



Shaping the future policy of the

# European Maritime Space

Motorways of the Sea  
Detailed Implementation Plan  
of the European Coordinator

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## **July 2022**

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### **Reference source of analysis:**

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## Acronyms and abbreviations

AFIR	Alternative Fuels Infrastructure Regulation
CEF	Connecting Europe Facility
CNCs	Core network corridors
CTF	Cleaner Transport Facility
DIP	Detailed Implementation Plan
eFTI	Electronic Freight Transport Information
EGD	European Green Deal
EIB	European Investment Bank
EMS	European Maritime Space
EMSA	European Maritime Safety Agency
EMSWe	European maritime single window environment
ETS	Emissions Trading System
EU	European Union
GHG	Greenhouse Gases
HFO	Heavy Fuel Oil
ICT	Information and Communications Technology
IoT	Internet of Things
IMO	International Maritime Organisation
LNG	Liquefied Natural Gas
MGO	Marine Gas Oil
MoS	Motorways of the Sea
MRV	Monitoring, Reporting and Verification
NECA	NO <sub>x</sub> Emission Control Area
NO <sub>x</sub>	Nitrogen Oxides
OPS	Onshore Power Supply
PRF	Port Reception Facilities
Ro-ro	Roll-on/Roll-off
SECA	Sulphur Emission Control Area
SO <sub>2</sub>	Sulphur Dioxide
SSMS	Sustainable and Smart and Mobility Strategy
SSS	Short Sea Shipping
TAF	Telematics Applications for Freight
TEN-T	Trans-European transport network
TSC	Technical Screening Criteria

## Foreword by the European Coordinator

Maritime transport plays a key role for the European economy, transporting about 75% of its external trade and approximately 31% of its internal trade. It ensures smooth and efficient trade flows in and out of the European Union (EU). Specifically, short sea shipping (SSS) makes up a majority (up to 60%) of the total maritime transport of goods to and from the main EU ports<sup>1</sup>. With its large network of 292 maritime ports on the trans-European transport network (TEN-T), the European maritime sector forms an important part of the intra-European transport system, facilitating and redistributing trade flows to and from land-based route networks, and connecting mainland Europe to its peripheral regions and islands.

In my role as European Coordinator for the MoS, I developed my first Detailed Implementation Plan (DIP) in 2020, in close collaboration with Member States and stakeholders. In the 2020 DIP I laid out the concept of the European Maritime Space (EMS), articulated around three pillars: sustainable, smart and seamless. Today, the concept of the EMS as the maritime dimension of the TEN-T is as important as ever. Indeed, with the revision of the TEN-T Regulation, the MoS programme will be replaced by the EMS. With this in mind I aim to shape the EMS of the future even further in this DIP.

Since the publication of my first DIP in June 2020, major world events have taken place, the most prominent being the COVID-19 pandemic and Russia's invasion of Ukraine. These events have changed the world significantly. I have reflected on how this has influenced the future of the European maritime sector and concluded that a fourth pillar should be added to my vision for the EMS: resilience. The need for a more resilient maritime sector is not a new idea, but major challenges such as the COVID-19 pandemic, climate change, geopolitical tensions and possible future exogenous shocks have heightened the need for additional mitigation and adaptation measures.

The MoS programme has played a key role towards achieving the vision that I have for the future EMS. It has certainly been the programme under the Connecting Europe Facility (CEF) with the highest EU cooperation spirit, as it by default links ports from different countries. With this in mind, one of my strategic objectives for the EMS is to better link the ports with the CNCs, to reinforce the maritime dimension of the TEN-T. Maritime transport has an integral role to play in European transport logistic chains. As a result, the hinterland connectivity, between the ports and the land based CNCs, is of crucial relevance.

For this reason, I have organised my work with a regional approach in mind, focusing on each sea basin to promote a better integration of the EMS and the CNCs<sup>2</sup>. I collected input from stakeholders by organising workshops dedicated to each sea basin, in collaboration with the coordinators of the CNCs. This approach has contributed to a better understanding of the interlinkages between the sea and the hinterland accessibility. It has also helped to identify the specific challenges and opportunities of each sea basin and thus to set more tailored priorities for the future.

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<sup>1</sup> Eurostat: Maritime transport statistics – short sea shipping of goods  
[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Maritime\\_transport\\_statistics\\_-\\_short\\_sea\\_shipping\\_of\\_goods](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Maritime_transport_statistics_-_short_sea_shipping_of_goods)

<sup>2</sup> This sea basin approach is also in line with the EU's ongoing work on Sea Basin Strategies and Macro Regional Strategies with a maritime component (e.g. Atlantic Action Plan, Common Maritime Agenda for the Black Sea, WestMed Initiative and EUSAIR for the Adriatic-Ionian and EUSBSR for the Baltic Sea)

The road towards a sustainable, smart, seamless and resilient EMS requires efforts from all stakeholders, including ship owners, ship operators, ports, shipyards and ship suppliers. It also requires support from local, regional, national and EU authorities. All stakeholders will have to adapt to rapidly evolving trends and market driven changes. Climate change is creating a need for increasing mitigation measures and for the greening of all transport modes, including shipping. The world population is growing, shifting supply chains and creating new demand hubs. Disruptive technological developments emerge and require constant adaptations from maritime stakeholders. Further yet, the emergence of exogenous shocks, such as the COVID-19 pandemic or Russia's invasion of Ukraine, are having a global impact on every aspect of our economies, and changing how we approach decision-making.

To adapt, the legislative landscape is similarly evolving. In particular, addressing environmental issues is a top priority of European policymakers, and many regulatory initiatives have been put on the table: the European Green Deal<sup>3</sup>, the Climate Law<sup>4</sup>, and the "Fit for 55" package of proposals<sup>5</sup> are the most recent examples. Overall, the European maritime sector is facing many evolutions, which are both opportunities and challenges for its further development.

SSS and the development of a sustainable, smart, seamless and resilient EMS has a key role to play in this respect. Indeed, a modal shift from road to sea would significantly improve the sustainability of the European transport sector given that maritime transport remains the most energy-efficient way of transporting cargo. In this context, the Sustainable and Smart and Mobility Strategy<sup>6</sup> (SSMS) sets the target of increasing SSS by 25% by 2030 and 50% by 2050. The modal shift would also have a positive impact in reducing socio-economic impacts (such as congestion and accidents). All four aspects of the EMS interlink here: a *seamless* and *smart* EMS will facilitate the shift of freight towards a more *sustainable* mode of transport, and improved *resilience* will ensure that the system holds when faced with exogenous shocks.

Significant investments will be needed to achieve a fully sustainable, smart, seamless and resilient EMS. Importantly however, public financing tools alone are not sufficient and a coherent mix of public funding and private financing will be needed for a timely completion of the whole TEN-T.

A sustainable, smart, seamless, and resilient EMS can only be achieved if all stakeholders come together. Only then will we be able to address the major challenges ahead of us.

I count on your continued engagement, and I thank you for your continuous efforts!

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<sup>3</sup> COM(2019) 640 final  
<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576150542719&uri=COM%3A2019%3A640%3AFIN>

<sup>4</sup> Regulation (EU) 2021/1119 of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1119&from=EN>

<sup>5</sup> European Green Deal  
[https://ec.europa.eu/commission/presscorner/detail/en/IP\\_21\\_3541](https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541)

<sup>6</sup> COM(2020) 789 final  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0789&from=EN>

## Executive summary

In international trade, no transport sector is as critical as the maritime sector. Roughly 80% of all goods in the world are transported by sea<sup>7</sup>, and in terms of tonnes per kilometre travelled, shipping is the most efficient and cost-effective transport mode<sup>8</sup>.

