which are off-the-beaten-track and have no airport facilities, thus only being served by sea through a very complex connectivity system of island-to-island, mainland-to-island and mainland-to-mainland lines. In case a part of this very complex connectivity network between the islands and the hinterland is not served, then a vital part of the logistics chain is equally removed resulting in ineffective MoS links.

Finally, the need to foster green corridors is clear. Green corridors would be a way to concentrate cargo in high-quality corridors, increase sustainability of the EU transport system and move away from a transport pattern where door-to-door road transport services are predominant.

2.2. Solutions

2.2.1. Sea and land side

MoS has co--funded a total of 21 works and studies and works projects in MoS links, representing a total of 1.21 billion Euros (actual total costs between 2008 and December 2014) of investments. MoS needs common solutions both at origin and destination ports of the short-sea link and good connections from the ports to the hinterland. Work undertaken by EU MoS co-funded projects is looking at the best ways to develop green corridors. KPIs such as energy consumption and emissions, operational aspects, external costs (including social and spatial planning aspects), infrastructure costs and internal costs have been defined in the SuperGreen (7^{th} Framework Programme funded project) as indicators to be used to assess the performance of corridors. This study has evaluated a series of green corridors covering different European regions and transport modes aiming to identify factors in need of improvement and bottlenecks to be solved.

Different consortia are studying which kind of incentives, financing mechanisms (e.g. ecobonus) and compensation measures generate the best results in terms of minimising the

environmental footprint. Business to business tools like the Clean Shipping Index allow cargo owners to select clean ships and quality ship operators. The internalisation of external costs (mainly environmental and congestion externalities) in the total transport price of the different modes of transport continues being a pending issue, as stressed in the OECD 2015 document mentioned before. Transport costs as well as emission and transit time information should be further analysed in order to optimise corridor performance, as underlined in the MoS project on Fresh Food Corridors.

Several partnerships of two or more ports in two Member States and a sea carrier are working together in the 21 MoS links projects previously mentioned to improve the connections between for instance Tallinn and Helsinki, Venice and Igoumenitsa and Patras, Frederikshaven and Gothenburg, in the Kvarken multimodal link and in the Dover and Calais "bridge". These MoS links projects will improve the efficiency of the logistics chain, expand or optimise cargo capacity at port terminals, improve railway connections between the ports and their hinterlands, share information by harmonising ICT platforms, among other tasks, and all of this will be carried out following a holistic approach that integrates the needs at shore and at sea in the same project.

Work is ongoing in other projects to pilot solutions for better integration of MoS, core ports and their hinterland and integrating processes and systems within different transport environments (road, rail, barge and maritime transport and in different transport infrastructure nodes: river ports, dry inland ports, railway stations and shunting areas, sea ports, logistical platforms and container terminals). The aim is to develop Corridor Information and Management Systems to optimise the flow of cargo and facilitate supply chain management for more efficient use of existing resources. Dedicated freight corridors would also contribute to these goals.

Ultimately, these projects will result in a more balanced modal split in Europe and a more environmentally friendly use of transport. These MoS Actions follow the guidelines of COP21 Paris, thereby generating positive effects in terms of reducing the environmental impact of transport in Europe. The environmental friendliness of MoS has been highlighted during the Second MoS Forum by the Director for Maritime Affairs of The Netherlands, Brigit Gijsbers. In her presentation, she stressed that using short-sea shipping should be promoted as it is the most energy-efficient and sustainable mode of transport. The Dutch Director for Maritime Affairs also recommended that shipping continues its efforts to become even greener and that the Rotterdam Rules are ratified so that digitalisation and machine to machine communication can become the norm in MoS and integrated logistics.

2.2.2. Research and Development

Developing smart, upgraded and fully interconnected transport infrastructures continues to be a challenge. MoS links projects and pilot actions show that defining common governance models and making the use of extensive ICT solutions , the creation of an integrated MoS transport chain and the connection of ports to their hinterlands and CNCs is possible. Connected to this, further research and development of a common information sharing and service distribution platform for enabling traffic management within respective mode of transport and as a basis for coordinating high utilization of available infrastructure / resources in the intermodal transport chain is needed in order enhance efficiency in intermodal integration and in terminal operations.

Furthermore, R&D on telematics applications and technological innovations (scanners, automated weighbridges, tracking technologies, different types of sensors for port terminal equipment, train locomotives and wagons, among others) is necessary for synchro-modality to become a reality and for MoS to be well integrated in the logistics chain.

More research on incentives and financing mechanisms contributing to greening corridors is necessary in order to assess which soft measures would reduce the most the environmental impact of the transport sector such as harmonisation of taxes on clean fuel and eco-incentives (to this respect the MED ATLANTIC ECOBONUS project, financed under the 2014 CEF Call, is already studying the development of eco-incentive solutions fostering MoS in Europe). This research should include socio-economic studies to evaluate which incentives would generate the largest increase in social welfare (thereby minimising opportunity costs of investing public money).

More effort should be also put on creating a common EU transport area ensuring smooth logistics operations, between the hinterland and the outermost areas. Equally important is the respective effort on incentives and financing mechanisms contributing to the recovery of lost ground from the outermost regions compared to the hinterland, in terms of connectivity means and infrastructure, including ports.

Finally, in order to cope with the increasing amount of general threats possibly affecting the overall transport network (including terrorism, natural disasters, societal changes etc.), the design and the adoption of an overall security management approach in the transport and logistics sector is recommended.

3- Efficient clearance procedures

3.1. Expediting Customs and other governmental agencies' procedures at ports

Cargo moving through ports must comply with Customs declarations and inspection formalities that take place in different locations such as border inspection points, port terminals and bonded warehouses. Furthermore, each public declaration and inspection has its own specific procedure that delays the clearance of cargo. Different authorities and bodies in charge of Customs controls and inspections are not perfectly coordinated and this results in longer than necessary clearance procedures and operational inefficiencies. On many occasions, one physical inspection may block a series of containers, trucks or goods declared in the same Customs Single Administrative Document. In many cases, the information exchanged is paper-based and this increases the potential for error. Finally, the use of several different information systems by Customs and other governmental agencies (OGAs) and the lack of interconnectivity of those systems also leads to inefficiencies in the controls.

Furthermore, the present Single Window structure does not appropriately take into account the possible synergies between maritime and customs processes, and therefore further reducing transit times at port logistics hubs should be possible. Information sharing is a key factor to achieve this.

An OECD report (Moise and Sorescu, 2013) concluded that the areas that seem to have the greatest impact on trade volumes and trade costs are the availability of trade-related information, the simplification and harmonisation of documents, the streamlining of procedures and the use of automated processes. According to the results of this study, the combined effect of improvements in these areas reaches almost 13.2% for upper middle income countries. Streamlining of Customs and OGAs procedures at ports would certainly have a significant impact on trade facilitation and contribute notably to costs reduction.

Promoting efficient cargo clearance procedures is particularly relevant for short-sea services as goods to be loaded onto a vessel deployed in short-sea shipping services usually arrive to the port at the last minute. Any initiative to be launched in this field should maintain port security and contribute to identifying, preventing and reducing losses as a result of criminal activity.

3.2. Solutions

3.2.1. Sea side

From June 1, 2015 it is compulsory to announce vessel calls at European ports electronically through a national single window (NSW). The parties mainly affected by the electronic announcement and vessel call notification are ship owners, shipping companies, shipping agents, ship masters and their representatives. MoS Actions have supported the process of

creation of NSWs therefore making the electronic announcement possible through a single point of data entry (data exchange by paper is no longer required), increasing data quality, avoiding redundancies in information reporting processes and harmonising notification obligations that allows easier data transmission between the maritime transport sector and the respective authorities. Reporting, therefore, must be done in a uniform matter and with the same reporting demands throughout the EU. Although further work is needed in this area, info-structures and systems allowing more efficient cargo clearance procedures and better coordination of administrative procedures (e.g. NSW) have been supported in various MoS co-funded projects involving Ministries, Customs, Health and Sanitary, Veterinary Police and Immigration, among other stakeholders.

The key proposals to further advance in this process are:

- The development of a unique Single Window for Trade and Transport comprising all modes, receiving data only once and redistributing them with a continuous effort in the development of common elements such as the machine to machine interface, the user interface, the data set and the message composition and the communication between Member States;
- The adoption of the eManifest in the EU, promoting synergies between DG TAXUD and DG MOVE to capitalize on common interest initiatives, promoting the implementation of fully integrated National Single Windows. It is also suggested to implement a process-driven approach at A2A and A2B level, including both ship and cargo-related data at the ship-port interface, for the harmonisation of the relevant administrative procedures, promoting the involvement, commitment and readiness of all parties to ensure that the NSW becomes a regular and standard feature of their business processes. These proposals have been supported by prominent stakeholders during the Second MoS Forum. The Italian Customs Agency has stressed the need to invest in IT projects to harmonise procedures and communication all over the European Union and to strike a balance between smooth trade flows and effective controls.

The need to promote more efficient customs clearance processes is shared at international level as stated by Mr Maaouni (Agence Nationale des Ports du Maroc, ANP) who emphasised the positive results that initiatives such as dematerialisation of foreign trade documents, electronic signature, using World Customs Organisation and IMO standards, trusting authorised economic operators, promoting fast clearance and in general achieving paperless trade would have.

3.2.2. Land side

Work is ongoing to ensure that trade is ready for the transition to the new Union Customs Code (UCC) and that intermodal transport security and safety can be improved via advanced integrated surveillance, monitoring and control systems, and incorporating intelligent systems to cross-border operations.

JIPs have increased the overall efficiency of the business processes across the hinterland logistics chain (e.g. access control procedures to ports by installing automated cargo and truck control systems at port and terminal gates), maintaining high levels of security and making it possible for new track and trace events to be included in traceability tools available for shippers and their representatives.

A good example of enabling multimodal and efficient freight transport logistics implemented within MoS projects is the Customs fast corridors. This concept supports multimodal delivery of cargoes from port terminals to inland final destinations, allowing unloaded containers in ports to be immediately moved to inland terminals or inland final destinations, thanks to the digital exploitation of the e-manifest across the logistics chain. Adequate levels of safety and security controls are ensured through the physical and documentary tracking and tracing of the goods. A simplified and paperless chain is the main outcome, allowing the smooth and seamless flow of electronic data throughout the supply chain specifically including the exchange of data with public authorities and businesses (e.g. Port Authorities, Customs, terminal operators, maritime and inland transport operators, etc.) and resulting in interconnected and interoperable digital infrastructures, exploiting the "Internet of Goods" paradigm and the "submitted-once" principle. The entire multimodal chain is digitally connected: cargoes are tracked in real time and clearing procedures are timely and efficiently differed to final destination, leading to a reduction in the overall time to destination and to lower management costs, thanks to the combined effect of simplification and digitalisation.

An unresolved quest for many port operators is good estimates of when particular operations will take place during port calls. It is common among ports that the estimated time of departure (ETD) differs significantly from the actual time of departure (ATD) and that the different actors fail to share real-time data about state changes of port operations. There is a solution. Inspired by the aviation industry. The Port Collaborative Decision Making (PortCDM) concept has been brought forward as a part of a sea traffic management MoS co-funded project. PortCDM is one of the concepts enabling a holistic approach to Sea Traffic Management (STM) and is thus a key enabler for realising the full potential of STM for safe,

efficient, and sustainable sea transport from berth-to-berth. Synchronised and coordinated port call operations build upon the principle that information objects are shared among different stakeholders. Port Collaborative Decision Making has been introduced for the purpose of ensuring synchronised and optimised port visits and it allows involved actors to share intentions, as well as actuals, about the occurrence of different events by standardised procedures, interfaces, and message formats. This enables involved actors to increase their ability to predict when a particular event is about to occur. The emergence of this concept, and real-life tests performed in two ports of Gothenburg and Valencia, has enabled an understanding of challenges that needs to be met for the coordinated port approach. This concept will be tested and validated in totally 13 European ports in a MoS co-funded project.

3.2.3. Research and Development

Research and development projects focusing on further automation at ports and digitalisation along the global transport chain can generate positive results in terms of growth in efficiency of cargo clearance procedures.

Scanners and other types of verification systems can be further automated and more specifically designed to identify threats and assess compliance with ISPS requirements, anti-smuggling and other security regulations. The use of new scanning technologies (e.g. muon tomography) could entail considerable improvements (for instance, there is no harmful ionising radiation and the muon scanner can be used to detect nuclear matter encased on another material so it can be vital for port security) in comparison with the currently more commercial options (i.e. X-Ray or Gamma technologies).

Introducing advanced robotics (e.g. new type of Autonomous Ground Vehicle and related container management systems), sensors in equipment and other port and transport elements, beacons, machine to machine communication and using seals for containers and other transport units can expedite the transition of goods through ports and other nodes in the logistics chain. R&D projects in the fields of robotics and Internet of Things are progressing continuously in this direction.

4- Enabling technologies

4.1. Bringing MoS into the digital society

As Motorways of the Sea comprise the European maritime space where ships are deployed in services coming to and from European ports, as well as the procedures that ensure safe and secure transport operations, the traffic management services and the links of ports to other modes to connect MoS with port hinterlands and CNCs, a wide range of technologies need to be used to enable smooth connection of modes of transport and nodes along the door-to-door logistics chain.

"*Access to data, data sharing and smart and collaborative logistics are important enablers for the integration of modes, enhanced supply chain management and better use of resources and infrastructures. This requires apart from innovative technologies the appropriate digital infrastructure, in combination with new business models. Electronic data should flow as smoothly and seamlessly through the supply chain including the exchange of data with public authorities and between businesses*"[10].

4.2. Solutions

4.2.1. Overall solutions

"The aim is to develop and establish Digital Corridor Information and Management Systems to optimise the flow of cargo, facilitate supply chain management and to make better use of existing resources. This should lead to concrete projects testing the feasibility of solutions and establishing the appropriate digital infrastructure"[2].

4.2.2. Sea side

MoS co-funding has provided support for the creation of National Single Windows, Sea Traffic Management and other e-maritime systems to streamline procedures and speed up the transport process and cargo clearance.

Additionally, projects and Administrations are working in MoS Actions to keep track of ships movements and provide navigational safety in a limited geographical area using typical VTS systems like radar, closed-circuit television (CCTV), VHF radiotelephony and automatic identification system (AIS). VTMS systems installed in some of the busiest waters in the world are making valuable contributions to safer navigation, more efficient traffic flow, and protection of the environment.

Vessel automated evacuation planning systems will soon be possible thanks to innovation co-funded by the MoS priority project.

[10] Issue paper in *Multimodal Freight Logistics.*

As part of the a sea traffic management project co-funded by MoS, so called application services (e.g. route optimisation services) and support services (e.g. authentication, authorisation, service discovery) are developed as modules based on a service-oriented architecture. To communicate, the application services depend on a maritime digital infrastructure that is called Sea System Wide Information Management (SeaSWIM). The fundamental objective for SeaSWIM is to provide and maintain a harmonized way of communicating within the maritime industry. This implies that open and accessible standards are promoted. Unifying the way maritime stakeholders communicate enable common understanding and strengthen the ecosystem by providing new ways of interaction.

4.2.3. Land side

On the land side, scanners, gates, weighbridges, beacons, sensors, optical character recognition, robotics, among other, are hardware elements usually deployed in MoS co-funded projects. These elements are connected to NSW, port community systems (PCS), rail traffic management systems (RTMS), river information systems (RIS) and intelligent transport systems (ITS). MoS actions are creating a co-operative network of PCS and other nodes as well as transport systems to optimise transport management, provide easier access to the market and exchange trade, logistics and transport information.

Technologies are also enabling to further improve interoperability of systems for the exchange of transport and trade documents in intermodal door-to-door MoS transport chains involving different combinations of maritime, rail, barge and road transport.

Additionally, several port authorities (e.g. North-Adriatic Ports Association; Port Authority of Piraeus and other Attica region ports) have developed common information systems and services for clusters of ports to optimise the use of infrastructure, generate efficiency gains and bring about larger economies of scale in the geographical area where they are inserted.

Some more examples of MoS results concerning enabling technologies are provided here below:

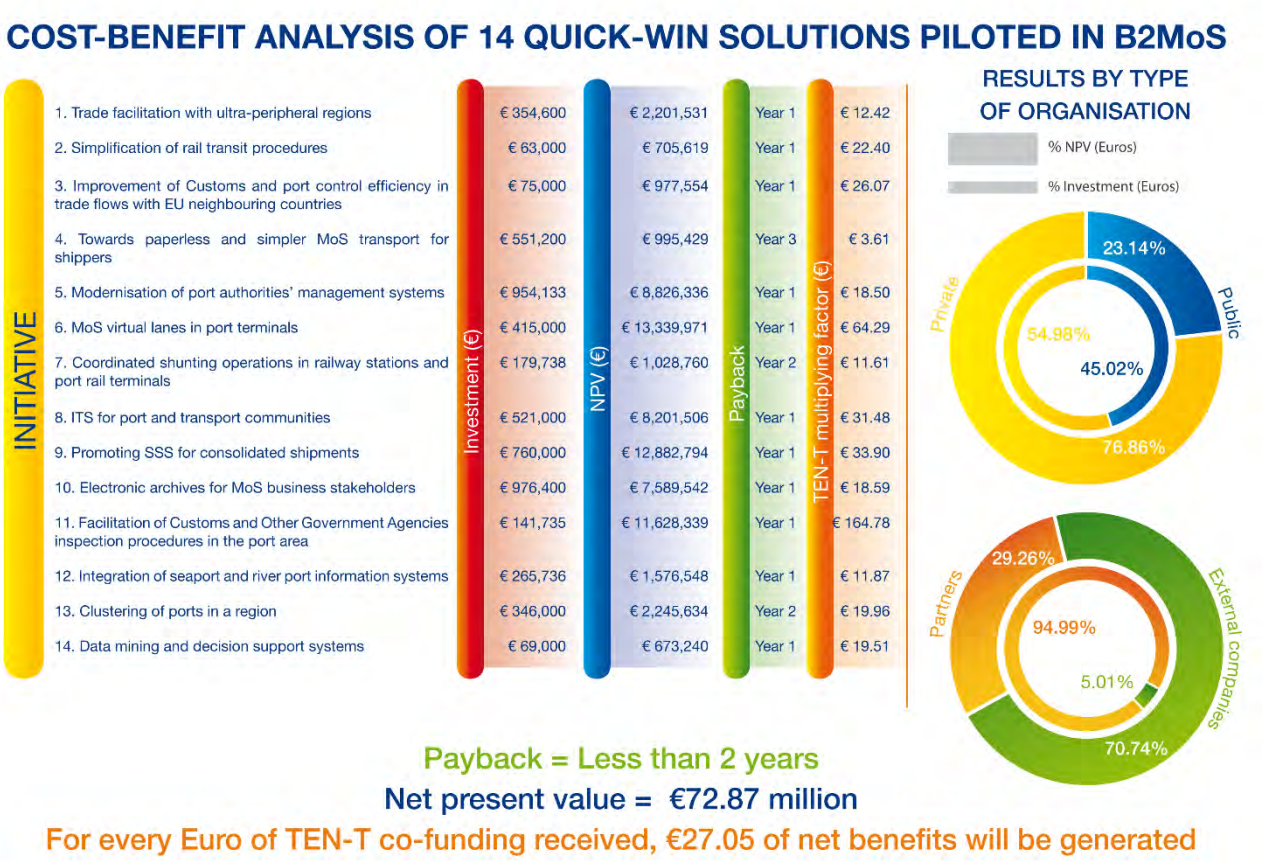
1) Appointment systems for all inspection services and cargo access to terminals. These systems enable users to share information about the list of shipments to be inspected or to enter and leave the terminal and the port, reducing queues and turnaround times for trucks in ports and consequently decreasing congestion. As an example, just the use of mobile technologies and apps to provide real time information to truck drivers waiting to collect inspected cargo at the Border Inspection Point has reduced waiting time from 1 hour to 15 minutes in the Port of Valencia.

2) Implementing auto-clearance processes for transhipment traffic enables the simplification of transactions (e.g. fully automated import/export transhipment process) and provides greater visibility, coupled with the use of quality data. The result is a significant reduction in consignments being held or detained, while greater visibility has enabled all parties to expedite clearances and subsequent release for on-carriage.

3) Corridor management platform connecting different actors across the maritime and hinterland transport chain supporting the rationalisation of processes focusing on the integration of their business processes and promoting the use of enabling technologies on tracking and tracing and the use of e-seals.

Results of MoS co-funded projects are being provided as input information to the Digital Transport Logistics Forum (DTLF) as both the MoS priority project and this new DTLF platform support digitalisation of freight transport and logistics. Examples of MoS findings provided are electronic messages defined to exchange information in crucial trade and transport documents such as the electronic sea waybill, electronic rail consignment note and electronic T2L (proof of Union status of the traded goods). The implementation of the electronic T2L (proof of Union status) in Spain was one of the results of the MOS4MOS piloted initiatives and according to Spanish Customs, just this initiative generates net savings for up to 39.8 million Euros only in Spain.

Investing in technologies and systems to facilitate trade and integrate MoS into the logistics chain can generate very good returns on investment as it has been proven in the MoS co-funded project B2MoS. Within this project, 14 ICT-related initiatives have been piloted by 27 companies in 6 EU countries and the net present value of implementing these initiatives has been estimated to be 72.87 million Euros over a period of 10 years. These results have been obtained using very conservative assumptions and hypothesising that these initiatives will only be implemented by those companies that have participated in the pilots (these assumptions are very conservative as any Customs or other governmental agency related initiative will be implemented nation-wide and will not affect only the small number of companies participating in the pilot). The following picture summarises the results of the cost-benefit analysis of the B2MOS project.



Source: B2MoS presentation, Second MoS Forum, Brussels, 17/05/2016

4.2.4. Research and Development

Internet of Things and big data are the two main fields of work concerning research projects at present. The combination of both provides a myriad of data to be analysed using decision-support systems in order to optimise vessel equipment, transport service and port capacity, improve energy efficiency and lower operational costs. On the vessel side, research should continue on sensors, beacons, onboard wireless communication and other systems able to work in a highly complex ship environment where so much steel is present.