In addition to serving worldwide trade, the maritime transport sector also forms a big part of the European transport system. Indeed, Europe has a key role to play in the sector with EU-owned ships representing 41% of the global merchant fleet<sup>9</sup> and trading on all oceans, serving markets all over the world. Furthermore, with its 292 maritime core and comprehensive ports, the European port landscape is also considered central to ensuring smooth and efficient trade flows, including connecting the mainland to Europe's peripheral regions and islands.

It facilitates and redistributes trade flows from land-based route networks, while contributing to the efforts to reduce the overall external environmental and social costs from transport. In 2020, SSS accounted for up to 60% of all cargo transiting through EU ports, or 1.7 billion tonnes of cargo<sup>10</sup>.

This Detailed Implementation Plan (DIP) seeks to continue the further development of a well-functioning and sustainable SSS sector in Europe, and follows in the footsteps of the first DIP, released in June 2020. Developed in close collaboration with Member States and stakeholders, the aim is to shape the European Maritime Space (EMS) of the future.

The concept of EMS remains at the core of this DIP. It encompasses the development of a European maritime sector, including ports, vessels and CNCs, for the transport of goods and services within, from and to Europe, efficiently and sustainably. Since the publication of the last version of the DIP in June 2020, major world events such as the COVID-19 pandemic and Russia's invasion of Ukraine have changed the world significantly. This has influenced the future of the European maritime sector and a fourth pillar has been added to the vision for the future EMS: resilience. The need for a more resilient maritime sector is not a new idea, but major challenges such as the COVID-19 pandemic, climate change, geopolitical tensions and possible future exogenous shocks have heightened the need for additional mitigation and adaptation measures.

In this DIP, the EMS vision is centred around 4 key pillars:

1. **Sustainable:** Reducing GHG emissions, air, water and noise pollution; this includes e.g. the further development and rolling out of alternative and non-fossil fuels, more widespread onshore power supply (OPS) in ports, or the use of eco-incentives;
2. **Smart:** improving digital tools and communication in the maritime sector; this includes data sharing and sea traffic management tools;

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<sup>7</sup> Unctad: Review of maritime transport

[https://unctad.org/en/Pages/Publications/Review-of-Maritime-Transport-\(Series\).aspx](https://unctad.org/en/Pages/Publications/Review-of-Maritime-Transport-(Series).aspx)

<sup>8</sup> European Environment Agency commissioned study, 2022: <https://www.eea.europa.eu/publications/rail-and-waterborne-transport>

<sup>9</sup> Unctad: Book of statistics

<https://hbs.unctad.org/>

<sup>10</sup> Eurostat: Maritime transport statistics – short sea shipping of goods

[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Maritime\\_transport\\_statistics\\_-\\_short\\_sea\\_shipping\\_of\\_goods](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Maritime_transport_statistics_-_short_sea_shipping_of_goods)

3. **Seamless:** enhancing the connectivity with the rest of the TEN-T (the CNCs in particular), other transport modes, peripheral and outermost regions, islands and European neighbouring countries;
4. **Resilient:** ensuring the EMS is capable of facing exogenous shocks, such as the COVID-19 pandemic, geopolitical tensions or the consequences of climate change. This entails fostering digitalisation, increasing alternative short-sea connections, diversifying energy usage and developing all relevant port infrastructures components to ensure connections are resistant to disruptions. Focus should be on the entire value chain, not only on individual links.

These four interlinked pillars underline what the EMS needs if it is to achieve its potential. Overall, the pillars fit within the objectives of the European Green Deal and reflect the crucial role that maritime transport plays in the TEN-T.

Regional particularities, challenges, and opportunities also need to be taken into consideration when developing the EMS. This is why a region-by-region approach has been taken. Six major sea basins can be distinguished in Europe: the Baltic Sea, the North Sea, the Atlantic Sea, the Western and the Eastern Mediterranean Sea and the Black Sea. These sea basins are all characterised by a more intensive exchange within them than between basins, though they are, of course, interconnected among each other. In addition, there are TEN-T maritime ports in the EU's outermost regions (e.g. Azores, Madeira, the Canary Islands, Guadeloupe, Martinique, Reunion Island and French Guiana).

Various trends, driven by i.a. political objectives or legislative initiatives, as well as practices stemming from the maritime industry, affect the development of the EMS. First, population growth and demographic changes are shifting the economic situation globally. Secondly, the consequences of climate change are increasingly being felt, which creates a strong impetus for the development of sustainable policies to counter its effects. Thirdly, in an ever more interconnected world, we are witnessing the rise of major exogenous shocks with global repercussions, such as the COVID-19 pandemic, the Ever Given crisis or Russia's invasion of Ukraine. Furthermore, technological developments such as the ever-increasing penetration of digitalisation in all aspects of our lives and the development of automation are both an opportunity and a challenge for the future of the shipping sector. Finally, increased expectations for safety, in terms of new shipping lanes or mitigating cybersecurity risks, also play a role.

Based on these trends, but also political and legislative drivers, and the long-term vision of European SSS as a sustainable, carbon-free transport mode fully integrated in the TEN-T network, the vision of the future EMS has been spelled out in this DIP. This exercise was executed by first establishing what is considered an "adequate state", i.e. the theoretical objective of a seamless, smart, sustainable and resilient EMS. By comparing the status quo with these targets, one can see where we stand today: the current 'degree of adequacy' of European SSS and the gap towards a vision of the adequate state. This DIP looks at these gaps and identifies the total investment costs needed to move from the status quo to the adequate state.

As far as they can be assessed today, the total investment needs up until 2050 amount to around EUR 9.5 billion. The infrastructure costs for future alternative fuels could not be assessed as it is yet unclear which fuel type (s) will lead the way in the transition to carbon-free maritime transport. Further, the investment needs for a resilient maritime transport network need to be assessed in future studies.

There is also uncertainty about the necessary capacity increases in ports, terminals, and hinterland connections. On the one hand, volumes have been more or less stable for more than a decade now and some major cargo segments – such as fossil fuels – will lose significance in the long term. On the other hand, whether the construction of new terminals beyond the ones currently planned and under construction is needed, or whether efficiency gains or reconversions of existing terminals would be sufficient to provide the capacity

increase, must be analysed case by case. As an order of magnitude, the total investment need related to capacity increases is estimated at EUR 1.1 - 1.4 billion.

The cost for the construction of new OPS facilities in line with requirements of the current proposal for an Alternative Fuel Infrastructure Regulation<sup>11</sup> (AFIR) is estimated at EUR 5.3 billion. Another EUR 1.4 billion is needed to reach the goals set out regarding LNG terminals in Directive 2014/94/EU on the deployment of alternative fuels infrastructure<sup>12</sup>.

Research, development and reconversion of the short sea fleet will also need large investments of around EUR 1.5 billion. The reconversion costs are quite uncertain as they depend on future fuel types and how much is needed to upgrade a vessel. The research costs are also high and insecure, but they are actually shared with deep-sea shipping globally.

Finally, taking into account the already mentioned costs of interoperability and focusing on core ports, the digital infrastructure in Europe needs around EUR 200 million to create or upgrade interoperable federated systems between the different actors.

Overall, as mentioned previously, we can expect these changes to require approximately EUR 9.5 billion in investment, an amount that cannot be covered by public funding alone and will hence require significant investment from commercial actors. It is thus more important than ever that maritime stakeholders make use of all financial instruments available to them. By collecting information from a wide range of sources, from thematic seminars and conferences to interaction with stakeholders, public and financial institutions, a wide range of financial instruments were identified to meet these aforementioned investment needs. The Connecting Europe Facility (CEF) remains a key instrument in this aspect, but it is complemented by many other instruments and programmes such as Horizon Europe, InvestEU, the EU Sustainable Taxonomy or green shipping initiatives.

With these parameters in mind, the European Coordinator for Motorways of the Sea, Prof. Kurt Bodewig makes the following 9 recommendations to enable the development of a sustainable, smart, seamless, and resilient EMS:

**Green the fleet:** Most emissions from the maritime sector come from vessels. As such, it is fundamental that we invest in pilot projects to develop new types of propulsion systems, and new types of ships that can achieve low to zero emissions.

**Deploy the infrastructure:** In line with the Alternative Fuel Infrastructure Directive (and the proposal for a new Regulation), it is crucial that we provide funds to deploy alternative fuel infrastructure and OPS across European ports, both core and comprehensive, in order to enable the deployment of low to zero emission vessels.

**Green the ports:** Another side of the coin is the greening of ports. If vessels generate the biggest part of emissions (through the fuels they use), ports are at the forefront of maritime transport, and the most visible part. They should improve their own environmental performance, e.g. by phasing out equipment using fossil fuels and greening terminals, but also facilitate vessels' access to alternative fuels. Ports also play a key role

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<sup>11</sup> Proposal for a Regulation on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU of the European Parliament and of the Council  
[https://ec.europa.eu/info/sites/default/files/revision\\_of\\_the\\_directive\\_on\\_deployment\\_of\\_the\\_alternative\\_fuels\\_infrastructure\\_with\\_annex\\_0.pdf](https://ec.europa.eu/info/sites/default/files/revision_of_the_directive_on_deployment_of_the_alternative_fuels_infrastructure_with_annex_0.pdf)

<sup>12</sup> Directive 2014/94/EU of 22 October 2014 on the deployment of alternative fuels infrastructure  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=en>

for facilitating the construction and maintenance of offshore wind farms. Finally, they can play an important role for the import and export of non-fossil energy products.

**Modal shift:** The highest benefit SSS can bring is by enabling the modal shift of freight from road to sea. Incentives to shift transport demand towards SSS should be encouraged.

**Foster connectivity:** At the heart of the TEN-T is the idea of fostering connectivity between European Member States. As such, investment should be targeted towards enhancing links between TEN-T ports and the CNCs, as well as peripheral and outermost regions and neighbouring countries.

**Digital Data Exchange:** Digital tools can bring many benefits to the maritime industry, including reducing the administrative burden for ship operators. To facilitate the exchange of data between operators and authorities, it is important to support the development harmonised/standardised exchanges of information and data across the entire door-to-door supply chain.

**Sea and Vessel Traffic:** Looking forward, digital tools, namely machine learning and data analytics have a strong role to play in optimising processes, including sea and vessel traffic. Such use of data can reduce emissions and increase safety by selecting the best route, or allow for more efficient processes in ports (e.g. just in time arrivals). It is thus important to support the development of such tools that can make the maritime sector truly seamless.

**Resilience Plans:** it is suggested that funds are allocated to establish resilience plans, to increase preparedness in the face of the unexpected, and the emergence of exogenous shocks with global impacts. Similarly, putting in place emergency routing solutions will ensure goods can continue to flow despite external shocks.

**Climate Adaptation:** The negative impacts of climate change are expected to become more and more prominent in today's world. Maritime infrastructure, especially in peripheral and outermost regions, is particularly exposed to worsening meteorological conditions. It is important to deploy infrastructure that is designed to face such conditions.

# 1 Introduction

In international trade, no transport sector is as critical as the maritime sector. Roughly 80% of all goods are transported by sea<sup>13</sup>, and in terms of tonnes per kilometre travelled, shipping is the most efficient and cost-effective transport mode. Europe has a key role to play in the sector with EU-owned ships representing 41% of the global merchant fleet<sup>14</sup> and trading on all oceans, serving markets all over the world. Furthermore, with its 292 maritime core and comprehensive ports, the European port landscape is also considered central to ensure smooth and efficient trade flows, including connecting the mainland to Europe's peripheral regions and islands.

In addition to serving worldwide trade, the maritime transport sector forms a big part of the intra-European transport system. It facilitates and redistributes trade flows from land-based route networks, while contributing to the efforts to reduce the overall external environmental and social costs from transport. In 2020, SSS accounted for up to 60% of all cargo transiting through EU ports, or 1.7 billion tonnes of cargo<sup>15</sup>.

Maritime transport not only forms a crucial part of international and intra-European trade, but is also a key tool for the achievement of the European Green Deal's objectives of achieving a prosperous European society with no net emissions of Greenhouse Gases (GHG) by 2050. Maritime transport indeed remains the most environmentally efficient mode of transport for freight (in terms of tonnes of cargo/GHG emissions). Looking at SSS more specifically, it can strongly contribute to greening freight transport in Europe by supporting the shift from road to a more efficient transport mode. The targets set in the SSMS of increasing SSS by 25% by 2030, and by 50% by 2050, are in this respect a strong pathway towards a more sustainable European transport system.

The first version of this DIP was published in June 2020; developed in close collaboration with Member States and stakeholders, the aim was to shape the EMS of the future. The concept of EMS remains at the core of this DIP. It encompasses the development of a European maritime sector, including ports, vessels and CNCs, for the transport of goods and services within, from and to Europe, efficiently and sustainably.

At the time of publication of the first DIP, the objective was to achieve an EMS that was sustainable, smart and seamless. These three pillars remain as important as ever, but a fourth pillar is added in this updated DIP: resilience. Indeed, since the publication of the first DIP, world events such as the COVID-19 pandemic and Russia's invasion of Ukraine has changed the world significantly. It has heightened the need for additional mitigation and adaptation measures to prepare for major challenges such as the consequences of climate change and possible future exogenous shocks similar to those experiences in the past 2 years.

These four interlinked pillars underline what the EMS needs if it is to achieve its potential. Overall, the pillars reflect the objectives of the European Green Deal and reflect the crucial role that maritime transport plays in the TEN-T. The parameters of the EMS are also aligned

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<sup>13</sup> Unctad: Review of maritime transport  
[https://unctad.org/en/Pages/Publications/Review-of-Maritime-Transport-\(Series\).aspx](https://unctad.org/en/Pages/Publications/Review-of-Maritime-Transport-(Series).aspx)

<sup>14</sup> Unctad: Book of statistics  
<https://hbs.unctad.org/>

<sup>15</sup> Eurostat: Maritime transport statistics – short sea shipping of goods  
[https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Maritime\\_transport\\_statistics\\_-\\_short\\_sea\\_shipping\\_of\\_goods](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Maritime_transport_statistics_-_short_sea_shipping_of_goods)

with those of the CNCs via the sea basin approach, to promote better integration. Finally, the pillars are solidly rooted in the existing legislative drivers and emerging trends in the maritime sector.