On the land side, as mentioned before, research and development projects focusing on further automation at ports, the use of robots, electronic seals, OCR, automatic and connected weighbridges and scanners, as well as digitalisation along the global transport chain can generate very positive results in terms of faster cargo clearance procedures, greater visibility for the shipper or its representative of the logistics chain and safer and more secure transport operations.

On the global door-to-door logistic chain, further opportunities of automated vessel tracking services to retain Community status of goods transported by sea between EU ports still needs to be sought. For example, the full traceability of goods supported by the definition of an EU reference standard for electronic seals (e-seals) as well as a set of minimum data to be included in the e-seals should be sought (as put forward by the Italian Customs Agency during the Second MoS Forum).

5- Maritime spatial planning

5.1. Improving maritime planning and management

Maritime space is experiencing a rapidly increasing demand for different purposes, such as installations for the production of energy from renewable sources, oil and gas exploration and exploitation, maritime shipping and fishing activities, ecosystem and biodiversity conservation, the extraction of raw materials, tourism, aquaculture installations and underwater cultural heritage, as well as the multiple pressures on coastal resources.

All these demands require an integrated planning and management approach. To achieve this, the EU adopted the legislation to create a common framework for Maritime Spatial Planning in July 2014 (Directive 2014/89/EU). While each EU country will be free to plan its own maritime activities, local, regional and national planning in shared seas would be made more compatible through a set of minimum common requirements.

5.2. Solutions

5.2.1. Integrated overall approach

Maritime Spatial Planning (MSP) processes including the interactions between land and sea are still being developed in most EU Member States. A recent workshop within the framework of the SSS high level meeting organised by the Dutch Government has shown that planners and the stakeholders in the world of maritime transport are better off by early engagement and that is essential to connect MoS and SSS with Blue Growth (wave, tidal and offshore wind power, aqua and mari-culture, deep sea mining, blue biotech and coastal and nautical tourism) and Maritime Spatial Planning (attention to be given to the land-sea interactions).

5.2.2. Sea side

Maritime Spatial Planning has become a widely acknowledged and necessary tool for coordinating spatial use in the sea. There are three main solutions from the seaside that

contribute to safer navigation, more efficient traffic flow, and protection of the environment: passage planning, traffic management and VTMS (Vessel Traffic Management Systems).

Passage planning or voyage planning is a procedure to develop a complete description of a vessel's voyage from 'berth-to-berth'. Regarding traffic management, Rule 10 of the COLREGs prescribes the conduct of vessels when navigating through Traffic Separation Schemes (TSS) adopted by IMO. A MoS project on sea traffic management is currently dealing with these two issues and it will provide support for individual ships in both the planning process and during a voyage, including route planning, route exchange, and route optimisation services.

VTMS systems installed in some of the busiest waters in the world are making valuable contribution to safer navigation, more efficient traffic flow, and protection of the environment. Typical VTS systems use radar, closed-circuit television (CCTV), VHF radiotelephony and Automatic Identification System (AIS) to keep track of vessel movements and provide navigational safety in a limited geographical area.

5.2.3. Land side

HELCOM Marine Protected Areas (MPA) synchronize the collaboration around the Baltic Sea and North Sea area where some of the country priorities are: Germany is ahead regarding wind; Norway ahead within offshore and fishery; Netherlands focus on spatial planning; and Sweden, as well as Poland, is looking into infrastructure and protected areas. EU MoS co-funded Joint Industry Projects contribute with data and information to the work in this group.

Furthermore the following aspects should be taken into account:
a. Offshore shipments for construction and maintenance of activities such as wind turbines and ocean energy converters.
b. Shipbuilding for the various sea borne activities such as fishing, aquaculture, deep sea mining and nautical recreation (sailing, yachting, super yachting and cruise vessels).

5.2.4. Research and Development

Europe’s waters need increased efforts in research and development projects aiming to develop activities at sea as efficient and sustainable as possible. This demand is expressed not only by the scientific community but also increasingly by the society in general.

In the past years, some initiatives were developed to support the introduction of Integrated Maritime Spatial Planning and preparation of Maritime Strategies, such as:

- Plan Bothnia - Preparatory Action on Maritime Spatial Planning in the Baltic Sea (2010-2012).
- BaltSeaPlan - Baltic Sea Region Programme project "Introducing Maritime Spatial Planning in the Baltic Sea" (2009–2012).
- TPEA, Transboundary Planning in the European Atlantic – Project on Maritime Spatial Planning in the Atlantic, including the Celtic Sea and Bay of Biscay (2012-2014).
- ADRIPLAN - ADRiatic Ionian maritime spatial PLANning (2013-2015).

Moreover, there are some R&D projects underway in Europe dealing with this topic, for example, the Baltic SCOPE - Cross-border solutions in Baltic Maritime Spatial Plans (2015-2017). Some key challenges that R&D projects should address are the delivery of Galileo, and the launch and implementation of concrete cooperation initiatives between Member States. Finally, a learning tool such as www.mspchallenge.info should be further exploited.

6- External dimension

6.1. Connecting the EU with third countries and facilitating EU external trade

MoS fosters actions to facilitate European trade and smooth the flow of goods in four natural geographical pathways for EU external trade: the Atlantic, North Sea and the Baltic, Mediterranean – Black Sea and the Suez Canal.

The EU has historically prospered in periods when their economies have opened to trade and it should be borne in mind that 70% of external trade is transported by sea (in tonnes). MoS will be the instrument to extend the reach to peripheral regions, both in Cohesion countries and in non-Cohesion countries as there are several regions in Scandinavia for instance that would benefit from efficient MoS supply chains to facilitate trade. The same case applies to neighbouring countries, where MoS is the instrument supporting the development of complementary efficient logistics chains in the Mediterranean, Black Sea and Eastern neighbouring countries. EU ports are encouraged to support port management in EU neighbouring countries as one of our first cooperation priorities, this field of work including making transport systems interoperable and networkable.

Within the Euromed countries, while there are no land connections between the respective networks, a process is on-going to define the transport network of the southern Mediterranean countries and some MoS projects are already been implemented. This network – through seagoing connections must be well connected with the TEN-T one (also

through the implementation of common standards) and could represent a possible first extension of the TEN-T towards Africa as the growth potential of Africa is important, but the transport connections remain still very weak.

In terms of cooperation the so called 'Macroregional strategy' (an integrated framework endorsed by the European Council to address common challenges faced by a defined geographical area relating to Member States and third countries located in the same geographical area) can play a key role. Currently, the European Union is implementing four macro-regional strategies: the EU Strategy for the Baltic Sea Region, the EU Strategy for the Danube Region, EU Strategy for the Adriatic and Ionian Region and the Alpine macro-regional strategy. They require more coherence between funds, structures and policies. The strategies have created working structures around priority areas, selected in a bottom-up process of consultation. MoS are well in the focus of those strategies: for instance in the EU Strategy for the Adriatic and Ionian Region (EUSAIR) comprising eight countries, namely 4 EU Member States (Croatia, Greece, Italy, Slovenia) and 4 non-Member States (Albania, Bosnia and Herzegovina, Montenegro, Serbia), the EUSAIR Action Plan is focused on strengthening maritime safety and security, developing a competitive regional intermodal port system and intermodal connections with the hinterland, both for freight and passengers.

Trade between the EU and US represents about one-third of the total EU external trade and the Transatlantic Trade and Investment Partnership (TTIP) which, according to current state of knowledge, is to be signed soon will create 800 million people where trade flows are expected to grow substantially. Two of the main contents of this trade agreement are helping cut red tape that companies face when exporting and setting new rules to make it easier and fairer to export, import and invest overseas. As it can be observed, the contents of the agreement coincide with two of the priorities that the MoS priority project has had over the last decade.

Commercial links with Asia, Africa and Latin America have been traditionally strong and continue to be so, MoS being in charge of strengthening those links and making them more efficient.

Consequently, MoS needs to continue working on trade facilitation and strengthening connections with our main trade partners worldwide. Finally, MoS contributes decisively to strengthening the EU territorial cohesion as it is the priority project that allows peripheral and outermost regions to be connected to the rest of the EU and to the world.

6.2. Solutions

MoS needs to take the wider external dimension of the EU and its related aspects into account, such as the need to create the conditions for EU ports to be regional hubs and enable shippers in their hinterlands to benefit from economies of scale and scope that come about. Although increasing port productivity is a must for all ports, it is particularly important for transhipment ports. MoS has contributed to co-funding investments for ports to become more efficient in many aspects (e.g. improving terminal handling productivity, cutting administrative burdens, automating accesses, among other).

MoS co-funded actions are also looking at the possibility to establish LNG bunkering stations in outermost regions like Açores and the Canary Islands as these archipelagos are strategically positioned for shipping lines crossing the Atlantic. Such stations would also strengthen the links between these regions and the TEN-T network, producing positive socio-economic effects.

Trade with outermost regions has also been facilitated in various MoS projects. For instance, the need to present the Customs declaration for exports to the Canary Islands has been eliminated for shipments of less than €3,000 or for those that take place intra-company. This initiative enables the digitalisation of the export documentation, which until now had to be presented in person to Customs. Information is now sent electronically. Additionally, the solutions proposed will decrease the amount of data which needs to be manually entered, reducing time spent compiling such data and minimising errors in the documents submitted to Customs. Although the value threshold for new Customs simplification is relatively low, this simplified process represents a very significant improvement for consolidated shipments. Small and medium-sized enterprises and intra-company trade flows will also benefit considerably from it.

Another MoS project is supporting the effective shipment of refrigerated cargo from the Middle East to the North of Europe using sustainable modes such as reefer block trains from Med ports to central and northern Europe. Attention is also being paid to maritime connections in the Scandinavian Region, where MoS aims to streamline the east-west connections between the northern parts of the Atlantic and Russia as well as with regions still further east. This is very relevant also in relation to the opening of the North-East Passage in combination with SECA stipulations and effects on freight transport. Moreover the need is felt also for promoting green corridors and connections for peripheral Member States with isolated road based freight networks, not only to mainland Europe, but also in the UK.

The impact of MoS support would be even larger if outermost regions in Cohesion countries were to be allowed to use Cohesion Funds for MoS projects. The CPMR Islands Commission proposes that aid intensities vary to adapt to specific regional situations, such as remoteness or insularity. Co-funding rates for MoS works actions in these regions could for instance be supported by more than the uniform rate of 30%.

6.2.1. Research and Development

Impact studies on the effect of the expansion of the Panama Canal, the Transatlantic Trade and Investment Partnership, the future opening of the Artic shipping route and the Union for the Mediterranean should be analysed in-depth and measures and actions defined to generate the maximum European social welfare out of these events should be put in place with the support of MoS.

7- Financing of ships and ports investments

7.1. Financial needs

Although EU MoS grants have made all the previously mentioned projects possible, the vast amount of investments needed for shipping, ports and their connections to the hinterland and CNCs cannot depend exclusively on grants. The European Investment Bank (EIB)'s products and new financial instruments will be necessary to finance crucial investments in the European maritime dimension and integration of MoS in the global transport chain.

As it was discussed in the 1st MoS Forum on the environment, the challenge for an LNG-fuelled newbuilding is that the ship acquisition price is approximately 25% higher than the same vessel using conventional fuels, whilst earning prospects remain the same in the both cases. Financial instruments are needed to cover the additional 25% for the environmental part of the investment.

Projects like the Green Shipping Financing Tools (GSFT), the Zero Vision Tool and the Europa Ship Plan can become decisive for the development of sustainable shipping in Europe. The Europa Ship Plan aims to introduce a sustainable financing strategy using the benefits of financial blending, for the renewal of the European Short Sea Shipping fleet by adding innovative and green characteristics to it for ensuring the green compliance to the existing and forthcoming environmental regulations. Economies of scale derived from standardisation of the ships construction process may bring down newbuilding prices by 15%. The implementation of this Plan is based on innovative European funding tools (TEN-T, CEF, Juncker Plan, EIB EFSI, etc).

The basic idea behind these Green Shipping Financing Tools is to stimulate ship-owners to invest in green ships by making use of EU guarantees providing easier access to finance and more attractive financial condition, even though some practical barriers become apparent. On a Member State level national banks seem to be reluctant to engage whilst at EU level, the EIB will only finance a maximum of 50% of the green investment and has indicated that it is essential for national banks to participate.

7.2. Solutions

7.2.1. Sea side

For European shipping and logistics to become more sustainable, competitive and safer, investments in the renewal or retrofitting of vessels so that they use alternative less-pollutant fuels will be necessary, as well as in the final implementation of NSW in some Member States where these projects have not been finalised yet, and in the deployment of VTMS in European waters.

In this respect, it is recommended to provide clear incentives to use financial instruments to promote the greening of shipping under the conditions of transparency and equal opportunities for EU Member States. Additionally, National Governments and the European Commission should facilitate greening of transport by providing a stable legal framework. All EU Member States should have equal opportunities to participate in the financing scheme with the aim of greening the European shipping industry. Intra-EU competition in the field of financial instruments needs to be avoided.

Fair competition in the market should always be kept as a basic principle concerning financing transport services and transport infrastructure as Mr Joao Carvalho, President of Autoridade da Mobilidade e dos Transportes stressed during the Second MoS Forum. The need to create a level playing field between the different modes of transport was also highlighted by Mr Charalambos Simantonis, President of the Hellenic Short-Sea Shipping Association.

Finally, it is recommended that the European Commission work closely together with the EIB and is open, clear and transparent on funding mechanisms and opportunities available for the EU Member States.

7.2.2. Land side

Only a small part of the port investments in the EU can be co-funded by grants from the EU and the need for ports to adapt to the demands of shipping (e.g. growth of vessel size) and the logistics sector (just in time and greater visibility of cargo movements) requires constant investments. Additionally, many ports need improved access to them and better connections (mainly by rail) to the hinterland and CNCs. Instruments such as the European Fund for Strategic Investments (EFSI) will be critical for many port sector investments to materialise.

The Second MoS Forum discussions stressed the importance of defining clear financing guidelines regarding transport infrastructure construction and the European Commission was asked by several relevant stakeholders to look into it. The need to keep time required to obtain necessary permits for transport infrastructure construction to a minimum was also highlighted by the Secretary General of the European Sea Ports Organisation. Several stakeholders (e.g. Port of Le Havre and UK Department of Transport) agreed on the need to keep permitting time to a minimum as it is an uncertainty period and time required has been progressively growing over the last couple of decades.

The principle of blending should be further supported, combining EU grants with loans or equity from public and private financiers. A blended use of grants and EFSI, for instance, can increase the number of transport projects supported such as rail and inland navigation. To this effect, a better coordination between CEF future calls for grants and financial instruments under EFSI and CEF should be ensured.

Examples of existing projects that have benefited from blended mechanisms are:

- The London Gateway Development that comprises a new deep water port terminal and an adjacent logistics park; funding was sought only for the development of the first phase of the port terminal (first 3 berths together with the required equipment, rail and road connections and dredging). Subsequent phases of the port terminal and the logistics park are financed separately. The London Gateway transaction is the seventh traffic risk TEN-T project to benefit from the LGTT instrument and the first maritime project in the LGTT portfolio;
- The Calais port consisting in the design, build, finance, maintenance and operation of an extension of the Port of Calais together with the operation and maintenance of the existing Port of Calais and Boulogne sur Mer (50 year concession). In July 2015 a transaction under the pilot phase of the Project Bond Initiative (PBI) has been successfully proposed to finalise the financing plan. The port extension, which requires investments in excess of EUR 700 million, was structured as a PPP. The private sector consortium issued project bonds for a total amount of EUR 503.5

million, which were in turn supported by the PBI for an amount of EUR 50.4 million. In addition, a EUR 98.5 million CEF grants has been allocated to the Nord Pas de Calais Region to support the public subsidy to be provided by them.

7.2.3. Research and Development

Several studies including pilot actions co-funded by MoS have shown the innovations that support the most the integration of MoS into the global transport chain. Dissemination of results has proven to be relevant to communicate main findings and encourage potential followers to adopt similar solutions. For innovative initiatives to become the normal investment decision in the port, transport and logistics sectors, it is important that studies including pilot actions carry out financial feasibility and cost-benefit analyses of the different solutions piloted, so that public administrations and potential followers can evaluate which initiatives would generate the best results. The same applies to R&D projects in the fields examined in points 1 to 6 in this discussion paper. Assessing which innovative technology or process generates the best results in R&D projects (and therefore it is worth to test it in real life operations in pilot actions) is relevant in order to speed up the time between research and implementation of a certain potential solution that can be adopted by the market.

TEN-T PROJECTS UNDER PILLAR 2

In total there have been 21 projects financed under TEN-T that related to integration of the maritime transport in the logistics chain in the period from 2008-2013. These have generated just over EUR 759,6 million of investments of which the EU has contributed EUR 167,3 million. Of the 21 projects, 14 were Links/intermodal connections projects, these projects amounted to an overall investment of EUR 695.3 million, EU contribution of EUR 125.4 million.

Below is the list of all TEN-T Links/intermodal connections projects related projects.

The TEN-T MoS Links/intermodal connections projects

Project Code	Title	Initial total costs (€ M)	Inital TEN-T funding (€ M)
2008-EU-21010-P	Motorway of the Sea - High Quality Rail and Intermodal Nordic Corridor Konigslinie	13.5	2.8
2008-EU-21015-P	Motorways of the Sea projects in the Baltic Sea Area Klaipéda-Karlshamn link	22.2	4.5
2008-EU-21020-P	Motorways of the Sea Esbjerg - Zeebrugge	16.9	3.3
2009-EU-21010-P	Baltic Link Gdynia-Karlskrona	85.5	17.1
2010-EU-21107-P	Motorway of the Sea Rostock - Gedser	111.8	22.4
2010-EU-21108-P	The Baltic Sea Hub and Spokes Project	172.6	15.8
2011-EU-21001-M	Adriatic Motorways of the Sea (ADRIAMOS)	56.7	12.2
2011-EU-21009-M	IBUK – Intermodal Corridor	32.0	7.3
2012-EU-21011-P	TWIN-PORT	56.3	11.3
2012-EU-21013-M	Kvarken Multimodal Link - Midway Alignment of the Bothnian Corridor	20.6	6.1
2013-EU-21001-P	BRIDGE - Building the Resilience of International & Dependent Gateways in Europe	72.0	14.2
2013-EU-21004-P	Sustainable Trelleborg-Swinousjcie MoS services based on upgrading port infrastructure, developing intermodal transport and integrating hinterland corridors	10.9	2.0
2013-EU-21017-S	Development of North Adriatic ports multimodal connections and their efficient integration into the Core Network (NAPA STUDIES)	5.6	2.8
2013-EU-21009-P	ATLANTICA OPTIMOS	18.1	3.6
Grand Total		**695.3**	**125.4**

Source:INEA

CEF projects under pillar 2

The total number of integration of the maritime transport in the logistic chain shipping projects financed under CEF so far has been 6, reaching a total investment of EUR 163.7 million. The EU total contribution to these 6 projects has been EUR 55.7 million. Moreover, Twin Port 2, has to be added to the list and to the table below.

CEF funded Actions on maritime transport integration in the global logistics chain

Project Code	Project Title	Action Type	Initial Total costs (€ M)	CEF support (€ M)
2014-EU-TM-0333-W	BRIDGE (Building the Resilience of International and Dependent Gateways in Europe) - Motorways of the Sea II	Work	111,645	33,493
2014-EU-TM-0507-M	Upgrading and sustaining the competitive Baltic MoS link Germany-Finland (RoRo multiple ports loop)	Study and Work	18,138	5,461
2014-EU-TM-0531-S	FRESH FOOD CORRIDORS	Study	21,406	10,703
2014-EU-TM-0544-S	MED-ATLANTIC ECOBONUS	Study	1,930	965
2014-EU-TM-0640-M	Sweden-Poland Sustainable Sea-Hinterland Services "Sustainable Swinoujscie-Trelleborg MoS based on upgrading port infrastructure, developing intermodal transport and integrating hinterland corridors."	Study and Work	6,221	2,912
2014-EU-TM-0671-S	Atlantic Interoperable Services (ATLANTIS)	Study	4,373	2,186
Total			**163,713**	**55,720**

Source:INEA

Moreover, a number of ICT related projects (under TEN-T) covering maritime and hinterland transport can be also identified as in the following table.

Project Code	Title	Actual total costs (€ M)*	Actual TEN-T funding (€ M)*
2010-EU-21101-S	MoS 24 - ICT based Co-modality Promotion Center for integrating PP24 into Mediterranean MoS	4,9	2,5
2010-EU-21102-S	Monitoring and Operation Services for Motorways of the Sea (MOS4MOS)	5,1	2,5
2010-EU-21105-S	MIELE	16,0	8,0
2010-EU-21106-S	ITS Adriatic multi-port gateway	2,9	1,4
2012-EU-21021-S	WiderMoS	5,9	3,0
2012-EU-21020-S	Business to Motorways of the Sea	11,4	5,7
2012-EU-21019-S	ANNA - Advanced National Networks for Administrations	37,1	18,5

VI. Development of priorities for Pillar 3: Safety, traffic management and the human element[11]

International maritime transport is regulated at global level by the International Maritime Organisation (IMO), the United Nation's specialised agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. Shipping is a global sector, and as such the vast majority of rules regulating maritime transport are discussed and adopted at IMO level to ensure a consistent level of application across the world. Through the implementation of IMO Conventions and EU legislation, the EU has achieved a high level of safety at sea, in cooperation with its Member States, its Agencies (including EMSA) and industry operators such as ports, shipowners, and classification societies.

However, more can be done in order to improve safety at sea. Future objectives have been outlined in the Europe 2020 strategy, which is relevant in this context as it highlights the importance of the "human element" by encouraging growth that is smart through more effective investments in education, research, and innovation. For 2050, the vision includes the deployment of intelligent waterborne transport management systems and making the EU a world leader in maritime transport safety and security.

Safety, traffic management and human element are therefore topics that have already been prioritised in the recent CEF Transport multi-annual work programmes and calls for proposals.