In more detail, the four pillars are:

1. Sustainable: Reducing GHG emissions, air, water and noise pollution; this includes e.g. the further development and rolling out of alternative and non-fossil fuels, more widespread onshore power supply (OPS) in ports, or the use of eco-incentives;
2. Smart: improving digital tools and communication in the maritime sector; this includes data sharing and sea traffic management tools;
3. Seamless: enhancing the connectivity with the rest of the TEN-T (the CNCs in particular), other transport modes, peripheral and outermost regions, islands and European neighbouring countries;
4. Resilient: ensuring the EMS is capable of facing exogenous shocks, such as the COVID-19 pandemic, geopolitical tensions or the consequences of climate change. This entails fostering digitalisation, increasing alternative short-sea connections, diversifying energy usage and developing all relevant port infrastructures components under the TEN-T Regulation to ensure connections are resistant to disruptions. Focus should be on the entire value chain, not only on individual links.

The MoS programme, with its focus on maritime links, port infrastructure and associated investments (hinterland connections, equipment, facilities and relevant administrative formalities etc.) has had a key role to play in reaching the EMS of the future. By prioritising the full integration of maritime transport in the logistic chain, the MoS programme has helped to concentrate freight flows on sea-based routes and to reduce road congestion, whilst enhancing the connectivity between European Member States. The MoS programme was rooted in the core and comprehensive networks of European ports and logistics centres. It also helped to boost trade and ensure that the maritime sector is on par with the latest technological and environmental developments. Over the 2008-2021 period, 100 MoS projects were co-funded, with a total EU contribution of EUR 716.4 million<sup>16</sup>.

The aim of this updated DIP is to set out what needs to be achieved to reach the vision of an EMS that is sustainable, smart, seamless and resilient. It is based on the supporting MoS Study<sup>17</sup>. This study (updated in September 2021) analysed legislative drivers and emerging trends affecting the European maritime sector, as well as regional investment needs, priority areas of investment and the financial tools needed to achieve an "adequate state" of the EMS.

Based on the results of the aforementioned MoS Study, this DIP is structured as follows: Chapter 2 presents key characteristics of the maritime dimension of the TEN-T by analysing the structure of maritime traffic in European sea basins. Chapter 3 presents an analysis of the emerging global trends and legislative drivers that affect the maritime sector. Chapter 4 is dedicated to defining an "adequate state" for SSS in Europe and identifying currently existing gaps in European sea basins. Based on this, Chapter 5 presents investment needs to achieve the adequate state, alongside an overview of financial instruments at the European level that could help support these investment needs. Finally, Chapter 6 presents key recommendations from the Coordinator and proposed investment priorities for the future.

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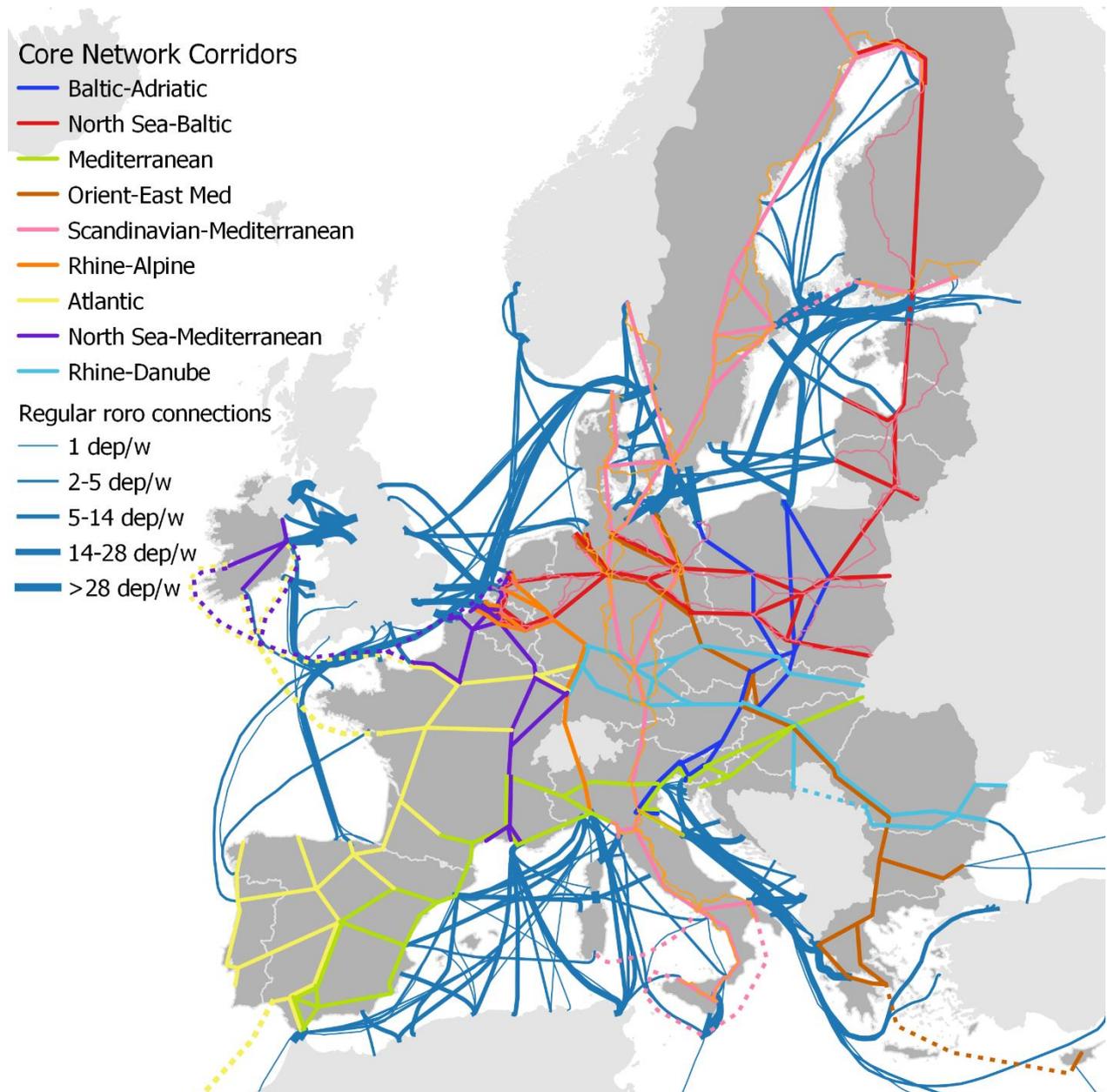
<sup>16</sup> CINEA data

<sup>17</sup> 2019-2021 Motorways of the Sea Study by the Consortium of Circle, ISL and ADS insight

## 2 Characteristics of the European Maritime Space

To assess the characteristics of the activities towards a seamless EMS, this DIP looks at the structure of each region with a sea basin approach. This enables a more detailed prioritisation of issues based on the challenges and opportunities in each sea basin. Furthermore, it should be noted that this DIP focuses on freight flows, given their importance within the framework of the TEN-T, and the associated investments needed to improve such flows (intermodal terminals, rail/IWW infrastructure, etc.).

Figure 1 European core network corridors and ro-ro shipping routes



Note: Core network corridors preliminary; ro-ro shipping routes exclude regular car carriers

Source: ISL, 2021

In 2019, the 292 maritime ports of the TEN-T core and comprehensive network handled around 3.3 billion tonnes of cargo. In 2020, traffic declined to 3.052 billion tonnes (see Table 1). Around 152 million passengers embarked or disembarked in TEN-T ports in 2020, an unprecedented decrease of passenger traffic from 302 million in 2019 due to the COVID-19 pandemic. Recent figures indicate that maritime cargo traffic is back to its pre-pandemic levels in 2021 while passenger traffic is still subdued.

Six major sea basins can be distinguished in Europe: the Baltic Sea, the North Sea, the Atlantic, the Western and the Eastern Mediterranean, and the Black Sea. These sea basins are all characterised by more intensive exchanges within themselves than between each other. They are however interconnected. In addition, there are maritime ports in the EU's outermost regions (e.g. Azores, Madeira, the Canary Islands, Guadeloupe, Martinique, Reunion Island and French Guiana). Out of the total 3.052 billion tonnes of cargo handled in 2020, close to two thirds were related to short sea traffic. SSS (including feeder traffic) has a particularly high share in the Baltic Sea, the Black Sea and the Eastern Mediterranean.

The largest volume of cargo is handled in the North Sea basin. Its TEN-T ports handled 1.2 billion tonnes in 2020, equal to more than one third of the total EU maritime traffic. It is followed by the Western Mediterranean (673 million tonnes) and the Baltic Sea (523 million tonnes). The Atlantic basin counts 13 CNC ports and has a high share of deep-sea traffic. Taken together, the Atlantic TEN-T ports handled 292 million tonnes.

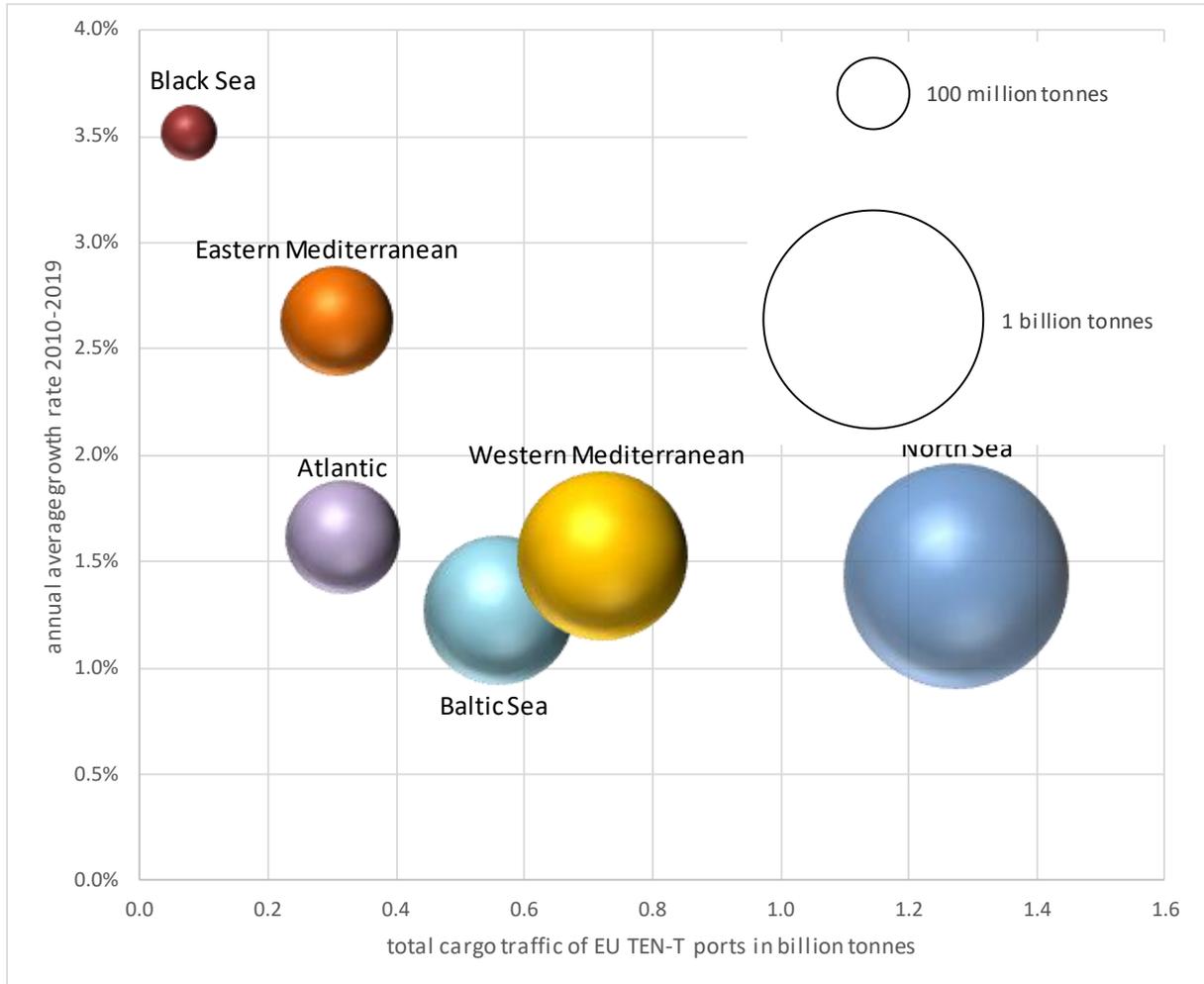
Table 1 Maritime cargo traffic of EU TEN-T seaports by major sea basins, 2020

Sea basin	Total cargo volume handled (mln tonnes)				of which short sea	
	CNC ports	Other core ports	Comprehen -sive ports	Total	Million tonnes	Share of total
Baltic Sea	335	9	179	523	441	(84%)
North Sea	1,126	1	52	1,179	588	(50%)
Atlantic	219	9	63	292	184	(63%)
Western Mediterranean	502	39	132	673	459	(68%)
Eastern Mediterranean	236	-	43	279	207	(74%)
Black Sea	57	-	11	67	52	(78%)
Outermost regions	-	26	13	39	23	(58%)
Total EU maritime ports	2,474	84	493	3,052	1,954	(62%)
of which short sea	1,441	62	387	1,889		
	(58%)	(73%)	(79%)	(62%)		

Source: ISL based on Eurostat, 2021

The Eastern Mediterranean (279 million tonnes) and the Black Sea (67 million tonnes) are the regions with the smallest absolute volumes of cargo, but they have also been the fastest-growing basins with 2.6% and 3.5% average annual growth during the pre-pandemic years 2010-2019, respectively. During the same period, the EU average was 1.6%.

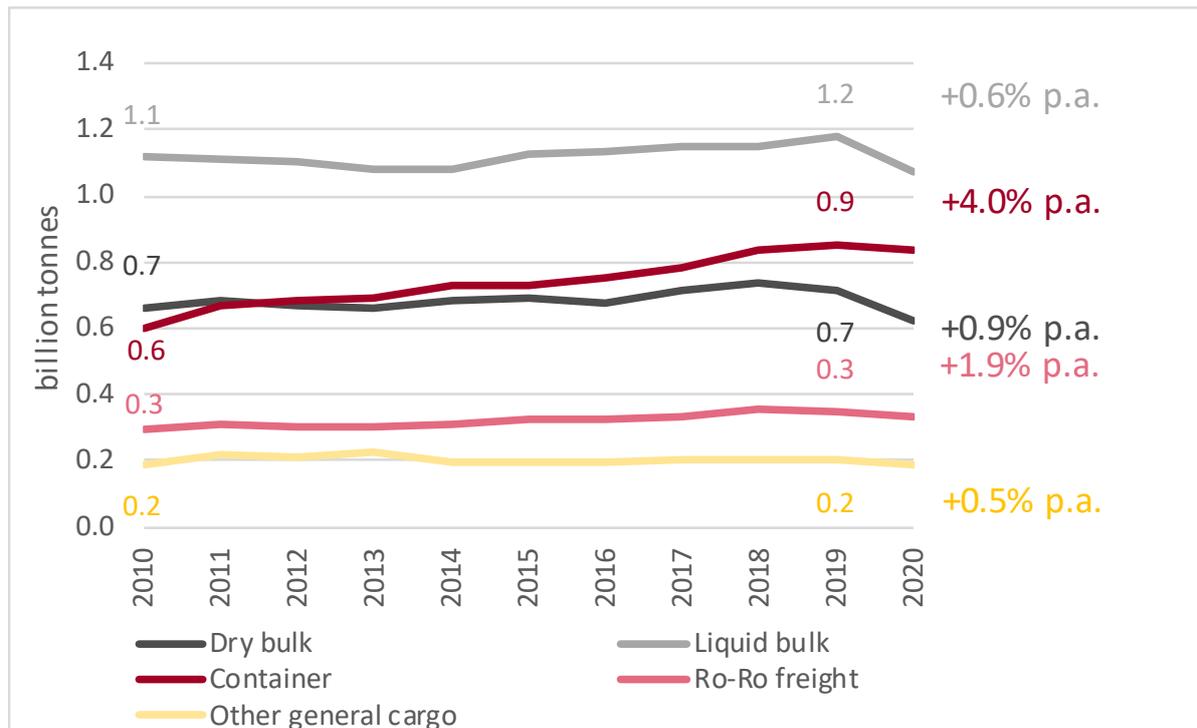
Figure 2 Average annual growth of EU TEN-T seaports by sea basins, 2010-2019