In the 2014 CEF calls for proposals priority was given to projects that would:

1. Develop ice-breaking capabilities, maritime ICT systems and services addressing safety and security
2. Implement survey and dredging operations
3. Optimise processes, procedures and the human element, ICT platforms and information systems including traffic management and electronic reporting systems
4. Enhance maritime port access and basic infrastructure
5. Provide safer, more secure maritime transport services

[11] The Issue Paper from which this chapter is taken was compiled Luisa Puccio, Aida Axelsson and Timo Schubert (ADS Insight) and endorsed byPer Stefenson (Stena), Dimitrios Lyridis (National Technical University of Athens), and Magnus Sundström (Swedish Maritime Administration). The full list of contributors is available in Annex 5.

Similarly, in the 2015 call priority was put on:

1. Actions aiming at providing safer, more secure maritime transport
2. Development of maritime ICT systems addressing safety and security for port handling operations and administrative and customs procedures
3. Ice-breaking and year round navigability, geographical surveying and dredging operations
4. Optimisation of processes, procedures and the human element, ICT platforms and information systems including traffic management and electronic reporting systems
5. Studies contributing to the promotion and development of a concept at a regional or European level that may also contribute to further policy developments in the field, for e.g. human element aspects in maritime transport, better security measures, introducing vocational training for the purpose of new technologies
6. Works as a wider benefit project for e.g. coordinated enhancement of maritime security and safety systems in several countries

1- Safety

As mentioned above, through the implementation of IMO Conventions and EU legislation, the EU has achieved a high level of safety at sea. As an integral part of the EU's role as a player in the field of maritime safety the European Maritime Safety Agency (EMSA) was created in 2003. Set up to provide technical assistance to the Commission and Member States in the field of maritime safety, the agency now covers a variety of responsibilities, extending to environment protection, standards for seafarers, and vessel traffic monitoring. Respective needs in such areas inevitably drive technical and operational innovation in the field of maritime safety. Finally, classification societies i.a. in their work as recognized organisations play a crucial role in ensuring safety at sea by establishing and upholding technical standards, requirements, and regulations for vessels.

With new challenges for the shipping sector, emerging and ongoing discussions at IMO, the EU and specifically the MoS programme assumes a leading role in ensuring the EU fleet and ports set development priorities that meet the highest safety standards both at sea and in ports.

1.1. Safety at sea

As mentioned above, work on improving safety at sea is continuously advancing and it is strongly linked to the overall developments in the sectors, such as i.a. environmental advancements.

Stakeholders have identified the following needs:

1. The use of new alternative fuels and propulsion methods for the purpose of reducing air emissions and decarbonizing maritime transport pose new safety challenges. Adequate risk analysis and certification processes have to be carried out to guarantee that the new fuels or methods are at least as safe as traditional propulsion methods.
2. The growing size of passenger ships, and particularly that of cruise ships, is a matter that needs to be addressed. Appropriate risk assessment and adequate contingency and mitigation planning is needed to ensure safe evacuation of passengers (with particular focus on disabled passengers) in case of accidents or illness on board, taking into account the specific situation of islands, archipelagic, and peripheral regions.
3. Research should focus on simplification of ship design and systems for safety, (lifecycle) cost improvement, sea traffic management, human element and the new advanced digital systemes as well as energy efficiency (systems and ship design).
4. More R&D work is needed in order to achieve the concept of “autonomous ship”, for the purpose also of enhancing safety. This includes navigation and precise route determination and monitoring in order to ensure collision avoidance and performance control (i.e. more efficient maintenance, system resilience, etc.)

1.2. Safety in ports

As the sea to land connection points, ports also play a significant role in ensuring safe operations. Safe navigation into ports, not to mention safe on- and off-loading of cargo, mooring, bunkering and other operations require a high level of organisation and innovation especially in the areas of automation and traffic management. The role of ports as contributors to safety is also recognised in the *Third Maritime Safety Package* considering the provisions it includes on the so called places of refuge, i.e. safe havens for ships in need of assistance.

Safety in ports is furthermore directly impacted by security risks. Many stakeholders stressed the importance of addressing security threats, such as terrorism and cyber threats.

According to stakeholders more efforts are needed in the following areas:

1. Safe storage and handling of alternative fuels

2. Different bunkering requirements for different vessel types, especially passenger ships
3. Safe procedures for shore power supply
4. Further development of high-mooring systems
5. Develop the necessary hardware for enhanced procedures for container inspection
6. Develop security platforms and adjust master plans accordingly
7. Address various issues emanating from the new procedures such as the question of liability in case of denied port access, etc.
8. Implement smooth and smart security control.

MoS contribution

The CEF project "FAMOS Freja: Finalising the Surveys for the Baltic Motorways of the Sea" is a clear example of the contribution of Motorways of Sea to maritime safety.

The objective of the project, which is currently ongoing, is to improve the efficiency of hydrographic surveys – and subsequently navigational safety – in the Baltic Sea, thought the following activities:

1. *Hydrographic surveys of approximately 34 000 km² of areas identified as important for shipping activities*
2. *Update nautical products such as charts and Electronic Navigation Charts (ENC), based on the survey data produced*
3. *Produce bathymetry base data for future navigation applications, such as Sea Traffic Management or the next generation of Electronic Chart Display & Information System (ECDIS)*
4. *Improve possibilities for accurate GNSS positioning at sea, through gravimetry measurements aiming at the computation of a highly accurate and quality-ensured geoid model before 2020. Start re-calculating vertical datum dependent chart data, such as charted soundings, depth contours or bridge clearings.*

However, safety is the foundation of any operation at sea and in ports. Therefore, it is important to note that many MoS projects – which in principle are categorised under other pillars – do include safety elements. Several LNG-related MoS projects have produced studies related to safety of LNG operations. Examples of such projects include:

- 2010-EU-21112-S - LNG infrastructure of filling stations and deployment in ships
- 2011-EU-21005-S - LNG in the Baltic Sea Ports

- 2013-EU-21007-S - LNG in the Baltic Sea Ports
- 2013-EU-21019-S - Costa II East - Poseidon Med
- 2014-EU-TM-0673-S - Poseidon Med II
- 2014-EU-TM-0095-W - ReaLNG: Turning LNG as marine fuel into reality in the North Sea-Baltic region

2- Traffic management

Sea traffic management is a key enabler for a safe and efficient maritime sector, as it allows the maritime industry to communicate effectively, manage traffic flows, and respond quickly in the event of adverse events.

The EU Member States have a robust vessel traffic management system in place at national level. SafeSeaNet and other operational systems and applications provided by EMSA link together all Member States' maritime authorities across Europe facilitating the exchange of maritime data.

Increasing levels of maritime traffic in EU waters requires efficient traffic management systems in order to reduce the risk of accidents (i.a. collisions), reduce congestion, and improve the smooth integration of shipping in the logistics chain, i.a. by providing enhanced collaboration and exchange of information between the stakeholders involved in arrival and departures to/from ports. In this context, further development of maritime ICT as well as of information sharing platforms to efficiently use and analyse big data will be paramount to improve safety at sea. An example of this will be the implementation of Sea Traffic Management for "intended route" monitoring and situational awareness, which will allow authorities to identify safety hazards, proactively intervene in case of high likelihood of accidents, as for example when ships deviate from their intended route.

The increasing competition for maritime space by various sea related activities (addressed by "maritime spatial planning") also puts additional burden on maritime transport and sea traffic management: environmental protection in specific areas, offshore wind energy generation parks, sea and wave energy harvesting, marine tourism and sports, and others affect or restrict sea traffic management making it increasingly more important to manage congestion and to ensure safe transportation.

MoS contribution

Sea Traffic Management (STM) was developed in order to provide a harmonised way of communicating within the maritime industry, putting in place open and accessible standards, and unifying the way in which the different maritime actors communicate with each other. The concept was addressed in detail through the MoS MONALISA 2.0 Action.

The concept can bring about significant gains in maritime safety. By sharing relevant data, vessels acquire the ability "to see each other", i.e. their crews have a better situational awareness (of their own position), heading, and speed vis-à-vis other vessels. In addition to real-time AIS and radar signals, services can be provided to advise vessels on their optimal routes, taking into account criteria such as avoiding congestion in high traffic areas, avoiding environmentally sensitive areas, and ultimately enhancing maritime safety.

Within the MONALISA 2.0 project the strengths and weaknesses of the current maritime ship- and related transportation systems, operations and interactions have been assessed and a target concept as well as Key Performance Indicators for four STM strategic enablers have been defined: voyage management services, traffic flow management services, port collaborative decision making, and the establishment of a common interoperable common information environment and structure (*SeaSWIM*). The concept of Sea Traffic Management is currently in the phase of validation in the MoS project STM Validation Project through large scale testbeds throughout EU involving 300 ships, 13 ports and 5 shore centres.

As part of the project a common technical protocol for route exchange was developed and *ultimately adopted as an international standard* in August 2015.

3- The Human Element

The IMO's International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) aims i.a. at setting training standards for seafarers with the ultimate objective of ensure safety of life and property at sea, and the protection of the marine environment. The EU has integrated the STCW Convention into its *acquis* via Directive 2008/106/EC (and subsequent amendments), and has strongly underlined the importance of the human element and the development and retention of maritime know-how as key conditions to maintain a strong maritime sector in the EU.

The Commission has underlined that some 70% of shipping-related jobs are "knowledge-intensive, high-quality jobs on shore" and expressed serious concerns that the "growing shortage of maritime professionals, officers and ratings entails the risk of losing the critical mass of human resources that sustains the competitiveness of the European maritime industries in general"[12].

A recent report[13] by BIMCO and ICS states that by 2025 there will be a shortage of 147.500 officers from the maritime profession. In order to overcome this continuing and alarming trend, dedicated university programmes that contribute to the development of human capital in all maritime related industries are desirable for the further development of MoS. They should aim at ensuring the long-term sustainability of the shipping industry by enabling experienced seafarers to advance their careers in related activities on shore. Such educational programmes should promote interdisciplinary skills. Seafarers should be given an understanding of the general context in which they operate, and should be encouraged to take a holistic view of their profession. Such programmes should focus on markets, business strategy, supply chain management, "non-technical skills" (team-work, dealing with stress, cross-cultural competences), and language competence ("shipping" English as used on board may be quite different than "proper" English). Increasing digitalisation of maritime transport also needs to be taken into account: as mentioned in chapter 4, training programmes should also address the growing risks of cyber security.

A new approach to training is also needed in order to address the specificities of the sector. Massive multimodal freight transport requires an integrated vision of human resources and responsibilities at different levels (the human element needed for the different intermodal systems to work). Considering that knowledge and experience of maritime professionals and seafarers are a necessary enabler of efficient and safe movement of massive freight using maritime links in Europe, the importance of the human element cannot be underestimated all along the supply chain. In addition to navigation, stevedoring, port management (with ever more complex energy, environment, safety and security, port operations, etc.), logistics platform management and land transportation systems, inland waterways, railways, and trucks etc., also require skills and training.

Specific training is also needed in order to safely operate and fully exploit new technologies, such as i.a. alternative fuels. The use of LNG as marine fuel, for example, due to the cryogenic character of the product, needs specifically trained professionals both on land and

[12] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52009DC0008&from=EN
[13] https://www.bimco.org/~/media/News/2016/Manpower_Report_2015_Executive_Summary_Final.ashx

at sea for safe bunkering and other operations. Eventually, its use as a fuel is likely to expand to large freight transportation on land.

Improving the image of the maritime profession is another issue raised and it is paramount in order to retain maritime skills in Europe. Stakeholders at the 3rd MoS forum outlined that this could be achieved by:

1. Improving access to training: making training widely and easily available, affordable, certifiable
2. Establishing EU-platforms for the sharing of best practices on maritime careers
3. Increase attractiveness of the profession (especially for women), e.g. through campaigns, social networks, apprenticeship scheme promotion, and other motivational measures.
4. Rethinking training and career paths for young seafaring professionals in order to allow them to successfully move from sea-based to land-based jobs.
5. Continue to seek ways to reduce the bureaucratic workload for seafarers, i.a. through digitalisation.

MoS contribution

Examples of projects focused on the human element include the *TrainMoS* and *TrainMoS II* Actions, which aimed at developing adequate training schemes for smooth and efficient freight transport by sea. The two Actions established the content of a modular M.Sc./Post Graduate level course and a Continuous Professional Development (CPD) programme. They targeted university graduates, but also professionals working in different sectors of the multimodal supply chain. By taking into account emerging needs in terms of transport and sustainability, building upon the knowledge and the tools generated, the Actions delivered new content/programmes and improved the existing IT tools, including:

1. A specific tool to match the demand and offer related with training and job on the maritime logistics sector
2. New content and training modules for stakeholder needs
3. A M.Sc. level course and a CPD programme based on the aforementioned training modules
4. An agreement among universities to provide the M.Sc. based on the Training Management System (TMS) training modules and experiences
5. A system of recognition by all of the credits obtained by each single participant that initiated the accreditation process

6. A significant improvement of existing IT tools so that they accommodate the increased requirements of the new training schemes and current circumstances

In addition the MONALISA 2.0 project (see Traffic Management section) encompassed a large part of Human Element and training. Training programmes for both safety at sea and safety in ports were elaborated.

Within the MONALISA 2.0 project, a network of maritime simulator centres was also established (European Maritime Simulator Network). The simulator Network is vendor independent, so that brand doesn´t become a factor when choosing which simulator centres could join the network. This has never been done before in the world of civil maritime simulations and presents ground breaking new ways to study and simulate large scale traffic patterns and how they evolve. The simulator network can engage a large number of seagoing personnel simultaneously, which facilitates large scale multi-cultural realistic simulations, training and development of the human factor. The possible future use of the European Maritime Simulator Network is vast, both in the area of research and development projects and in studies of the logistic chain and safety management. Also other possible areas of use of the simulator network are predicted to have a major impact to the maritime sector, i.a. in the field of maritime education and maritime Search and Rescue coordination.

4- Future challenges

The shipping and port industry is facing new challenges impacting safety, traffic management, and the human element.

Digitalisation of maritime transport is one of the most important areas of discussion in the shipping industry. New technologies can improve navigational safety, safety of operation on board ships and in ports, and ensure safer and more efficient traffic management. However, better digital skills for seafarers and shore-based professionals are a key requirement.

In an industry where digitalisation plays an ever-growing role, discussions on cyber security are also gathering momentum. Work is ongoing in the Maritime Safety Committee (MSC) of IMO on the development of industry guidelines on cyber security on board vessels identifying i.a. safety considerations related to potential cyber attacks. They are intended for use by shipowners, managers, and seafarers with the objective of reducing maritime

cyber security risks and of mitigating the effects of related incidents. A cyber security incident could result in disabling or manipulating electronic navigational equipment and propulsion or other critical systems. Loss of or tampering with ship-based or land-based data is another possibility. Adequate contingency planning will be crucial for such instances.

In responding to cyber security incidents, the human element will play a fundamental role. Adequate training on how to respond to such incidents and on how to execute plans to avoid safety accidents will be increasingly more crucial in the coming years.

Furthermore, the ongoing irregular and acute migration crisis is also putting a strain on the shipping industry. Formal SAR operations are struggling to cope with the flows of immigrants trying to reach Europe in overcrowded and unseaworthy vessels. Commercial vessels are therefore often involved in rescue operations involving immigrants: while saving life at sea is and remains a priority, it is important to consider that such operations could put vessel and crew safety as well as commercial operations at significant risk.

Discussions on this pressing issue are ongoing at an IMO and EU level. Enhanced coordination between EU bodies (including EMSA), government agencies (such as Coast Guard Authorities), and private operators is needed in order to address these challenges. Furthermore, dedicated training for personnel handling migrant search and rescue, as well as enhanced surveillance capability are under discussion.

During the MoS Forum on 18 May, stakeholders mentioned the need to design specific SAR training related to migration as well as “train the trainers” programs and to improve management practices and preparedness, including information sharing.

The challenges of MoS in respect to Safety, Traffic Management and Human Element will require research and pilot actions in a “triple helix cooperation” involving elements of all three areas. The structure and priorities in the Horizon 2020 are not currently optimal for addressing these research needs. It is proposed that MoS and MoS priorities will be identified as one of the priority areas of the next Horizon 2020 work programme (2018-2020) and that MoS will continue to co-fund this area as long as the identified issues continue to be of relevance.

5- Conclusions

The EU generally has an excellent record as regards maritime safety and traffic management. IMO and EU legislation implemented in the last decade have ensured a high level of safety for both freight and passenger transport. Symptomatically, safety, traffic management and human element have not featured heavily on the MoS agenda to date. Indeed, one would find a comparatively higher number of projects related to the environment and logistics, than projects related to safety, traffic management or human element.

However, this paper and the third MoS forum highlighted current and future challenges. The use of new fuels and propulsion systems, the ever-increasing share of intermodal transport and logistics, the challenges brought on by the growth of digitalisation in the shipping sector, the decreasing numbers of maritime professionals in Europe, the increased need for training in new thematic areas are all issues that require adequate resources and training to handle the increasing volume of maritime transport in a safe, sustainable, and efficient manner.

MoS can - and is called upon by stakeholders to - play an ever more important role in addressing these issues.

PROJECTS UNDER TEN-T CEF UNDER PILLAR 3

In total there have been 6 projects financed under TEN-T and CEF. The projects generate a total investment of over EUR 131.7 million, of which the EU has contributed over EUR 60.8 million. While this analysis covers the projects identified by INEA as belonging to Pillar 3, it is important to note that many other environmental and logistics projects belonging to Pillar 1 and 2 also included activities contributing to the enhancement of maritime safety and the further development of traffic management and of the human element.

Safety and Traffic management

Of the 6 funded project, 4 were related to safety and traffic management. Of these, 2 were funded under TEN-T from 2010 to 2015, while the remaining 2 were funded under the 2014 CEF call.

These projects generated over EUR 123.6 million in investments, to which the EU contributed over EUR 56.7 million.

The TEN-T-funded projects, MONALISA and MONALISA 2.0 both aimed at contributing to efficient, safe and environmentally friendly maritime transport by further developing and disseminating innovative e-navigation services, including i.a. route planning and global sharing of maritime information. MONALISA 2.0 was followed and complemented by the STM Validation Project, which aims at testing the STM (Sea Traffic Management) concept in the Nordic and Mediterranean Sea.

The FAMOS Freja project also contributed to safety in the Baltic Sea i.a. through detailed hydrographic surveys of areas of relevance to shipping and through the updating of nautical charts.

Below is the list of all TEN-T and CEF projects related to safety and traffic management.

European Commission

Safety and Traffic Management Projects

Project No	Project title	Total Costs	EU contribution
2010-EU-21109-S	MonaLisa	22,486,006	11,234,003
2012-EU-21007-S	MONALISA 2.0	24,316,000	12,158,000
2014-EU-TM-0152-M	FAMOS Freja: Finalising Surveys for the Baltic Motorways of the Sea	33,826,969	11,890,731
2014-EU-TM-0206-S	STM Validation Project	42,977,434	21,488,717
TOTAL		123,606,409	56,771,451

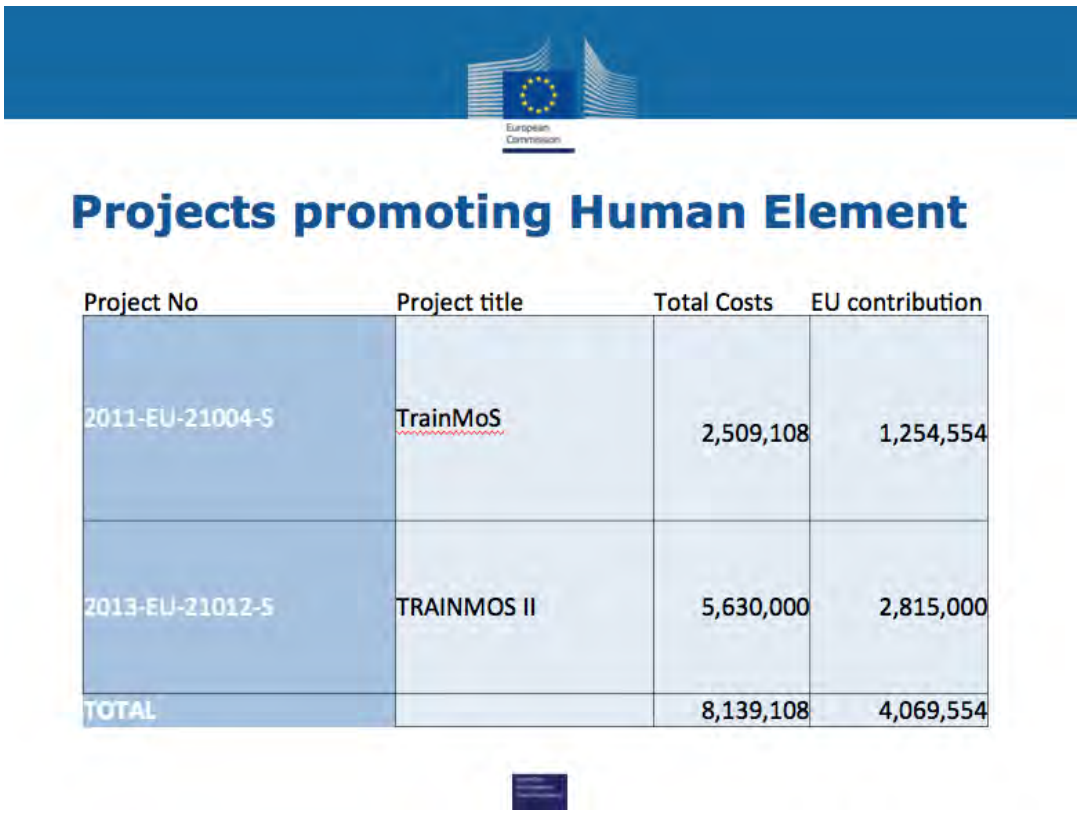
Source: INEA

Human Element

Two projects related to the human element have been funded under TEN-T and CEF, for a total investment of more than EUR 8.1 million. The EU contributed approximately EUR 4 million in total.