Note: Based on CNC ports  
 Source: ISL based on Eurostat, 2021

The most important cargo types – in terms of tonnes handled in TEN-T ports – are liquid bulk (1.2 billion tonnes in 2019, down to 1.1 billion tonnes in 2020), containers (2019: 0.9 billion tonnes; 2020: 0.8 billion tonnes) and dry bulk (2019: 0.7 billion tonnes; 2020: 0.6 billion tonnes). During the years 2010-2019, unitised traffic showed the strongest growth. Container traffic grew by 4.0% per year on average and Roll-on/Roll-off (ro-ro) freight traffic by 1.9% per year. Non-unitised general cargo grew least (0.5% per year).

Figure 3 Cargo traffic of EU TEN-T seaports by cargo type, 2010-2019



Note: growth rates indicate average annual growth between 2010 and 2019.

Source: ISL based on Eurostat, 2021

Passenger traffic was mainly concentrated on the Western Mediterranean and the Baltic Sea (57 and 53 million passengers in 2020, respectively) and the Eastern Mediterranean (20 million). Together, the ports in these three sea basins handled 86% of total European passenger traffic.

There are dozens of regular short sea links between the different sea basins and hence between different parts of the TEN-T. Broadly speaking, two types of SSS services can be distinguished: (a) those bridging straits or connecting islands (e.g. across the Fehmarn Belt, the Strait of Gibraltar or the English Channel), and (b) long-distance services along coastal lines that form an alternative to parallel land-based routes. The former are sometimes part of a CNC (e.g. the connection between south of Italy and Malta), while the latter connect different corridors (e.g. services in the Western Mediterranean between Italy and Spain) or run in parallel to such corridors (e.g. North Sea-Baltic or Atlantic coastal services).

Despite several direct deep-sea services, the Baltic Sea and the Black Sea strongly rely on short sea connections with the North Sea and the Mediterranean Sea, respectively. In the North, there is an extensive exchange between the North Sea and the Baltic Sea – more than between any other pair of basins in Europe. In Spring 2021, there were around 60 regular short sea container services and almost 40 regular ro-ro services between these

two seas.<sup>18</sup> In the South, the Black Sea is connected via the Sea of Marmara to the Mediterranean with around 20 short sea container services and 4 ro-ro services (excluding car carriers). The Atlantic coast provides around 50 regular container and ro-ro connections with the outermost regions, particularly with the Azores, Madeira, the Canary Islands and the French Caribbean.

To fully develop the potential of the EMS, the role of each basin and its maritime ports must be acknowledged. As a basis for identifying the needs of the different sea basins, the relevant traffic structures in each sea basin are described below.

## 2.1 Baltic Sea

Four CNCs connect the Baltic Sea<sup>19</sup> with the European hinterland. Two corridors start in ports of the southern coast (northeast Germany and north Poland) and move southwards (Orient-East Med and Baltic-Adriatic). The Baltic Sea ports on these corridors connect them with Sweden and Denmark through a dense network of ro-ro services, and with other countries surrounding the Baltic Sea through ro-ro and container services, including the non-EU countries Norway and Russia. In the south, the Baltic-Adriatic corridor links to countries in the eastern Mediterranean through various regular ro-ro services, creating a North-South axis stretching from Scandinavia to Turkey.

Further to the west, the Scandinavian-Mediterranean corridor connects the ports of Lübeck and Rostock with the continental European hinterland. Unlike the Orient-East Med and the Baltic-Adriatic corridors, the Scandinavian-Mediterranean includes a land link to Denmark, Sweden and Finland. This part of the corridor is hence in parallel to several ferry routes between the German Baltic Sea ports on the one hand and Denmark, Sweden and Norway on the other hand. The current land route via Jutland and the Öresund between Copenhagen and Malmö is mostly used for direct block trains, while most of the cargo travels in trucks, trailers and rail waggons on one of the ferry routes. There is competition between the land and maritime routes, but also a possibility for forwarders to set up synchromodal offers, especially after the opening of the Fehmarn Belt fixed link, which will make land-based transport more attractive. For transport between Sweden and Finland, the Scandinavian-Mediterranean corridor includes a short sea link (between Sweden's East coast and Southwest Finland, see dotted line in Figure 4).

The North Sea-Baltic corridor stretches along the southern and eastern coast of the Baltic Sea, crossing Germany, Poland, Lithuania, Latvia, Estonia and Finland up to the North of Sweden. Here again, there are parallel maritime routes from Belgian, Dutch and German ports to Polish, Lithuanian, Latvian, Estonian and Finnish ports. The maritime routes take more time but are considerably cheaper than the land-based routes (mostly truck traffic due to the lack of regular rail services). The corridor includes the ro-ro link between Tallinn and Helsinki.

Besides the links on or in parallel to CNCs, there are various maritime links between CNCs, e.g. between Swinoujscie (on the Baltic-Adriatic corridor) and Trelleborg (the Scandinavian-Mediterranean corridor) or between Riga (the North Sea-Baltic corridor) and Stockholm (again the Scandinavian-Mediterranean corridor). Due to the geographical