The projects, TrainMoS and TrainMoS II, aimed at developing adequate training schemes for smooth and efficient freight transport by sea, i.a. by establishing the content of a modular MSc/Post Graduate Diploma/Certificate/Continuing professional development (CPD) programme and by starting the accreditation process.

Below is the list of all TEN-T and CEF projects related the human element.



Projects promoting Human Element

Project No	Project title	Total Costs	EU contribution
2011-EU-21004-S	TrainMoS	2,509,108	1,254,554
2013-EU-21012-S	TRAINMOS II	5,630,000	2,815,000
TOTAL		8,139,108	4,069,554

Source: INEA

VII. Motorways of the Sea – Qualitative status-quo assessment

The success of Motorways of the Sea cannot only be measured in tonnes and tonne-miles. The very motivation for increasing their use was to alleviate the environmental impact of transport by shifting traffic from road to short sea shipping services. While the fuel-efficiency of ships generally leads to a reduction of carbon-dioxide emissions per tonne-mile, sulphur-oxide emissions are still much higher than in road transport if Heavy Fuel Oil is used and no abatement technology in place. Therefore, the environmental assessment is perceived as crucial for analysing the qualitative status quo of Motorways of the Sea.

Second, a high potential is seen in a smoother integration of maritime transport into international logistics chains. This integration has a physical dimension – i.e. the adequacy of the transport infrastructure – but also a digital and organisational one. Administration of transport chains involving maritime transport is generally much more complicated than land-based transport.

Finally, safety and security are issues that cannot be neglected. Promoting seaborne transport also means increasing the traffic density on the Motorways of the Sea. Efficient traffic management and trained personnel are key success factors.

1- Pillar 1: Environmental assessment

In order to address the issue of sulphur emissions (which – in contrast to carbon dioxide – have a local/regional impact), a 0.1 % limit on sulphur content was introduced for fuel burned inside EU port areas (Directive 2005/33/EC, effective 1 January 2010). However, this regulation only covers the port areas. As soon as ships have left a port, they can switch to Heavy Fuel Oil resulting in much higher sulphur emissions. Stricter regulations apply for the North Sea and the Baltic Sea, which have become Emission Control Areas (ECAs) in line with MARPOL Annex VI. Since 1 January 2015, the maximum sulphur content for fuel used in these areas is 0.1 % unless abatement technologies are used. Currently, the introduction of ECAs in other European waters is under discussion.

In order to comply with the regulation, ship operators have used different strategies:

- Using Marine Diesel Oil (with low sulphur content) instead of Heavy Fuel Oil
- Installing scrubbers
- Using LNG

While LNG is considered the cleanest solution, it is currently also the rarest one. Out of the 2,300 ships regularly calling European ports as part of ro-ro or container liner services, only 21 are equipped with LNG-ready engines by May 2016, i.e. less than one per cent. Most of the ferries are not even calling in EU ports as they are used on domestic Norwegian services.

The use of scrubbers is more widespread. Scrubbers are installed on about three per cent of ships regularly calling European ports. Not surprisingly, scrubbers are mostly used in the Emission Control Areas of the North Sea and the Baltic Sea – here around 12 per cent of the ro-ro ships in both areas are equipped with scrubbers. However, for container vessels, the share of ships equipped with scrubbers is below one per cent even in the ECAs.

The dominant strategy is still the use of compliant fuel (Marine Diesel Oil with lower sulphur content) in order to comply with ECA regulations. One reason for this strategy is certainly the rather low oil price that has taken some pressure off the ship operators in the recent past. In addition to the costly technology, the non-availability of LNG supply points in the ports hampers the widespread uptake of LNG-propelled ships. Particularly striking is the absence of supply points on the German and Polish shores and in South Sweden. The many ferry links in the area are hence lacking in adequate LNG supply.

Scrubber use is one alternative abatement measure that is more widespread. Its uptake is however hindered by insufficient waste reception capacities for wash water and sludge from scrubbers. In fact, the use of open-loop scrubbers has received a lot of attention recently and may lead to stricter regulation in the near future. The legislative uncertainty and technology compliance is what leads ship owners to be hesitant to invest widely in scrubbers.

LNG terminals in EU ports (mid-2015)

Source: ISL based on Gas Infrastructure Europe "LNG map"

To summarise, the share of ships with LNG engines and the number of LNG supply points are still far from the objective. The continued support of their development could hence contribute to improving the environmental performance of Motorways of the Sea. Promoting the use of LNG as a fuel for regular liner services in Europe needs to address both ships and ports at the same time.

Apart from reducing sulphur emissions, onshore power supply (OPS) is promoted as a way to improve local air quality and to reduce noise emissions in ports. Close to 200 ships regularly calling in European ports can use shore-side electricity installations – more than 90 % of which are container vessels. As universal standards are still lacking, this does not necessarily mean that these connections are compatible with local OPS installations.

Given the fact that more than 2,000 ships are employed on services calling in European ports, there is still a strong potential. Given that the share of renewable energies in the European energy mix is increasing, OPS systems can potentially also help reducing global air emissions.

2- Pillar 2: Logistics and Integration of Maritime Transport in The global Logistics chain – Status Quo

The physical part of the integration of Motorways of the Sea into the global transport and logistics chain encompasses seaside access, the maritime terminals, the availability of transport modes, and the connection to the main hinterland network.

In order to establish whether the infrastructure is adequate, it is important to take into account the different needs of different ports. Intercontinental container services – and especially the Far-East services – are the strongest challenge to any port. This is not only a matter of ship dimensions (draught restrictions, insufficient outreach of container gantry cranes, etc.), but also a matter of cargo volumes. Several thousand cargo units are moved during a single call and have to find their way between the ship and the hinterland.

In early 2015, every tenth deep sea container service featured ships with a draught of 15 metres or more, and every fourth service had draughts of 14 metres and above. The tendency towards larger ships is still ongoing despite the weak market growth. Therefore, ports that want to handle these services need to handle ships with draughts of 14 metres and more. If possible, this draught should be possible independently of the tide because waiting time causes additional costs and causes delays.

In reality, many of Europe's largest container ports are not able to handle the world's largest container ships with full load. Due to the multi-stop strategy used by the liner operators, the first port in Europe or the first port in a range should be able handle the largest vessels without restrictions. As the ships continue their journey through European waters, more and more cargo is discharged and the actual ship draught is less than the ship's maximum draught.

From the ports' perspective, one can speak of inadequate draught when cargo is deviated from a port because of ship size restrictions (e.g. moving transhipment to ports that are called earlier on the incoming string) or – in the worst case – when the port is taken out of a liner service due to the restrictions. A universal standard of 16 metres to accommodate the largest vessels in all relevant ports is neither feasible nor necessary.

With regard to hinterland transport, a direct rail connection is often regarded as a 'must have' for container terminals. However, not all container terminals are prone to use rail transport, even if total handling volumes are in the millions. First, some terminals have high shares of transhipment so the hinterland volume is only a small fraction of total quayside

handling. But even if hinterland traffic is important, rail transport is only economically viable on longer distances. Therefore, ports that mostly serve the local hinterland (including ports on small islands) will not be able to reach a considerable share of rail hinterland traffic.

3- Pillar 3: Safety, Traffic Management And The Human Element

In the pillar on safety, traffic management, and the human element, defining measurable objectives is more complicated. Ports differ with regard to their safety needs depending, e.g., on the complexity of a port and the type of cargo handled. Traffic management systems are not necessary in ports where only a pair of ferries is calling each day, nor is hinterland traffic management necessary in all ports.

In order to identify needs and to set objectives, work in this pillar will rather concentrate on the promotion of best practices among concerned ports.

VIII. Conclusions and summary of identified development priorities

Motorways of the Sea have been a key factor for the development of maritime transport.

Numerous data related to MoS was collected either through experience resulted from past or ongoing projects (80 in total) as well as close and regular discussions with industry stakeholders and Member States.

Motorways of the Sea play the right methodological approach and constitute a fundamental contribution to the TEN-T network bringing the right complementarity required to the development of corridors.

This report proposes the further development of MoS, particularly along the following priorities:

1. Environment (maritime green solutions).
2. Integration of maritime transport in the logistic chain.
3. Safety, Traffic Management and Human Element.

The Detailed Implementation Plan reflects various views of institutional and industry stakeholders and it constitutes basis for a comprehensive work programme, providing an integrated approach with the other work plans for the nine strategic Core Corridor Networks.

Once consultation with the European Parliament and Member States will have taken place, the Detailed Implementation Plan will constitute a clear and precise guidance for the future orientation of MoS policy.

Below, the reader will find the whole list of recommendations identified for each development priority. The list is non-exhaustive but it provides a clear focus for MoS future actions.

MoS should most importantly:

- Foster maritime transport within the internal market (e.g. Short Sea Shipping, linking it logically with 9 core network corridors, sear-river operations).
- Develop ports to perform their required role as the main gateway for European trade (ship and port interface development to achieve efficient logistics operations and improve connectivity with hinterland).
- Improve the environmental performance of ships as well as related infrastructure.

- Invest in traffic management and navigation services.
- Underline the corner stone elements, which allow for maritime transport: safety, training, as well as specific regional requirements such as year round navigation or links with outermost regions.
- Contribute positively to Europe's external trade, exploiting logically four natural geographical pathways for trade: Atlantic, North Sea and Baltic, Mediterranean-Black Sea and Suez Canal. The new opportunities opened by the North Sea route gateway (including Artic access) should also be taken into account.

MoS requires a smart dual approach for development, meaning that Maritime Transport should be developed simultaneously as a tool connecting Europe to the world as well as to efficiently link its own countries and regions.

In order to achieve this dual objective, maritime operations and ports require the deployment of efficient tools to be effectively interconnected and utilized.

By providing support to the development of highly complex technical tools for efficient transport operations, MoS bring innovation to the real world and make a definite claim on its ability to support European growth and competitiveness.

A detailed summary of all three development priorities can be found below.

1- Pillar 1: Environment

Development Priorities

a) Environment

Climate change

- Vessel
  - Continue the current evolution of hybrids and battery use
  - Further the development of alternative fuel use
  - Continue the optimisation of hull, propeller incl. development of light material and new design possibilities (energy efficient light-weight designs) and their interaction
  - Further the development of LNG and methanol use
  - Explore new fuel possibilities, such as hydrogen and biofuels

- Further developed closed loop scrubbers to take into account both the air and water impact.

- Infrastructure
  - Continue the cold ironing implementation
  - The implementation and use of charging stations for batteries and hybrids
  - Digital support for route efficiency.
- Regulatory
  - Support EU work in IMO as shipping is a global sector that needs to keep being regulated at a global level
  - Address the differences and inconsistencies in LNG safety regulations and gas handling guidelines (e.g. LNG bunkering and bunkering connections, emergency shutdown systems for vessel machinery, emergency release of LNG stored onboard, data exchange and incident reporting) to reduce uncertainty for operators and facilitate the uptake of LNG
  - Predictability in the regulatory frameworks and collaboration.
- R&D
  - Develop joint KPIs to visualise benefits to society, to achieve common goals aiming at the reduction of the climate footprint of shipping
  - Support development of 3rd and 4th generation bio- and electro-fuels for maritime.

Air quality/emissions/ECA

- Vessel
  - Continue the current evolution of hybrids and battery use
  - Further the development of LNG and methanol use as well as exploring other new and innovative technological solutions
  - Explore new fuel possibilities
  - Further the development of closed loop scrubbers to take into account both the air and water impact
  - Support the voluntary and proactive approach of ship-owners through multi financing platforms.
  - Support vessels' green compliance while protecting competition via EU MoS, especially for the short sea shipping routes at regional level related to new maritime transport developments such as future European NECAs
- Infrastructure
  - Continue to look into ways of lowering LNG storage and logistics costs

- Promote synergies with other uses of LNG in road transportation and energy sector
- Development and harmonisation of training and education when handling and using new fuel types
- Facilitate further development of infrastructure for alternative fuels (the supply, port infrastructure, refueling vessels)
- Support the voluntary and proactive approach of ports and terminal operators through multi financing platforms.
- Continue to support the uptake of cold ironing technologies via EU MoS.

- Regulatory
  - Stable regulatory environment to facilitate and promote investments in green technologies for shipping.
- R&D
  - Simplification of systems for safety (and further study into cost)
  - Further research into renewable fuels and their impact/use in maritime transport, including cost consequences
  - Joint KPIs to visualise benefits to society, to achieve common goals aiming at the reduction of the climate footprint of shipping
  - Further harmonisation to gain standardisation of green ship production.

Operational pollution

- Vessel
  - Further development and piloting of exhaust gas cleaning systems (e.g. scrubbers, SCR)
  - Further development and piloting of onboard water treatment systems (e.g. ballast water, recycling, black/grey water)
  - Pilot testing of monitoring equipment to for improvement of energy efficiency
    - Further develop instruments to facilitate route optimisation
  - Further develop noise reduction measures.
  - Financial support by MoS for the green compliance of vessels
- Infrastructure
  - Further development of port reception facilities to prepare for support to new technologies
  - Trials for noise reduction solutions
  - Further development of port reception facilities co-funded by the MoS Programme to prepare for new or increased waste streams and support new technologies

- Regulatory
  - New technologies should be given incentives to develop best practice and new industry standards.
  - R&D
  - Further develop scrubber bleed-off and other discharge and emission analyses for environmental impact assessments
  - Further investigate smart vessels and autonomous safety systems.

Accidental pollution

- Vessel
  - Measures aimed at improving safety through education and training practices focusing on accidental pollution
  - Pilot testing of technology to minimise accidental pollution in Artic and warm environments.
- Infrastructure
  - Continued development of traffic management tools for collision and grounding avoidance
  - Further investigation of how pilotage is used and improvements of routines
  - Digital infrastructure to further simplify and reduce administrative burden.

Integrated use of marine fuel resources

- Vessel
  - Pilot testing of new solutions and their interaction with existing technologies.
- Infrastructure
  - Development of special planning instruments for integrated use of marine resources (building on discipline defined by UNCLOS).
- Regulation
  - Develop tools to manage Marine Spatial Planning as a method to solve conflicting needs.

Environmental compensation measures

- Infrastructure
  - Promote ports and port users cooperation to share best practices and achieve cost-effective and efficient environmental compensation measures
- Finance and R&D

- Further development of support tools, such as Environmental Performance Indicators, to find joint KPIs and benefits to society and sea
- Further development of supporting initiatives to incentivise modal shift and/or avoid modal backshifts through the strenghtening of existing routes or the development of new efficient routes (e.g. Ecobonus)

Financing of green shipping

- Vessel
  - New investments in environmentally efficient solutions should be supported by public investment incentives
  - Support new financial instruments through risk reduction mechanisms can help the industry achieve a paradigm shift in the uptake of green efficient technologies
  - Promote common interest strategies of Shipowners pooling combined with EU incentives and EU reindustrialization.
- Infrastructure
  - Access and competitiveness of outermost regions remains an issue and requires the development of sustainable transport to guarantee cohesion
  - Development of incentive systems to encourage the use of climate efficient sea alternatives such as ECO bonus.
- Regulatory
  - Regulatory incentives (carrots) are needed to encourage the industry to cope with the required changes and to do so on time.
- Finance & R&D
  - Pilot testing of new mechanisms that consider both the capital expenditure (CAPEX) and the operational expenditure (OPEX)
  - Attract beneficiary stakeholders such EU shipyards, engine and equipment manufactures in the risk sharing model
  - Maritime investments should be further considered in the cohesion and other structural funds agenda.

2- Pillar 2: Logistics

Efficient shipping and port operations: optimising maritime transport operations

- Sea side
  - Further develop flow management services to support both onshore organisations and ships in optimising overall traffic flow

- Continue to develop voyage management services
- Implement port collaborative decision-making (Port CDM) services to increase the efficiency of port calls for all stakeholders
- Encourage data sharing using common information environment and structures using established well used standards recognized by the trade.

- Land side
  - Continue to invest in equipment to increase terminal handling productivity
  - Innovate to reduce port equipment consumption
  - Automate port and terminal gates
  - Invest in rail connections to ports quays and terminals
  - Make alternative fuels bunkering and short-side power supply possible at European core ports
  - Install reception facilities for scrubbers sludge at ports
  - Create a collaborative network of ICT platforms for ports and MoS services to adapt to the needs of shippers using established well used standards recognized by the trade.
- R&D
  - Facilitating the transition of European port terminals towards low carbon and even local zero emission operative models is a challenging goal that should be promoted in R&D projects
  - Designing more types of LNG (and other alternative fuels) engines for port cargo handling equipment
  - Dynamic lighting for ports and terminals
  - Hybridisation of port equipment
  - Using hydrogen cells for port equipment
  - Innovative energy storage systems
  - Further development of Sea Traffic Management Services and infrastructure.

MoS links: effective connections to the hinterland

- Sea and land side
  - Improve last-mile connections to ports and thus to maritime transport services, connecting TEN-T Corridors via MoS and promoting green corridors
  - Foster synchro-modality to bring about routing flexibility, improved quality of MoS door-to-door transport services and sustainability
  - Assess the performance of corridors using KPIs

- Further study and pilot the incentives, financing mechanisms and compensation measures that generate best results in terms of minimising environmental footprint and maximise benefits to society
- Continue improving links between key ports connecting European regions and connecting the EU to neighbouring countries
- Share information to increase the efficiency of the logistic chain by harmonising ICT platforms in different transport environments
- Create corridor information and management systems to optimise the flow of cargo
- Ensure links between hinterland and outermost regions and islands.

- R&D
  - Developing smart, upgraded and fully interconnected transport infrastructures
  - Further research on telematics applications and technologies for an efficient support of synchromodality
  - More studies, including pilots, on incentives and financing mechanisms to green corridors and motorways of the sea services, including socio-economic studies / benchmarks on which incentives would generate the largest increase in social welfare
  - Design an overall risk and security management approach in the transport and logistics sector.

Efficient clearance procedures

- Sea side
  - Develop a unique single window for trade and transport comprising all modes
  - Encourage the adoption of the eManifest in the EU
  - Further harmonise relevant administrative procedures.
- Land side
  - Support shippers and logistics providers in the transition to the new Union Customs Code
  - Support information sharing between various stakeholders
  -
  - Improving intermodal transport security and safety via advanced integrated surveillance and control systems
  - Develop more comprehensive track and trace systems
  - Implementing simplified and paperless Customs fast corridors resulting in interconnected and interoperable digital infrastructures

- Support synchronised and coordinated port call operations and the development of port collaborative decision-making systems.

- R&D
  - Further research on port automation and digitalisation to support efficient cargo clearance procedures
  - More automation of scanners and other verification systems along with further research in new scanning technologies (e.g. muon tomography)
  - Further research in advanced robotics, sensors, machine to machine communication and other means to expedite the transition of goods through ports and nodes in the logistics chain.

Enabling technologies

- Sea side
  - Further develop technologies to ensure navigational safety
  - Develop vessel automated evacuation planning systems
  - Provide and maintain a harmonised way of communicating within the maritime industry using open and accessible standards.
- Land side
  - Promote the use of technologies (scanners, weighbridges, beacons, sensors,…) and their integration into connected IT systems creating networks of nodes and transport services systems aiming to optimise transport management
  - Support the implementation of common information systems and services for clusters of ports to optimise infrastructure use.
- R&D
  - Further research in internet of things and big data as well as their application to improve decision-support systems
  - Improvement of sensors, beacons, wireless communication and other systems to be installed onboard vessels
  - Research in new or improved technologies to automate ports and other nodes in the logistics chain.

Maritime spatial planning

- Integrated overall approach
  - Further develop maritime spatial planning processes with interactions between land and sea

- Better connections between MoS and short-sea shipping with blue growth and maritime spatial planning.

- Sea side
  - Support the adoption of solutions contributing to safer navigation, more efficient traffic flow and protection of the environment such as passage planning, traffic management and vessel traffic management systems.
- Land side
  - Promote collaboration among countries concerning maritime spatial planning
  - Encourage information sharing among countries and regions in this field.
- R&D
  - Further research into ways, methods and technologies to make activities at sea as efficient and sustainable as possible.

External dimension

- Integrated sea and land approach
  - Need to take the wider external dimension of the EU and its related aspects into account
  - Implement trade facilitation measures and systems and strengthen connections with main EU trade partners worldwide
  - Strengthen EU territorial cohesion by improving the connection of peripheral and outermost regions to the rest of the EU and to the world.
- R&D
  - Further studies on the impact of the expansion of the Panama Canal, the Transatlantic Trade and Investment Partnership, Union for the Mediterranean, and future opening of the Arctic shipping route, and definition of measures and actions that generate maximum EU social welfare.

Financing of ships and ports investments

- Sea side
  - Provide clear incentives to use financial instruments to promote the greening of shipping under the conditions of transparency and equal opportunities
  - Establish a stable legal framework to facilitate greening of transport
  - Work closely with the EIB on funding mechanisms.
- Land side

- Promote the use of the European Fund for Strategic Investments and other instruments for ports investments on accesses and connections to their hinterland and to core network corridors
- Support blending of financial instruments
- Better coordination between CEF grants and financial instruments.

- R&D
  - Further studies on financial feasibility and cost-benefit analyses of MoS actions
  - Research on use of financial instruments to speed up the time between research and real implementation of piloted solutions that can be adopted by the market.

3- Pillar 3: Safety, Traffic Management and the Human Element

Safety

- Safety at Sea
  - Address the safety challenges posed by the use of new alternative fuels and propulsion methods for the purpose of reducing air emissions and decarbonizing maritime transport. Adequate risk analysis and certification processes have to be carried out to guarantee that the new fuels or methods are at least as safe as traditional propulsion methods.
  - Adequate contingency planning to ensure safe evacuation of passengers onboard large passenger ships (with particular focus on disabled passengers) in case of accidents or illness on board, taking into account the specific situation of islands, archipelagic and peripheral regions.
  - Research should focus on simplification of ship design and systems for safety, (lifecycle) cost improvement, sea traffic management, human element and the new advanced digital systems as well as and energy efficiency (systems and ship design).
  - More R&D work to achieve the concept of “autonomous ship”, for the purpose i.a. of enhancing safety. This includes navigation and precise route determination and monitoring in order to ensure collision avoidance and performance control (i.e. more efficient maintenance, system resilience, etc.).

- Safety in Ports
  - Address the differences and inconsistencies in LNG safety regulations and gas handling guidelines (e.g. LNG bunkering and bunkering connections, emergency

shutdown systems for vessel machinery, emergency release of LNG stored onboard, data exchange and incident reporting)
    - Safe storage and handling of alternative fuels
    - Different bunkering requirements for different vessel types, especially passenger ships
    - Safe procedures for shore power supply
    - Further development of high-tech mooring systems
    - Develop necessary hardware for increased procedures for container inspection
    - Develop security platforms and master plans
    - Address the issues liability question in case of (denied) port access
    - Implement smooth and smart security checks.

- New challenges
    - Focus on migration management and preparedness, including information sharing
    - Specific search and rescue training related to migration, including "train the trainers" programmes.

Traffic management

- Focus on further development of maritime ICT for sea traffic management, "intended route" monitoring and situational awareness, which will allow authorities to identify safety hazards
    - Support the further development and deployment of sea traffic management by establishing a dedicated EU programme and a mechanism for coordination and dissemination
- Focus on development of information sharing platforms to efficiently use and analyse big data in sea traffic management.

Human element

- Training
    - Educational programmes should address the specificities of the maritime sector and promote interdisciplinary skills: e.g. include markets, business strategy, supply chain management, "soft skills" (team-work, dealing with stress, cross-cultural competences) and language competence ("shipping" English as used on board may be quite different than "proper" English).)
    - Focus on training to safely operate and fully exploit new technologies, such as i.a. alternative fuels (e.g. LNG).

- Increase the focus on digital skills for seafarers and maritime professionals at sea and onshore. Further research is required on the interaction between seafarers and the technology.

- Promotion of maritime careers
  - Improving access to training: making training more available, affordable, certifiable
  - Establishing EU-platforms for the sharing of best practices on maritime careers
  - Increase attractiveness of the profession (especially for women), e.g. through campaigns, social networks, apprenticeship scheme promotion, and other motivational measures.
  - Rethinking training and career paths for young seafaring professionals to allow them to successfully move from sea-based to land-based position.

- New challenges
  - Continue to seek ways to reduce bureaucratic workload for seafarers, i.a. through digitalisation.
  - Cybersecurity: focus on adequate training on how to respond to such incidents and how to execute contingency plans to avoid safety accidents.

IX. ANNEXES

1- The methodological approach: content and data

Introduction to the methodology

The Motorways of the Sea Detailed Implementation Plan (DIP) is strongly based on 2 elements:

- MoS content
- MoS Data

The **first element**, moving from existing content, generated in the space of several years, has led to a full array of development priorities, based on the 3 pillars identified by the MoS Coordinator Brian Simpson, OBE, that have received contribution and validation for a large number of stakeholders (as a part of the more than 300 invited to contribute).

The **second element** relies on a large-scale data collection on the status of the Motorways of the Sea today. The focus is on data that is – at least in principle – available in a reliable and comparable format as only such data allows drawing meaningful conclusions on the status quo of Motorways of the Sea. Clear definitions of each parameter are hence necessary as well as a methodology identifying relevant terminals in ports with several handling facilities for the same cargo category. For most of the parameters, alternative independent sources are used to identify possible errors or misinterpretations of the main source (see 'Data' section below).

In order to evaluate the 'adequacy' of ports and maritime links with regard specific objectives, standards have to be defined. This can be done based on the identification of common standards for certain groups of ports (e.g. tide-independent draught of at least 14 metres for deep sea container ports) or based on political aims (e.g. provision of on-shore power supply in as many ports as possible).

The data collected concerns maritime links (e.g. characteristics of the ships used on regular services) and ports (cargo volumes by type, infrastructure, maritime and hinterland connections). Data is collected either for all core and comprehensive network ports or for all core network ports, depending on the feasibility. Port authorities and ship operators will be integrated into the data verification process. Some of the data (port cargo traffic and

infrastructure) will be transferred to the TENtec database, while other analytical data (e.g. the number and type of maritime connections) is collected exclusively for the purpose of this Detailed Implementation Plan.

Once the level of adequacy has been determined by comparing the status quo with the objective, the data analysis can support the identification of those areas that can serve as horizontal priorities for the Detailed Implementation Plan. If only single ports or maritime links have a need for further development to comply with a certain objective, this objective is not considered as suitable as a horizontal priority or needs to be put into a broader context. Those areas where there is still a large potential for improvement, by contrast, can be considered further.

From MoS content to development priorities

The overall process guiding the DIP development comprises many structural parts that, when combined, integrated and validated, bring about the outline of the present document.

The content part of the work entailed an initial reconnaissance of main outcomes of existing MoS studies, projects and conferences constituting the Literature Review, considered as a starting point in terms of knowledge, notion, and background for the developing the following part of the work. Studies on MoS experiences, outcomes and results, both in terms of contents and recommendations, have been critically reviewed and analysed.

Together with a more holistic review approach, a further focused activity has been carried out based on a selection of successful stories deriving from the implementation of MoS projects. The review of past MoS projects brought to light some cases that were particularly effective and considered as today's best practices. These flagship projects could be taken as reference work for other or further projects development.

Additional sources of valuable information and suggestions were the proceedings from the past MoS conferences, held respectively in Gothenburg in 2014 and Liverpool and Venice in 2015. The main outcomes and recommendations of these conferences have been highly considered, having had as main themes the same three MoS Pillars already identified at the time by the MoS Coordinator, Mr Brian Simpson, OBE, and having seen the involvement of MoS projects leaders as speakers and interlocutors.

The listed three main sources of information constituted the key references for the development and setting of the three MoS Fora, that took place in Brussels during the

spring 2016. The MoS Fora constituted a unique occasion of gathering specialists and experts from the industry, academy and policy environments being asked to express their opinions or giving advices in relation to relevant issues linked to the three MoS Pillars: Environment; Integration of the maritime transport in the logistic chain; Safety, human element and traffic management. It was moreover possible to outline a Scene Setter and a Teaser Paper that would encompass the current key topics linked to the three MoS Pillars; these documents have been circulated among the MoS Fora attendants in order to obtain their valuable point of views, criticisms and recommendations for defining the content of the DIP. Taking into account the contributions received before, during and after the Fora, these documents have been elaborated in terms of content, thereby also contributing to the fleshing out of the development priorities for the 3 pillars.

To complement and to enrich the work, further input has been gathered from side events where the Consortium took part and from direct interviews with selected stakeholders (including MEPs).

The aforementioned phases of work convey the framework followed in order the outline the strategic approach to define an array of development priorities for MoS in the future. The DIP as such comprises a number of topics that covers the full spectrum of possible TEN-T development options, embracing a list of elements that may help in providing wider benefits, directly linked to MoS projects and also to MoS links.

Within the content gathered for the MoS DIP, a particular focus has to be put on the role played by the MoS digital multichannel platform of knowledge, www.onthemosway.eu. Onthemosway.eu aims at facilitating the exchange of information, knowledge and experiences in the field of freight, logistics and maritime co-modal transport. Content is updated on a daily basis with the most important news in these fields thanks to partnerships with specialised news titles and to the original content produced by the onthemosway staff.

Data

As explained above, the second element related to data depends on a large-scale data collection on the status quo of MoS, identifying and defining objectives, and then evaluating the ‘adequacy’ of ports and maritime links with regard to the specific objectives, standards as defined.

Data on maritime links and employed vessels

The first set of indicators is on regular ro-ro and container services and on the ships used on these services. This information is not intended to be used for evaluation of the adequacy, but rather to group the maritime links (ro-ro vs. container, deep sea vs. short sea). The ship dimensions, however, are used to define the objective for ports (see below).

Figure 1: Data on Maritime links and ships

Indicator	data collection progress	main source	quality check/ alternative sources	objective	adequacy
Number of services	100%	MDS Trans-modal	Web / Ship operators / Ship movement data (AIS)	-	-
ro-ro services	100%			-	-
container services	100%			-	-
Geography/routes	100%			-	-
Operator	100%			-	-
Ship dimensions	100%	Clarkson	Web/ Ship operators	-	-
Capacities (TEU/lane m)	78%			-	-
LNG readiness	99%	technology providers	Web/ Ship operators	yes	1%
Scrubber	95%			yes*	3%
OPS ready	95%			yes	8%

* for non-LNG vessels

With regard to the roro and container ships used on regular services calling in European ports, three environmental indicators have been analysed: the share of LNG-ready engines, the share of ships with scrubbers, and the ships that can use onshore power supply (OPS). Though it is clear that LNG is not a viable solution for all ships in the short medium term due to missing LNG infrastructure in some European regions and especially in the corresponding deep sea regions, it is clear that it could be used for more than one per cent of the regular services calling in European ports.

The installation of scrubbers is more widespread, but still only used on about three per cent of all services. Even in the North Sea and Baltic Sea ECAs, only one out of eight ships is equipped with a scrubber. Finally, around eight per cent of the ships calling regularly in Europe are able to use shore-side electricity while at berth. For container ships, this share even reaches 12 %. Still, it is safe to say that for all three indicators, there is room for improvement with regard to the environmental performance of ships.

None of the data on maritime links is as yet available in TENtec because no category for maritime links exists. In contrast to port and hinterland infrastructure, the services and the ships deployed are subject to short-term changes.

Data on Ports

Just as for maritime links, data on seaports includes general information characterising the ports and data regarding the performance of ports. While information on the cargo traffic by type and on the infrastructure will be included in the TENtec database, information on the regular maritime and hinterland connections will be collected for the sake of the Detailed Implementation Plan only. The data can be used to generate aggregate Key Performance Indicators (KPIs) on the maritime and hinterland connectivity of ports.

Figure 2: Data on EU seaports

Indicator	data collection progress	main source	quality check/ alternative sources	objective	adequacy
Cargo traffic by type	98%	Eurostat	ESPO / ISL	-	-
Regular connections	69%	MDS Trans-modal	Ship movement data (AIS)	-	-
roro lines	100%			-	-
container lines	100%				
hinterland (rail/barge)	8%	Web	Operators/ports		
Hinterland traffic (total)	13%	Ports	Studies	-	-
Modal split	9%			-	-
Rail connection	49%	Ports	Maps/ CNC studies	yes*	
Container terminals	49%			yes*	85%
RoRo terminals	49%			yes*	52%
Rail terminal	49%			yes*	
Container terminals	49%			yes*	81%
RoRo terminals	49%			yes*	48%
Maximum ship draught	67%	Port handbooks	Ports	**	…

* with exceptions

** depending on port group; analysis ongoing

One important aspect of the hinterland connection is the availability of rail connections. Among the ports in which rail connections are viable (i.e. ports potentially serving a wider hinterland reachable by rail), 85 % of the container ports analysed so far have a container terminal with rail connection, but only 52 % of the ports with ro-ro terminals.

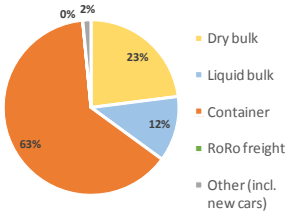
Figure 3: Data summary in port profiles (examples)

Port: Hamburg

Locode: DEHAM

Freight traffic

Cargo traffic composition



	1.000t
Dry bulk	27.702
Liquid bulk	14.541
Container	76.482
RoRo freight	0
Other (incl. new cars)	1.844
Total cargo traffic	**120.568**
	1,000s
Passengers	589
of which cruise passengers	*589*

Sea connection

Infrastructure

Parameter	Value
Maximum draught (all tides)	12,5 m
Total port area	108 km²
of which terminal area	...
Total quay length	43000 m

Container liner services

Parameter	Value
Number of weekly departur	84
of which deep sea	34
of which short sea	50
Weekly capacity (1,000 TEU)	702

Installations and amenities

Parameter	
Bunkering	HFO, MDO
Waste reception	oil, chem, ww, dry
VTMIS	yes
Single Window system	yes
Dredging equipment	yes
On-shore power supply	yes

RoRo liner services/Ferries

Parameter	Value
Number of services	-
of which international	-
of which national	-
Total Weekly l.m. capacity	-
Total weekly pass. capacity	-

Hinterland traffic

Road

Parameter	Value
Lanes:	4
Road share:	47%

Rail

Parameter	Value
Tracks conn.:	2
Services/week:	400
Terminals:	5
Total tracks:	43
Rail share:	44%

Barge

Parameter	Value
IWW class:	VI
Barges/week:	9
internat.:	-
Barge share:	9%

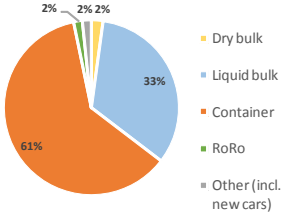
Nearest corridor: North Sea-Baltic/Scandinavian-Mediterranean/Orient-East Med
Distance: 0 km

Port: Bahía de Algeciras

Locode: ESALG

Freight traffic

Cargo traffic composition



	1.000t
Dry bulk	1.544
Liquid bulk	23.954
Container	44.221
RoRo	1.149
Other (incl. new cars)	1.192
Total cargo traffic	**73.822**
	1,000s
Passengers	5360
of which cruise passengers	-

Sea connection

Infrastructure

Item	Value
Maximum draught (all tides)	23,0 m (tanker)
Total port area	63 km²
of which terminal area	...
Total quay length	17114 m

Container liner services

Item	Value
Departures per week	53
of which deep sea	48
of which short sea	6
Weekly capacity (1,000 TEU)	437

Installations and amenities

Item	
Bunkering	HFO, MDO, LNG
Waste reception	oil, chem, ww, dry
VTMIS	yes
Single Window system	yes
Dredging equipment	yes
On-shore power supply	under construction

RoRo liner services/Ferries

Item	Value
Number of services	10
of which international	6
of which national	4
Total Weekly l.m. capacity	...
Total weekly pass. capacity	...

Hinterland traffic

Road

Item	Value
Lanes:	4
Road share:	98%

Rail

Item	Value
Tracks conn.:	1
Services/week:	...
Terminals:	1
Total tracks:	3
Rail share:	2%

Barge

Item	Value
IWW class:	-
Barges/week:	-
internat.:	-
Barge share:	0%

Nearest corridor: Mediterranean / Atlantic
Distance: 0 km

Role of Key Performance Indicators

The analysis of the port's maritime cargo traffic, their regular maritime services and hinterland volumes indicates how ports are integrated into the logistics chains. When evaluating the status quo, reference must always be made to comparable ports, e.g. ferry/ro-ro ports, deep sea container ports, short sea/feeder container ports, etc.

Table - Identification of port types (39 sample ports)

Country	Port	Container/ RoRo	Deep sea/ Short sea traffic	Core port/ Comprehensive port	Core Network Corridor
BE	Antwerpen	cont & roro	deep/short	Core	NSB, NSM, RA
BE	Zeebrugge	cont & roro	deep/short	Core	NSB, NSM, RA
BG	Varna	cont & roro	deep/short	Comprehensive	-
CY	Limassol	cont & roro	deep/short	Core	OEM
DE	Bremen/Bremerhaven	cont & roro	deep/short	Core	NSB, OEM, SM
DE	Hamburg	cont	deep/short	Core	NSB, OEM, SM
DE	Kiel	roro	(deep)/short	Comprehensive	-
DK	København	cont & roro	(deep)/short	Core	SM
EE	Tallinn	cont & roro	deep/short	Core	NSB
ES	Bilbao	cont & roro	deep/short	Core	ATL
ES	Las Palmas	cont & roro	deep/short	Core	-
ES	Valencia	cont & roro	deep/short	Core	MED
FI	Helsinki	cont & roro	short	Core	NSB, SM
FI	Kemi	cont & roro	deep/short	Comprehensive	-
FR	Calais	roro	(deep)/short	Core	NSM
FR	Le Havre	cont & roro	deep/short	Core	ATL
FR	Marseille	cont & roro	deep/short	Core	MED, NSM
GB	Dover	roro	deep/short	Core	NSM
GB	Hull	cont & roro	deep/short	Comprehensive	-
GB	Liverpool	cont & roro	deep/short	Core	NSM
GR	Piraeus	cont & roro	deep/short	Core	OEM
HR	Rijeka	cont	deep/short	Core	MED
IE	Dublin	cont & roro	deep/short	Core	NSM
IT	Genova	cont & roro	deep/short	Core	SM
IT	La Spezia	cont	deep/short	Core	SM
IT	Triest	cont & roro	deep/short	Core	BA, MED
LT	Klaipeda	cont & roro	deep/short	Core	NSB
LV	Riga	cont & roro	deep/short	Core	NSB
MT	Marsaxlokk	cont & roro	deep/short	Core	SM
NL	Amsterdam	roro	deep/short	Core	NSB, NSM, RA
NL	Rotterdam	cont & roro	deep/short	Core	NSB, NSM, RA
PL	Gdynia	cont & roro	deep/short	Core	BA
PL	Swinoujscie	roro	deep/short	Core	BA
PT	Canical	cont	short	Comprehensive	-
PT	Leixoes	cont & roro	deep/short	Core	ATL
RO	Constanza	cont & roro	deep/short	Core	RD
SE	Malmö	cont & roro	deep/short	Core	SM
SE	Trelleborg	roro	short	Core	SM
SI	Koper	cont & roro	deep/short	Core	BA, MED

Corridors: ATL: Atlantic; BA: Baltic-Adriatic; MED: Mediterranean; NSB: North Sea-Baltic; NSM: North Sea-Mediterranean; OEM: Orient-East Med; RA: Rhine-Alpine; RD: Rhine-Danube; SM: Scandinavian-Mediterranean

For each port group, benchmarks are set. The performance of each port is then evaluated based on the comparison with the respective group benchmark. With regard to maximum ship draught, for example, deep sea container ports may have to serve ships with 16 metres draught, while most ro-ro ships and ferries have draughts below 10 metres. In ports with different types of traffic, the most important terminals for each type of traffic will be used to evaluate the status quo.

The preliminary list of Key Performance Indicators includes:

- Maximum ship draught (tide-independent)
- Ro-Ro traffic volume per ro-ro berth and/or per quay metre (Ro-Ro terminals)
- Container traffic volume in TEU per quay metre (container terminals)
- Available bunker fuels/distance to LNG terminal
- Availability of on-shore power supply
- VTMIS in place
- Single Window system in place
- Distance to closest Core Network Corridor(s)
- Modal Split of Ro-Ro and container traffic

The indicators can be used to identify performance benchmarks with regard to traffic per berth/quay metre in the different groups, to identify investment needs (non-compliance with benchmarks), but also to monitor the development of the status quo of ports and Motorways of the Sea.

Determining 'adequacy': data-based status quo analysis

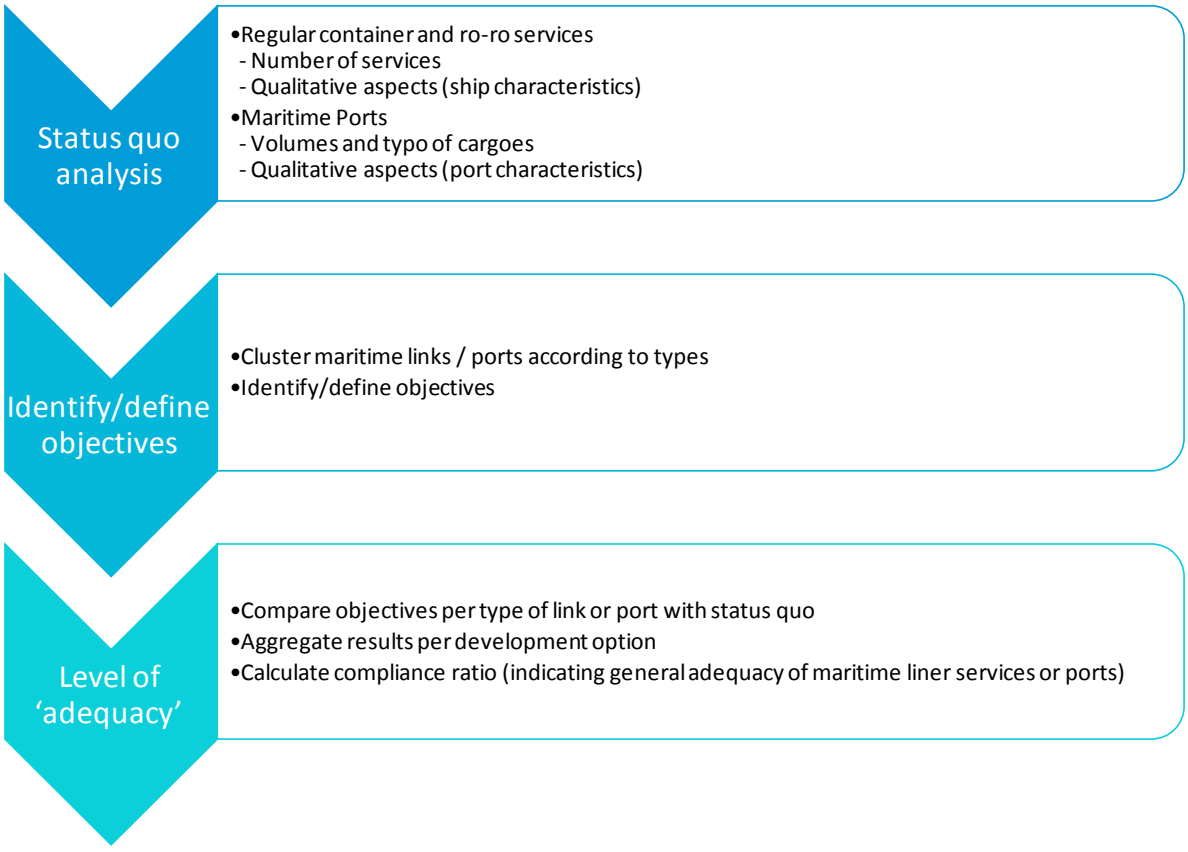
In order to exploit the full potential of Motorways of the Sea, many conditions have to be fulfilled. It is essential that the physical infrastructure be sufficient to make maritime transport an economically viable solution compared to competing modes. This encompasses the readiness of ports for certain ship sizes, sufficient terminal capacities, and adequate hinterland connections. Also the digital infrastructure has to contribute to the smoothness and safety of shipping and – in larger conurbations – of hinterland traffic. Digital services like Single Window systems and secure data sharing also add to the attractiveness of maritime transport vis-à-vis land-based transport since truck, rail and barge Generally require less administrative procedures.