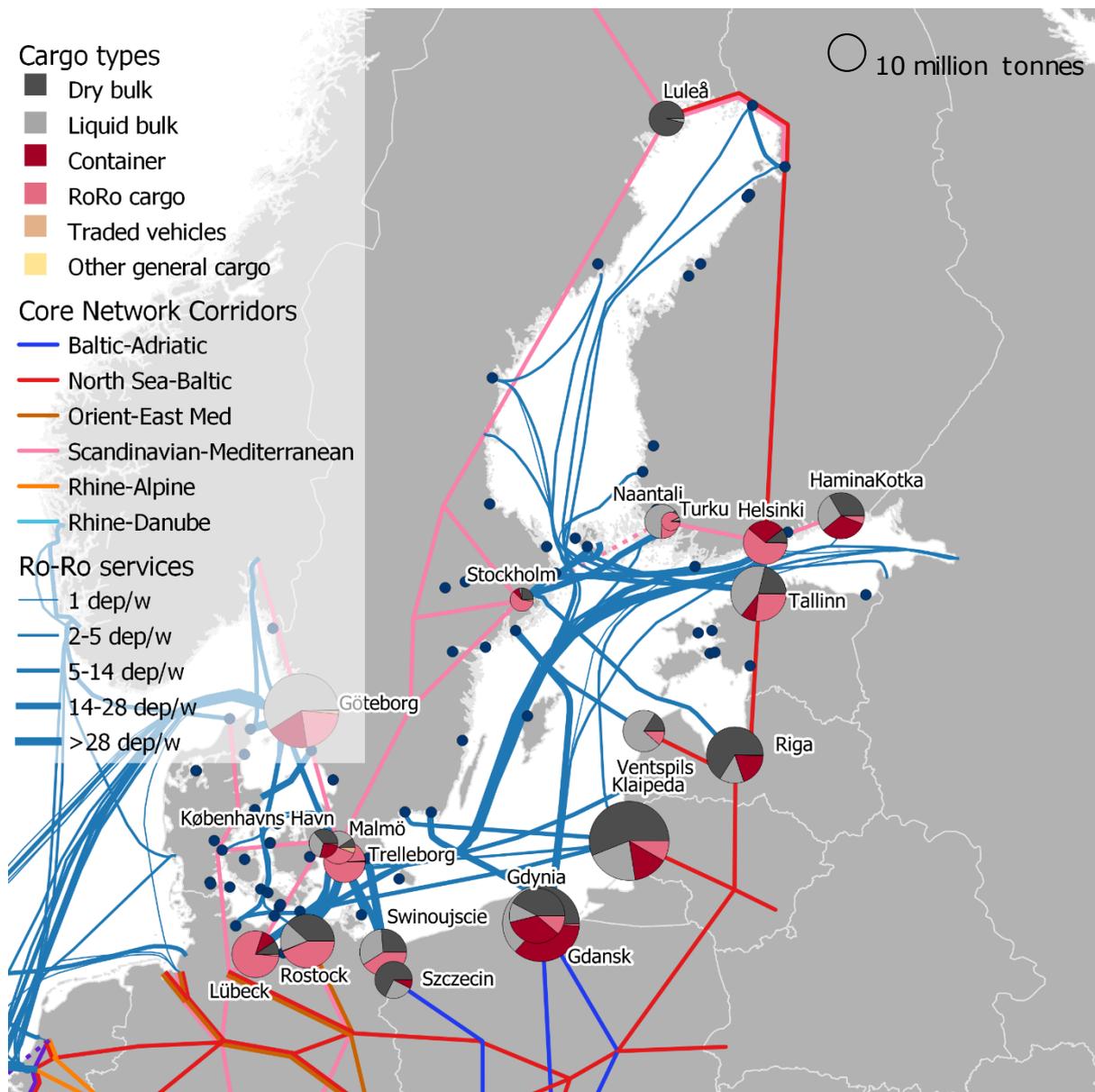
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<sup>18</sup> Regular services are services that sail with a regular schedule. Container services normally have one departure per week or more, ro-ro services often have much higher frequencies.

<sup>19</sup> Including Great Belt, Little Belt, Öresund and Kattegat

location, maritime transport is vital for connecting Sweden and Finland as well as for connecting Estonia, Latvia and Lithuania with other EU markets.

Figure 4 Core network corridor ports and regular ro-ro services in the Baltic Sea basin, 2019



Note: International ro-ro shipping routes exclude regular car carriers for traded vehicles ; Source: ISL, 2021

In addition, there is a strong interchange between the North Sea and the Baltic Sea. All Baltic Sea CNC ports have regular container and/or ro-ro connections with ports in the North Sea. Container traffic has a much higher share, as hub ports in the North Range have a dense feeder network for transshipment of deep-sea traffic. However, these services also transport intra-European short sea traffic, particularly on the longer distances (e.g. between the North Range ports and Finland). Some core ports (e.g. Gothenburg, Aarhus or Gdansk) also have direct deep-sea container services (e.g. with Asia) so they do not rely on feeder traffic to and from the North Sea ports on these trades.

There are 21 core ports in the Baltic Sea area, handling a wide variety of cargo types (see Table 2). Seven ports handle more than 20 million tonnes, all with a focus on bulk traffic. The port of Trelleborg stands out with its strong specialisation on ro-ro traffic. It connects the Scandinavian-Mediterranean corridor with the Orient-East Med corridor (Rostock) and the Baltic-Adriatic corridor (Swinoujscie).

The ro-ro routes – particularly the shorter cross-Baltic routes – are also important for passenger traffic. The Baltic Sea basin accounts for roughly one third of EU maritime passenger traffic.

Table 2 Maritime cargo traffic by type and passenger traffic of TEN-T ports in the Baltic Sea, 2020

Country/port	Share of cargo segment in %					Million tonnes	Av. annual growth 2010-2020	Million passengers
	Dry bulk	Liquid bulk	Container	Ro-ro freight	Other general cargo			
<b>Denmark, of which</b>	22%	26%	12%	37%	3%	55.4	-1.1%	18.1
Aarhus	32%	14%	50%	4%	0%	8.9	-0.4%	2.4
København	31%	29%	22%	2%	16%	5.7	1.2%	0.2
<b>Sweden, of which</b>	15%	31%	11%	35%	8%	121.5	-0.1%	12.8
Göteborg	0%	58%	18%	21%	2%	38.5	-1.1%	0.6
Malmö	9%	27%	3%	51%	10%	7.6	-2.4%	0.3
Trelleborg	1%	0%	0%	99%	0%	11.9	1.0%	1.2
Stockholm	23%	3%	8%	54%	12%	3.8	-1.5%	1.9
Luleå	93%	4%	0%	0%	3%	8.5	-0.9%	0.0
<b>Finland, of which</b>	22%	39%	10%	18%	11%	93.3	1.8%	7.2
Naantali	11%	62%	0%	25%	2%	8.1	0.0%	0.1
Turku	1%	5%	1%	77%	16%	2.4	-2.0%	1.1
Helsinki	10%	0%	26%	57%	6%	13.3	2.0%	4.8
HaminaKotka	28%	23%	28%	5%	17%	14.8	...	0.0
<b>Estonia, of which</b>	25%	47%	6%	17%	6%	32.3	-2.5%	8.3
Tallinn	21%	42%	9%	26%	2%	21.1	-5.3%	4.3
<b>Latvia, of which</b>	48%	28%	9%	5%	10%	40.4	-3.4%	0.5
Rīga	57%	12%	17%	0%	13%	22.1	-2.7%	0.3
Ventspils	15%	69%	0%	11%	5%	12.0	-6.6%	0.2
<b>Lithuania, of which</b>	54%	21%	14%	8%	3%	43.7	4.2%	0.3
Klaipėda	54%	21%	14%	8%	3%	43.7	4.2%	0.3
<b>Poland, of which</b>	34%	26%	25%	10%	6%	88.1	4.1%	1.6
Gdańsk	28%	33%	35%	1%	3%	40.6	4.4%	0.2
Gdynia	40%	11%	33%	11%	4%	21.2	5.6%	0.5
Świnoujście	26%	32%	0%	40%	3%	15.1	3.5%	1.0
Szczecin	50%	18%	5%	0%	27%	9.6	1.9%	0.0
<b>Germany, of which</b>	23%	7%	4%	54%	12%	48.6	-0.5%	4.4
Rostock	35%	16%	0%	40%	9%	20.1	0.3%	1.4
Lübeck	8%	0%	9%	69%	13%	15.3	-1.5%	0.1
<b>Total Baltic Sea TEN-T ports</b>	<b>27%</b>	<b>29%</b>	<b>12%</b>	<b>24%</b>	<b>8%</b>	<b>523.2</b>	<b>0.4%</b>	<b>53.2</b>

Source: ISL based on Eurostat, 2022

## 2.2 North Sea

With 1.2 billion tonnes handled in 2020, the North Sea<sup>20</sup> TEN-T ports are by far the busiest group among the six sea basins. They represent more than one third of the total TEN-T port traffic of the EU.