However, reducing the carbon footprint by increasing the share of Motorways of the Sea in the modal split is only one side of the coin. In parallel, the environmental impact of shipping

itself can be reduced, e.g. by lowering the the use of Heavy Fuel Oil with a sulphur content of 3.5 % which is still widespread even in European waters (Atlantic and Mediterranean).

A crucial element in the development of the Detailed Implementation Plan is the identification of those development priorities with the highest potential impact on the efficiency and competitiveness of Motorways of the Sea. This is achieved by a large-scale data-based analysis of the status quo of maritime transport on the one hand and an identification or definition of market-oriented objectives for the various development options on the other hand. These objectives need to take into account the diversity of maritime links and their specific requirements.

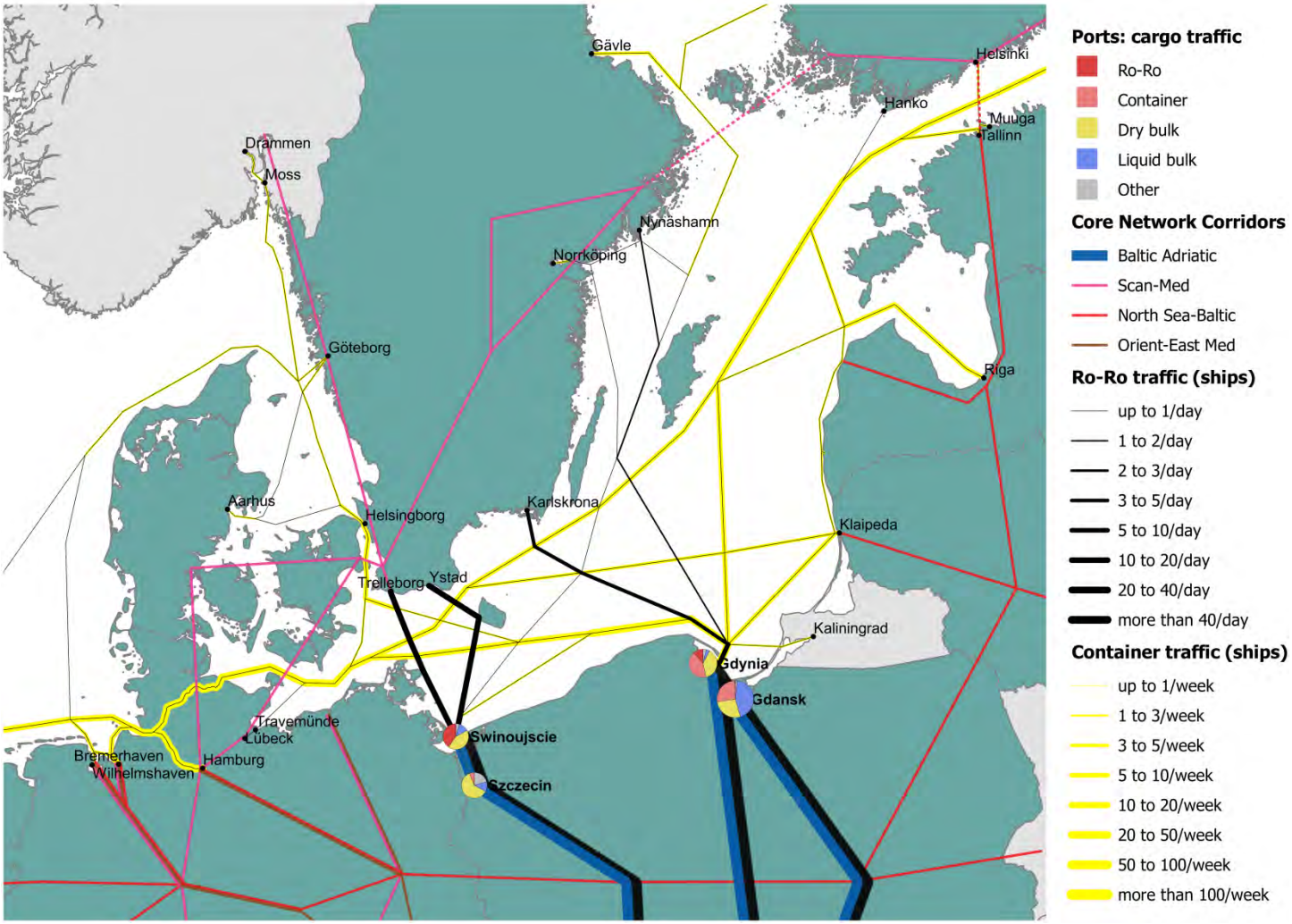
Figure 3: Process towards determining the level of adequacy



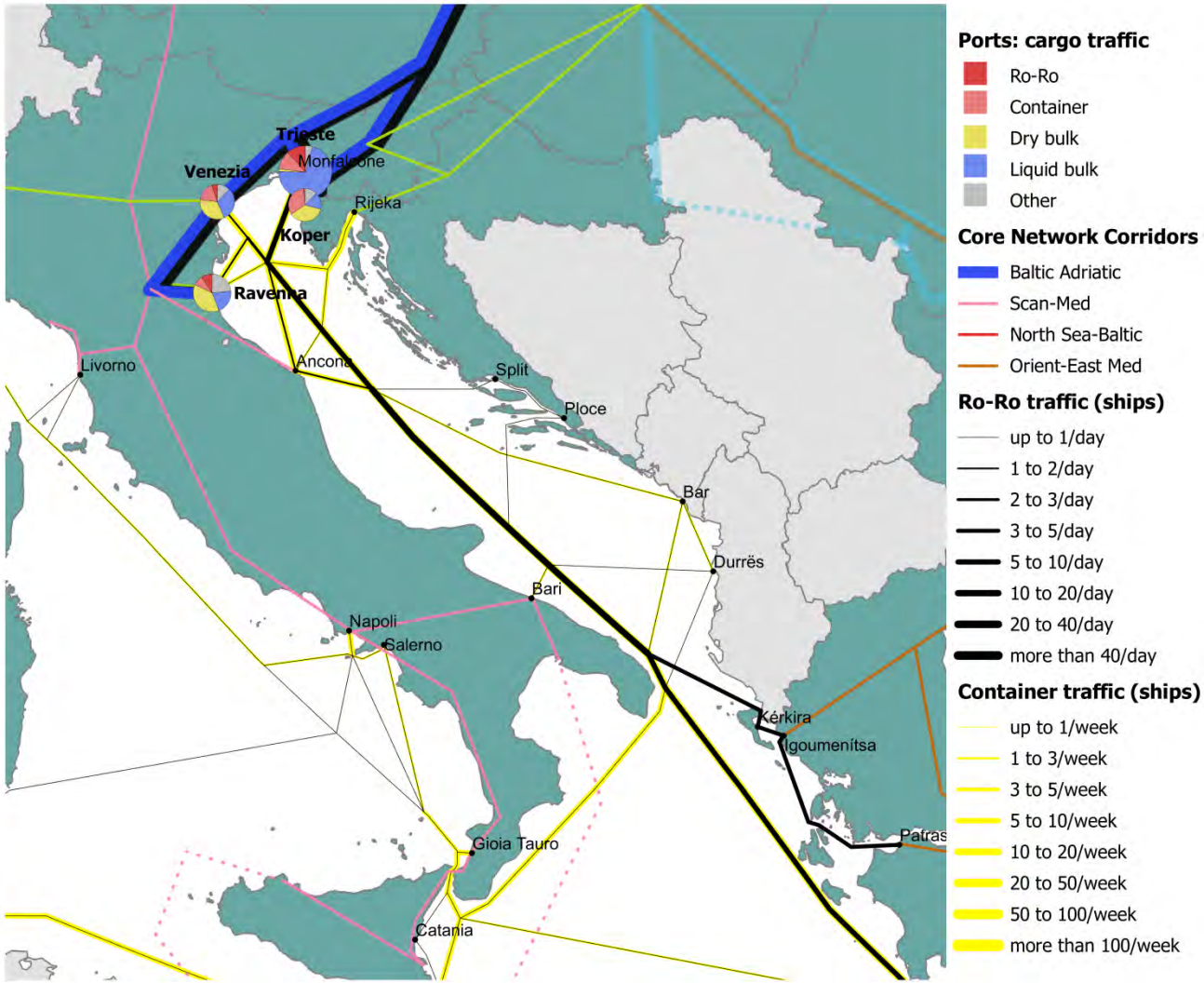
Once ports and maritime links are clustered, specific objectives can be set for each cluster. A comparison with the status quo reveals the share of ports or links that already comply with the objectives. If this share is very high, it means that development in that area will only be relevant for single cases and that support should be concentrated on other objectives. If a low share is achieved (e.g. below 50 %), there is generally a high potential for improvement to be assumed.

2- Maps

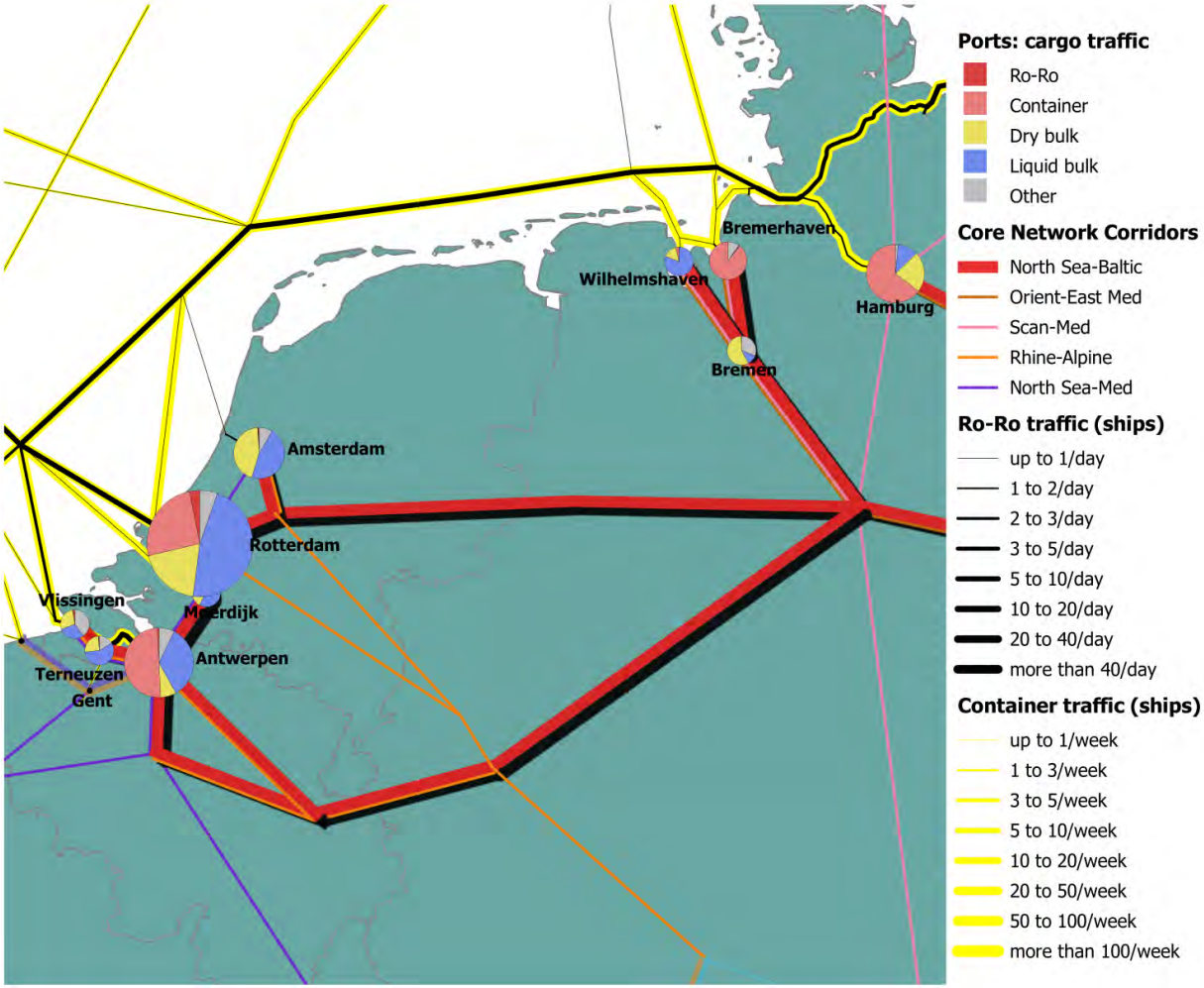
Baltic-Adriatic Corridor (North)



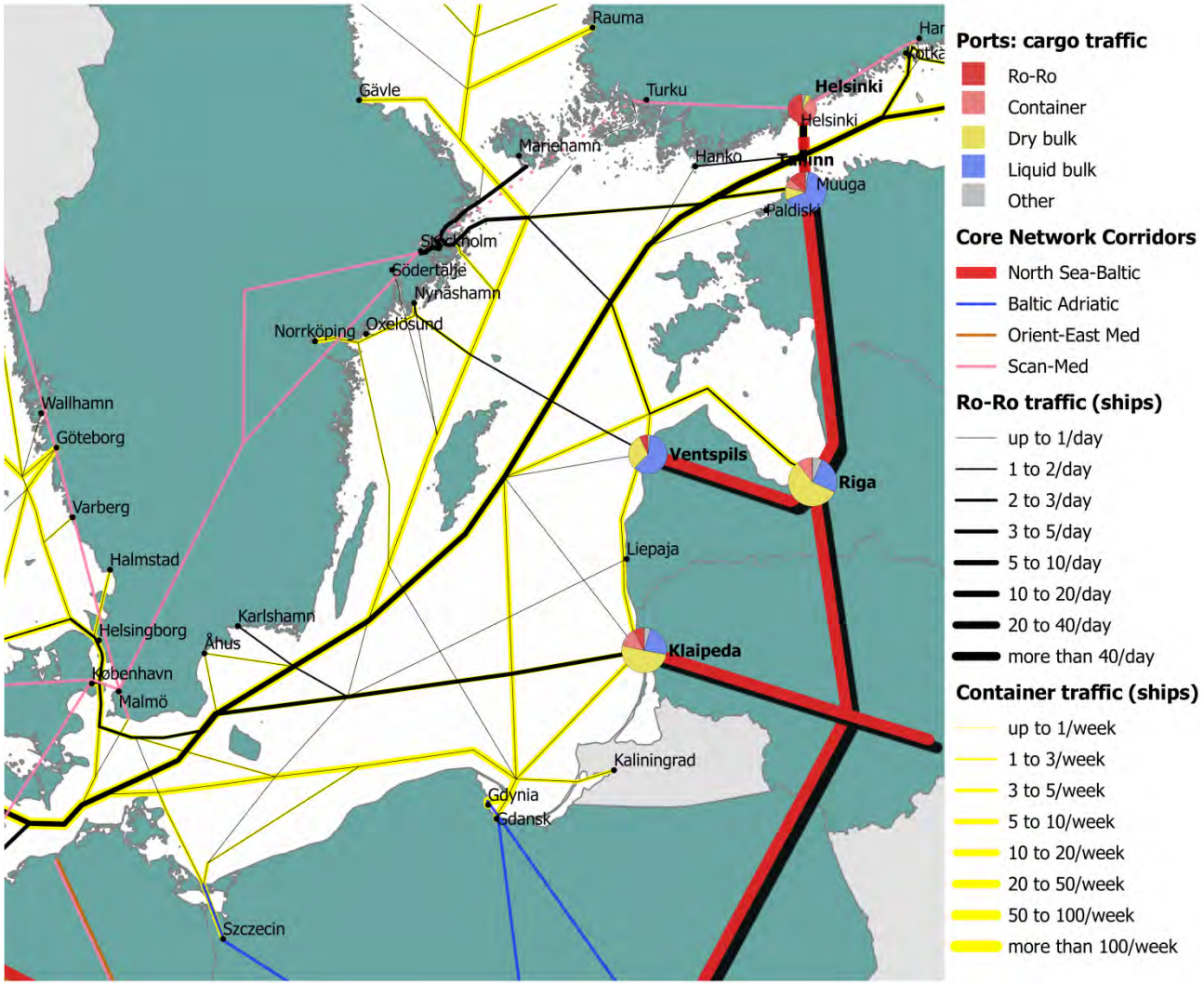
Baltic-Adriatic Corridor (South)



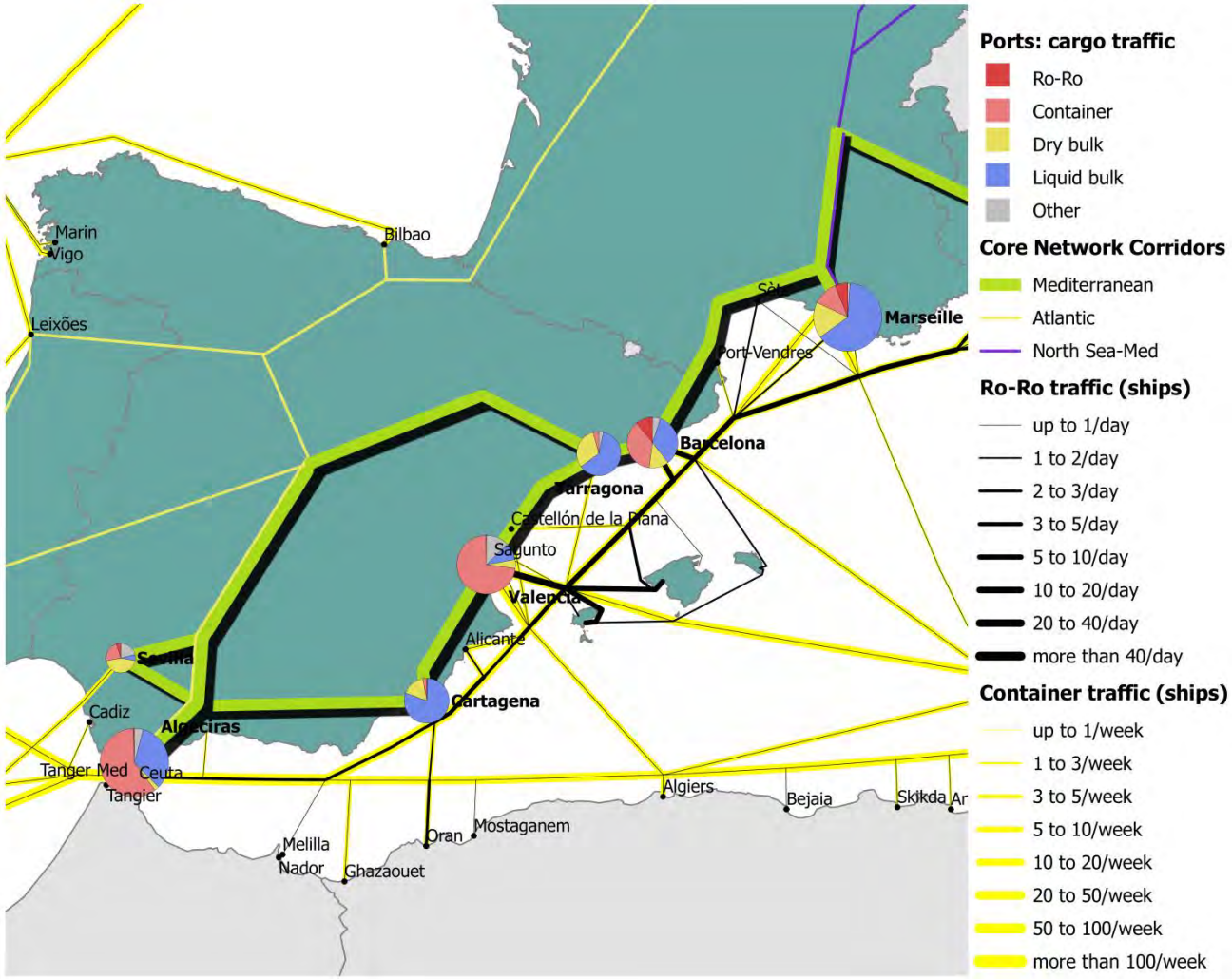
North Sea-Baltic Corridor (West)



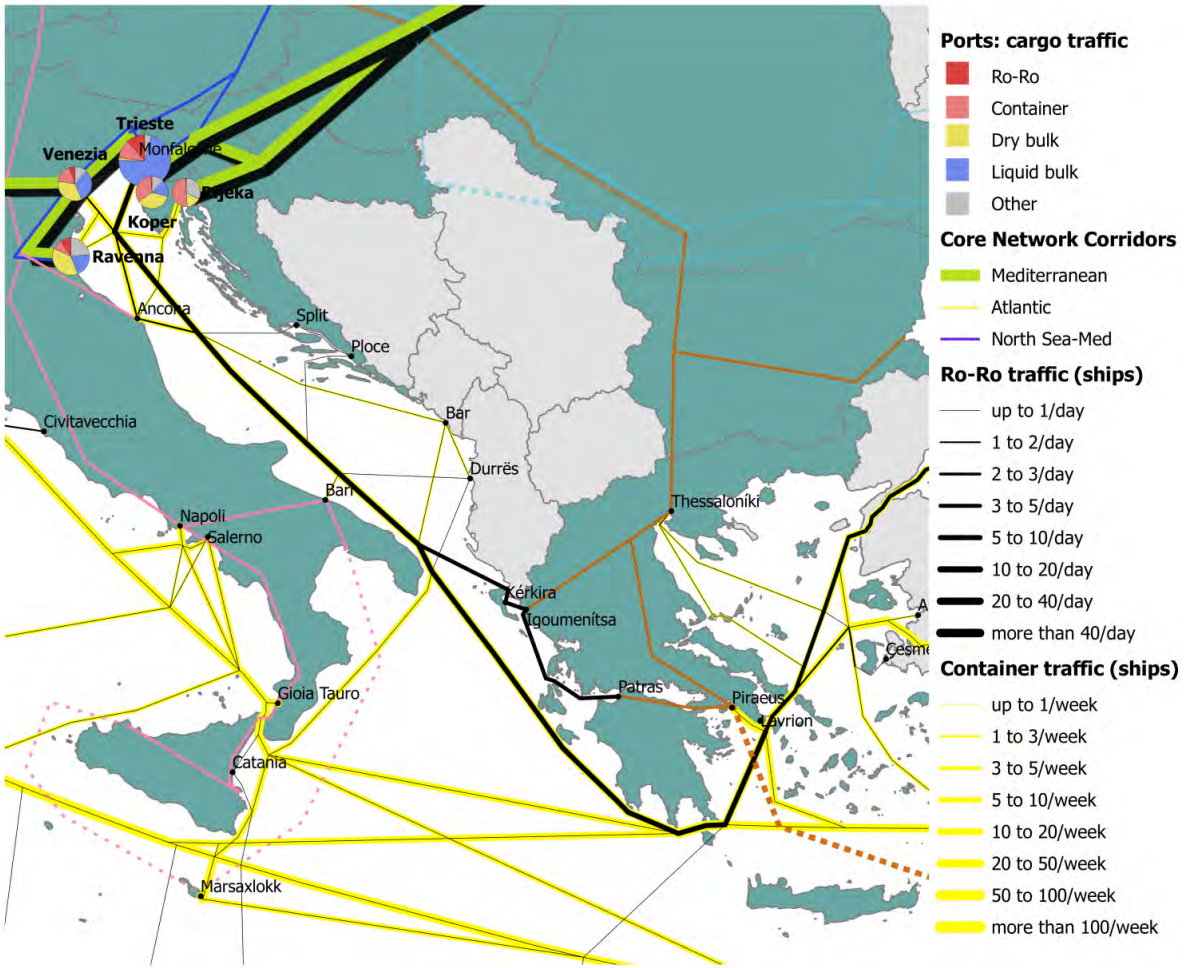
North Sea-Baltic Corridor (East)



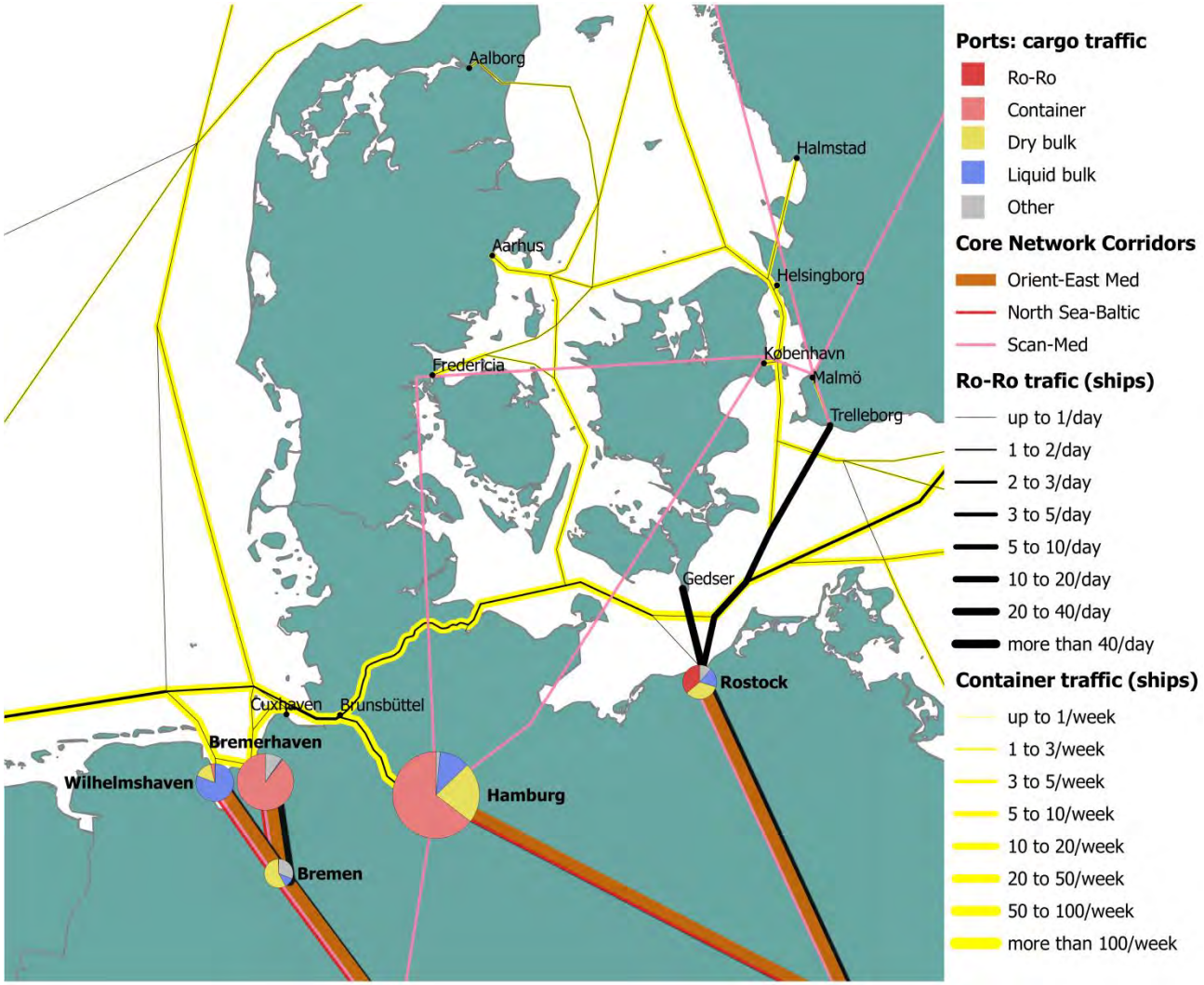
Mediterranean Corridor (West)



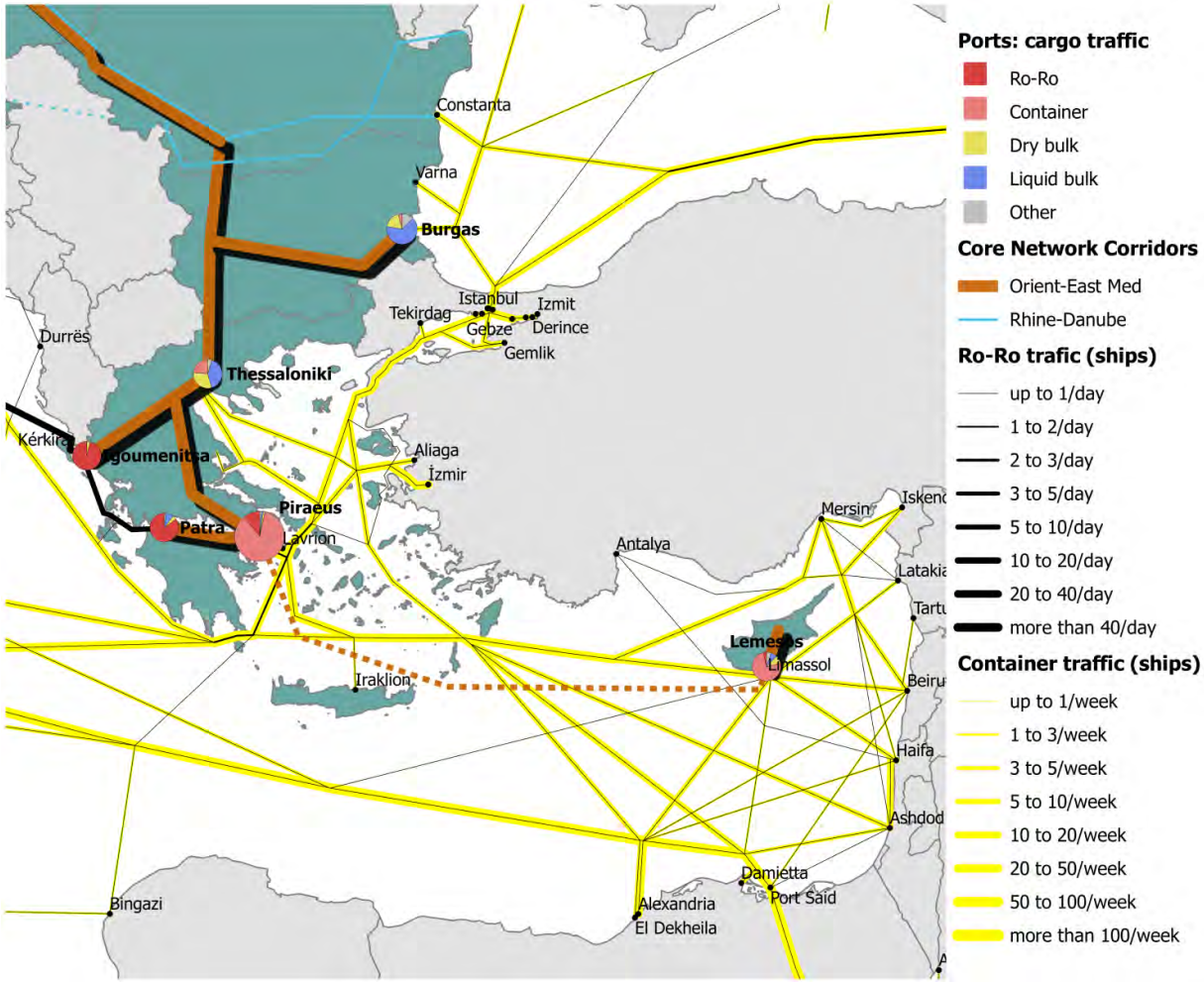
Mediterranean (East)



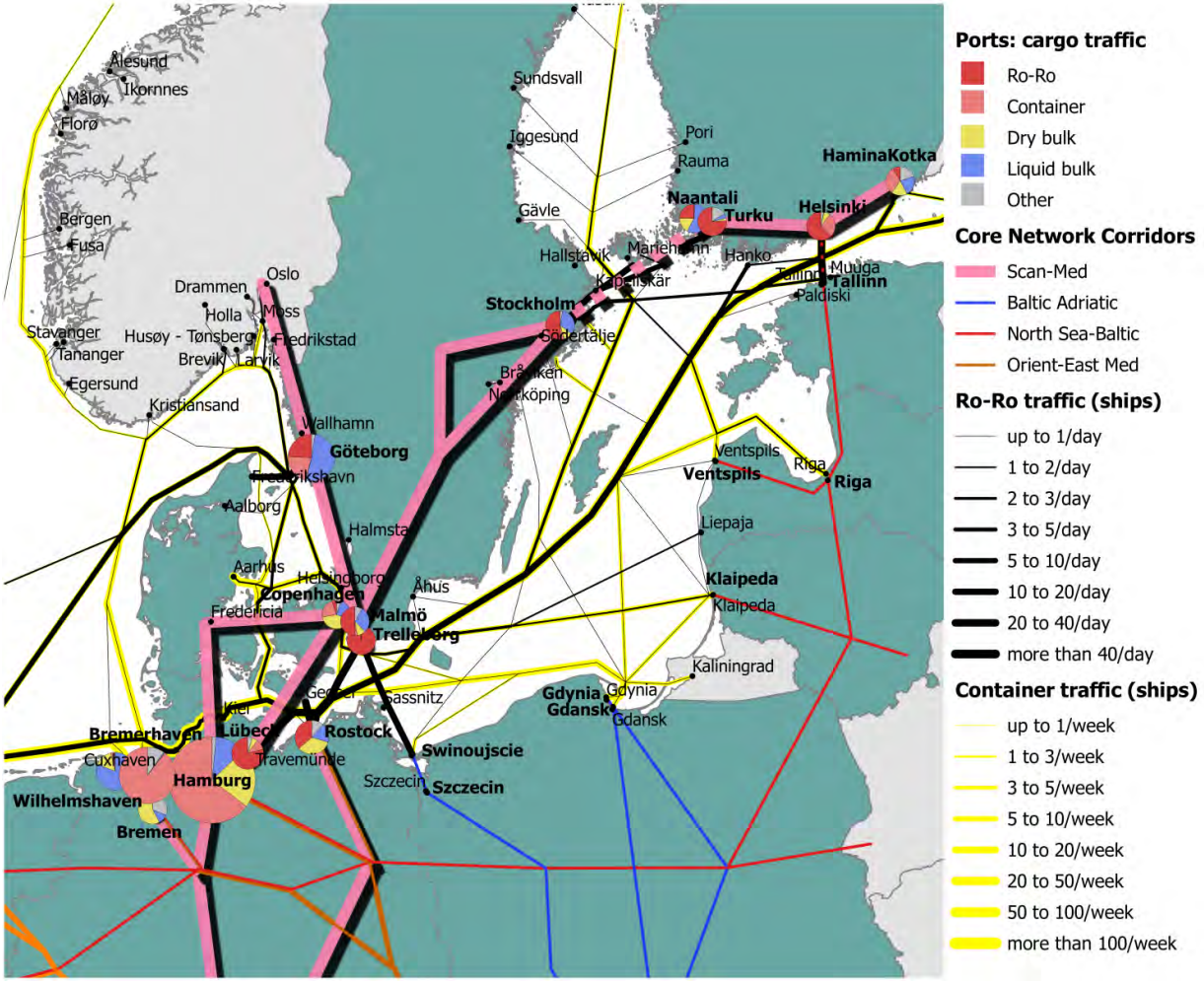
Orient-East Med Corridor (North)



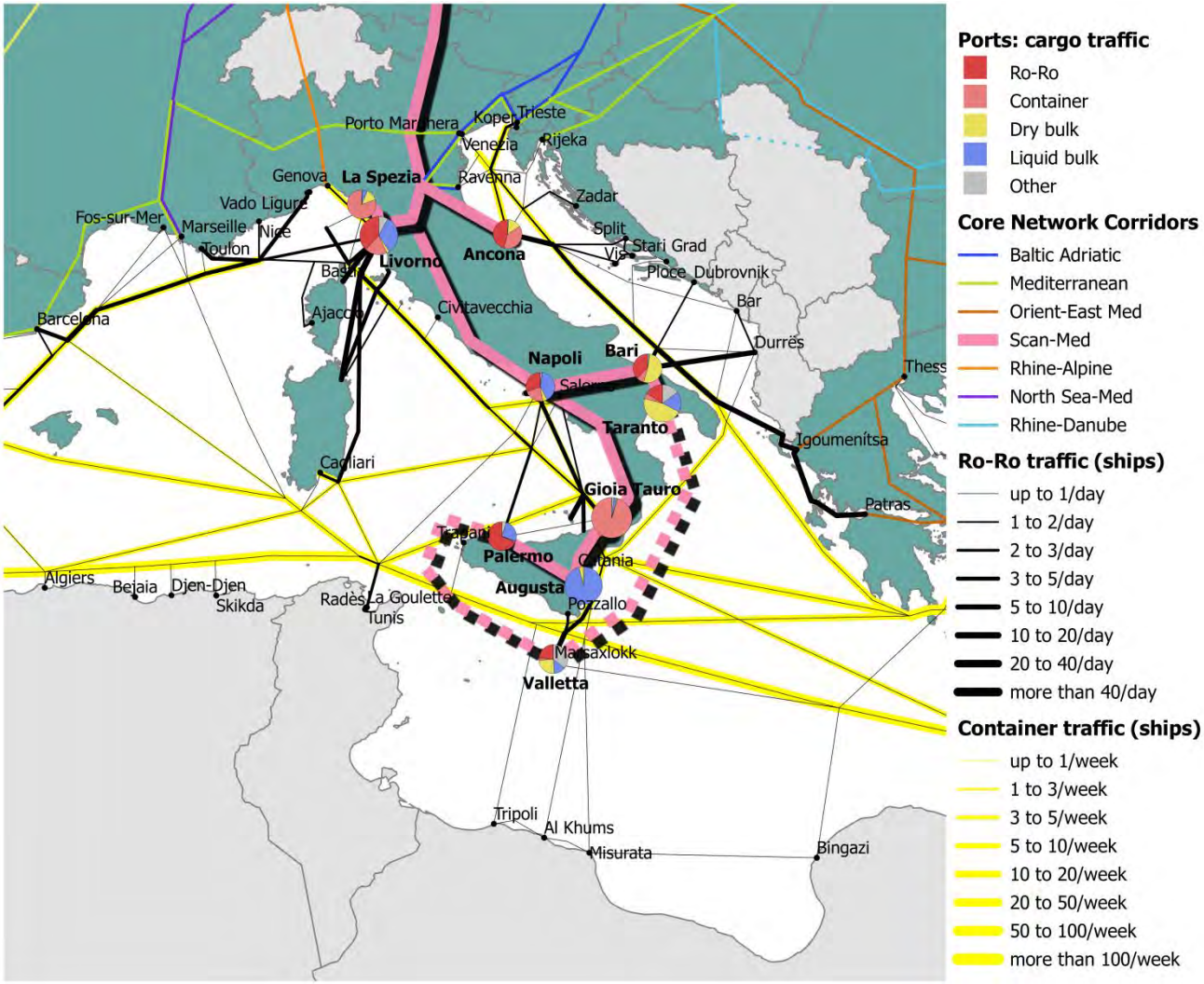
Orient-East Med Corridor (South)



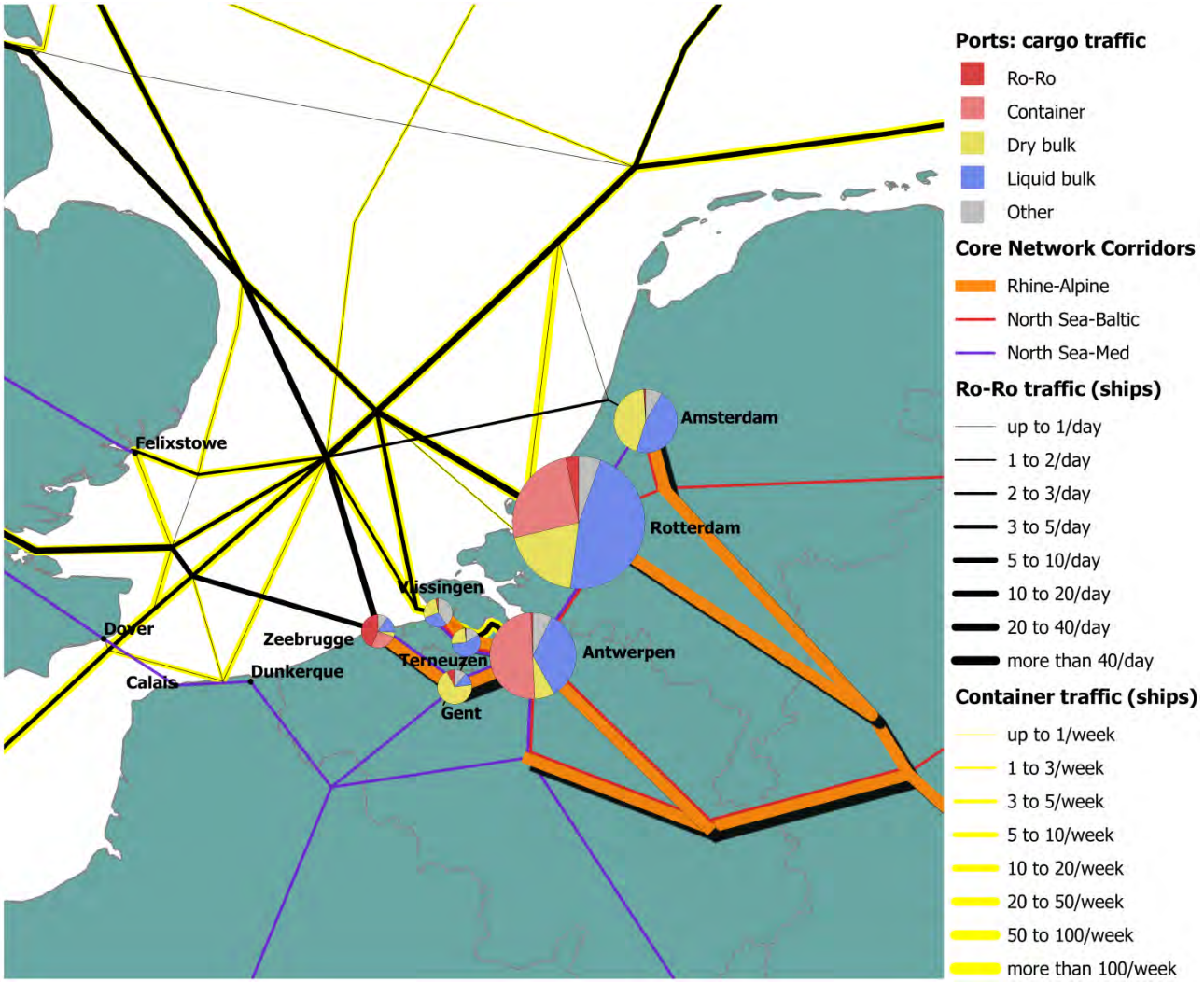
Scandinavian-Mediterranean Corridor (North)



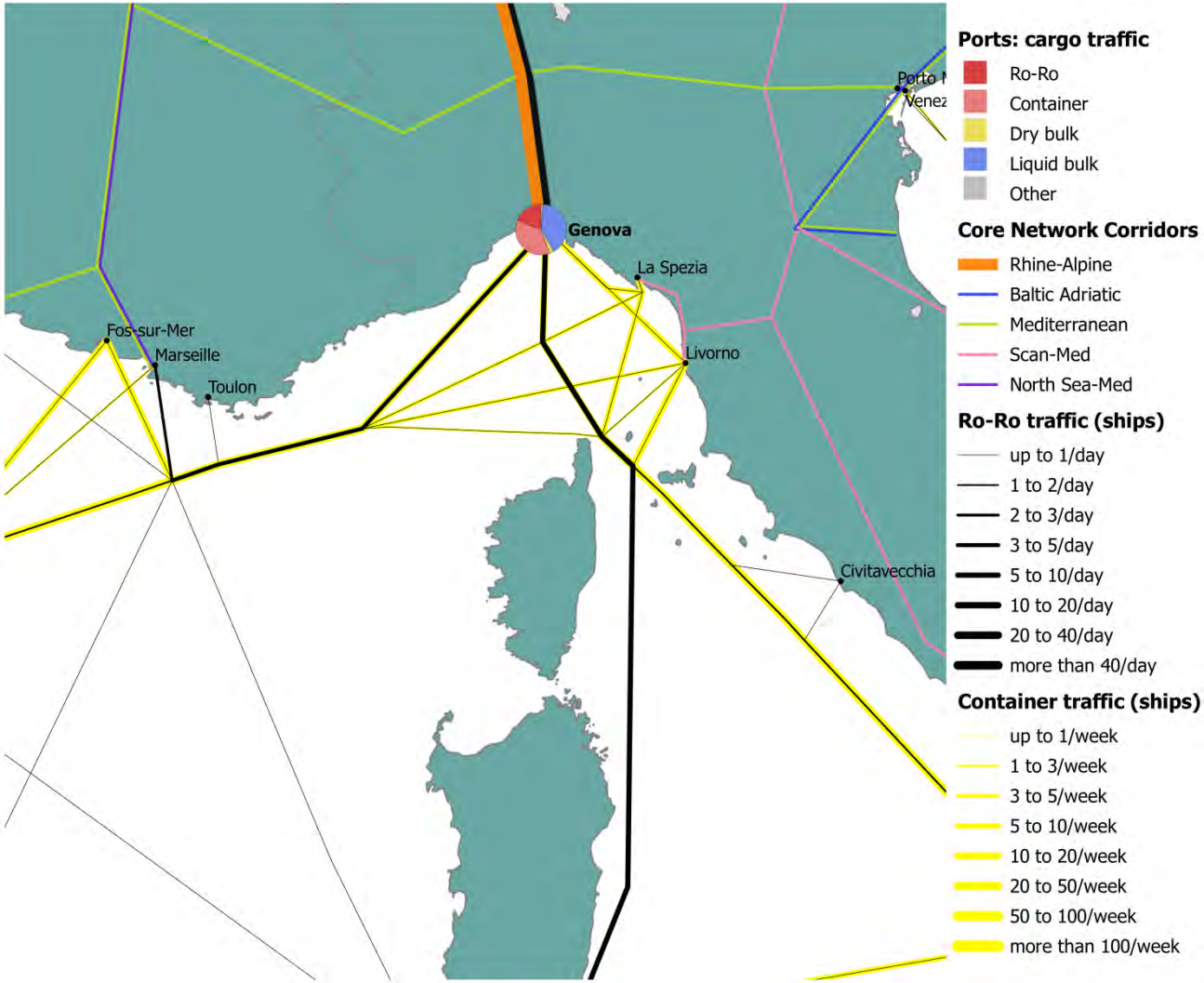
Scandinavian-Mediterranean Corridor (South)



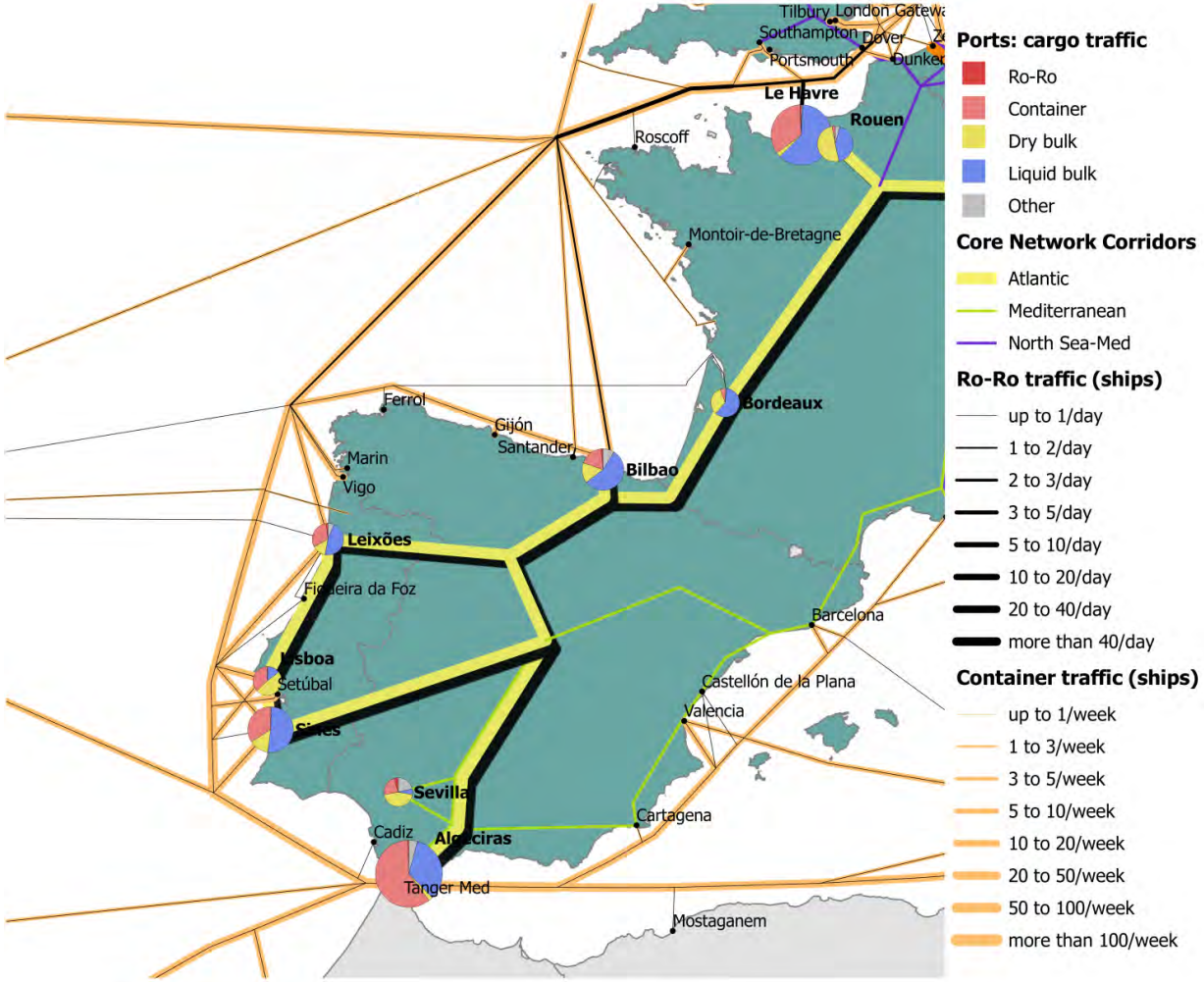
Rhine-Alpine Corridor (North)



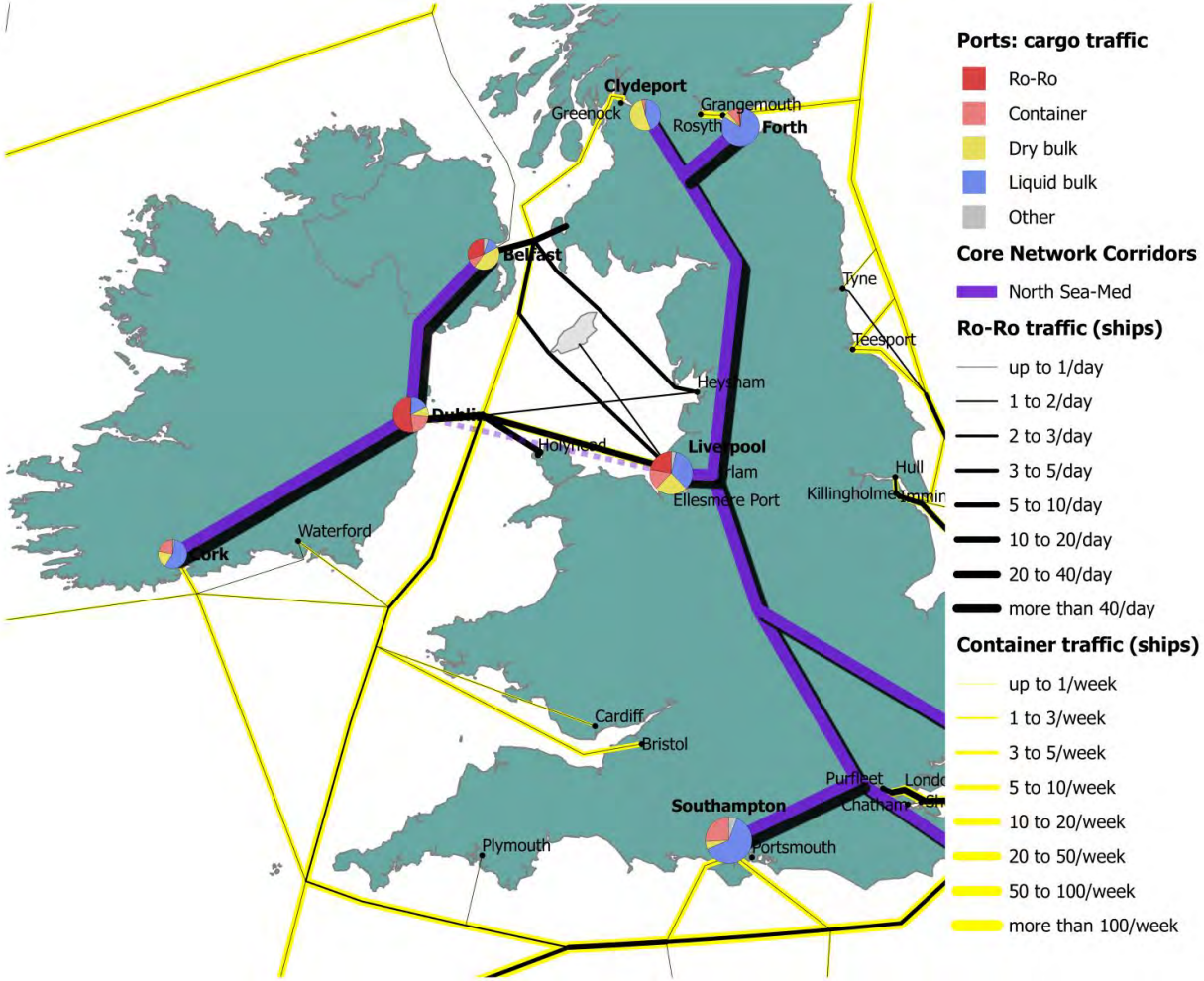
Rhine-Alpine Corridor (South)



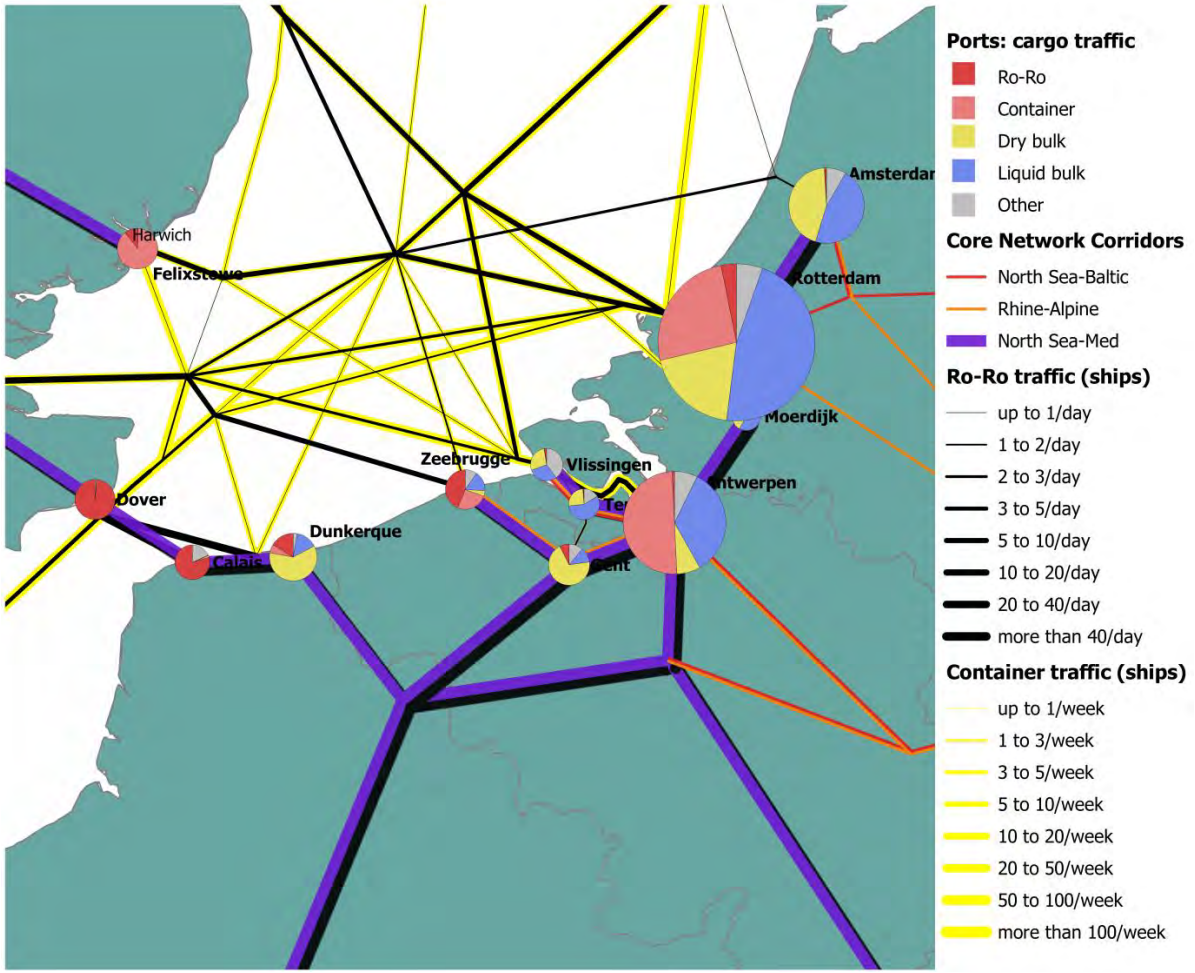
Atlantic Corridor



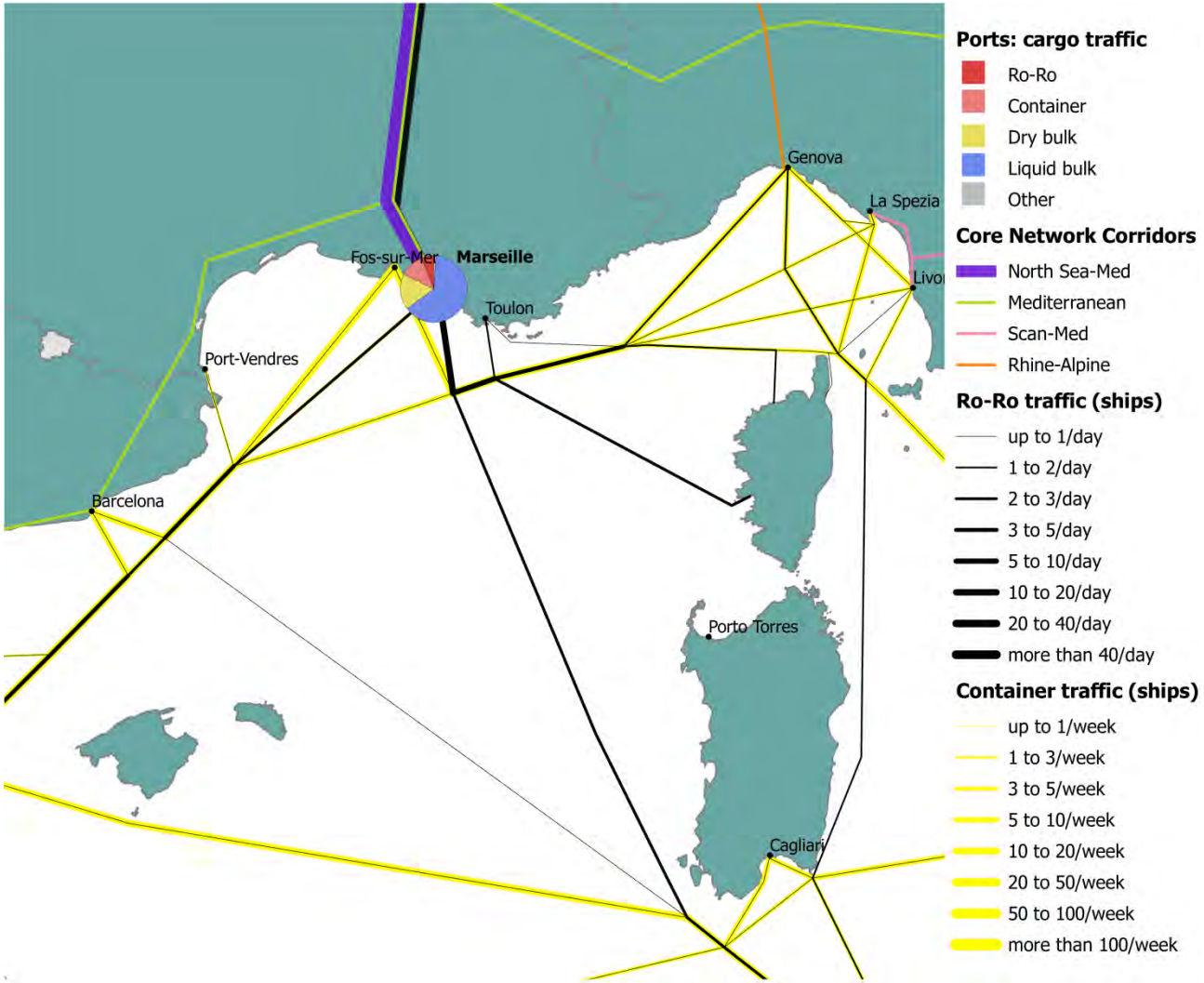
North Sea-Mediterranean Corridor (North)



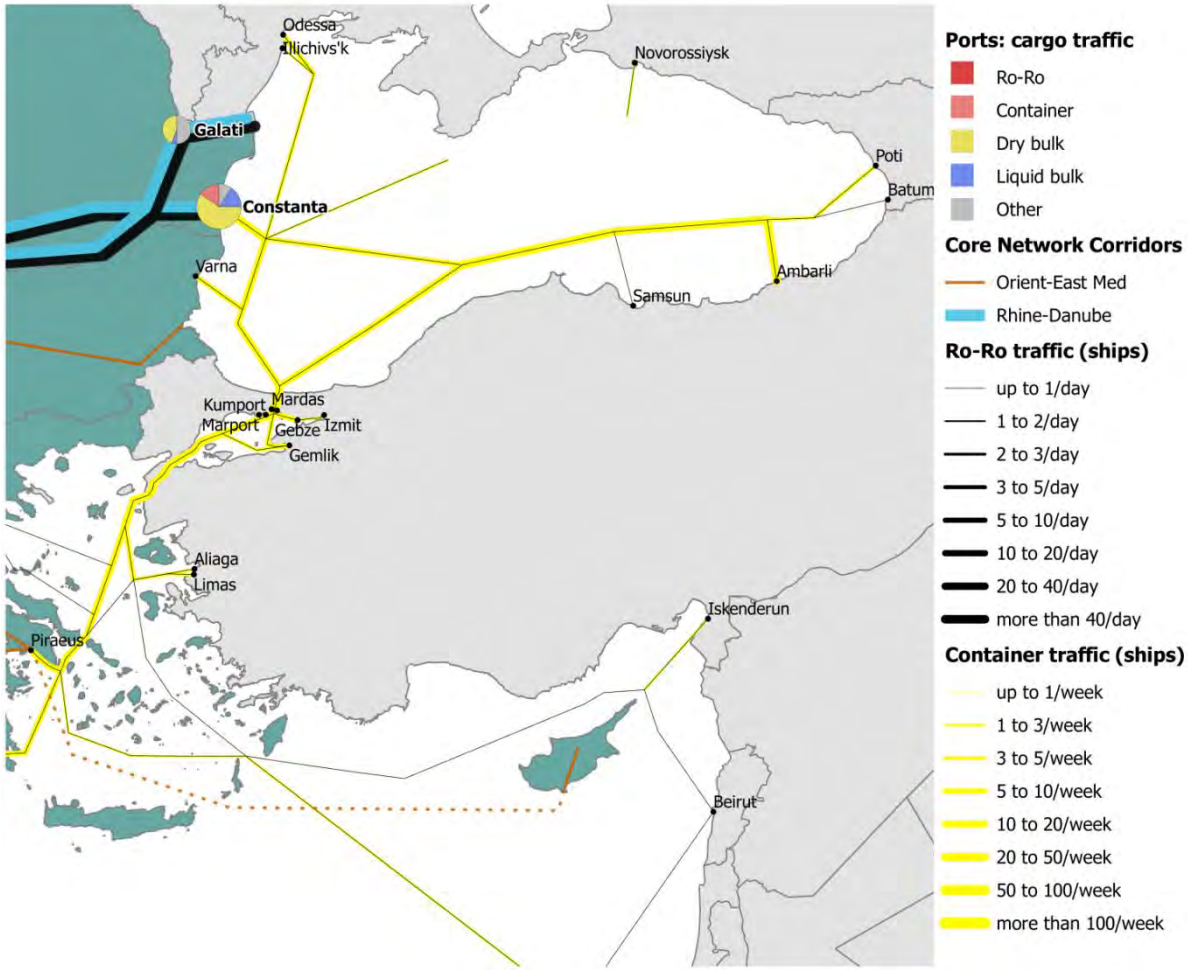
North Sea-Mediterranean Corridor (Central)



North Sea-Mediterranean Corridor (South)



Rhine-Danube Corridor



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