Six CNCs connect the North Sea ports with their hinterland. Most of them – the North Sea-Mediterranean, the Rhine-Alpine, the Scandinavian-Mediterranean and the Orient-East Med corridors – are North-South corridors and hence important hinterland connections of the North Sea ports. The Scandinavian-Mediterranean corridor marks the eastern end of the North Sea and is the only one connecting Sweden (and also Norway) with the central European core markets. There are parallel maritime connections, but mostly from Baltic Sea ports (see 2.1). The North Sea-Mediterranean corridor marks the western end and connects Ireland with the continent. Traffic with the neighbouring UK plays an important role in the French, Belgian and Dutch North Sea ports. This includes Europe's busiest ro-ro route Dover-Calais.

After the UK left the EU, direct links between the continent and Ireland intensified as shippers shifted away from the UK transit routes.<sup>21</sup> The North Sea-Mediterranean corridor now includes a corridor that connects the ports of the English Channel with Ireland. Nevertheless, UK transit routes still play an important role in connecting Ireland with the continental European markets so the ferries across the English Channel are not only connecting the UK, but also Ireland with the EU continental market.

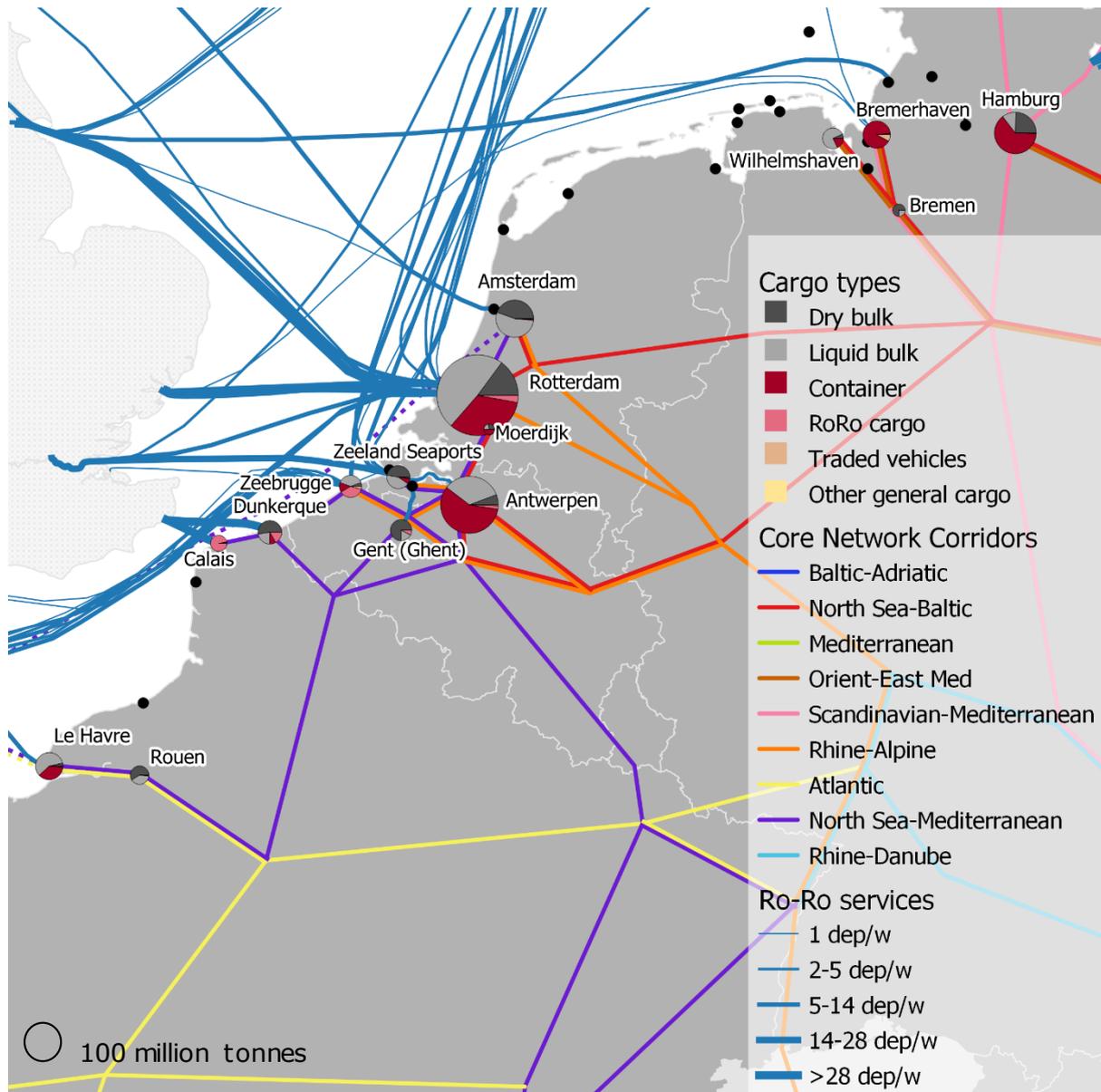
The two other corridors – namely the Atlantic corridor and the North Sea-Baltic corridor – include important hinterland axes for the French, Belgian, Dutch and German North Sea ports.

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<sup>20</sup> Including English Channel and Kattegat

<sup>21</sup> Direct ro-ro traffic between the EU and Irish ports approximately doubled between 2019 and 2021 while the volume transported between the Republic of Ireland's and UK ports – which includes trade between the two countries – stabilised at around 80% of its previous volume (see Irish Maritime Transport Economist, vol. 19, p. 27).

Figure 5 Core network corridor ports and regular ro-ro services in the North Sea basin, 2020



Note: ro-ro shipping routes exclude regular car carriers for traded vehicles; only international ro-ro services calling in one of the TEN-T ports are included  
Source: ISL, 2021

There are seventeen core ports in the North Sea, including Europe's top four ports in terms of cargo handling: Rotterdam, Antwerp-Bruges, Hamburg, and Amsterdam. Oil imports have a higher share than in other basins, while ro-ro traffic is less important as it concentrates on the English Channel. In the top four ports, its share is between 0% and 4% only (see Table 3).

Table 3 Maritime cargo traffic of CNC ports in the North Sea by cargo type, 2020<sup>22</sup>

Country/port	Share of cargo segment in %					Million tonnes	Av. annual growth 2010-2020	Million passengers
	Dry bulk	Liquid bulk	Container	Ro-ro freight	Other general cargo			
<b>Denmark</b>	30%	13%	5%	38%	15%	4.3	2.1%	3.6
<b>Germany</b>	21%	20%	52%	0%	6%	222.5	0.4%	5.3
Hamburg	25%	11%	64%	0%	1%	109.1	0.4%	0.1
Bremen	58%	19%	0%	0%	23%	10.4	-2.3%	0.0
Bremerhaven	0%	1%	89%	0%	9%	46.5	0.2%	0.0
Wilhelmshaven	7%	75%	18%	0%	0%	27.8	1.2%	0.0
<b>Netherlands</b>	20%	45%	24%	3%	8%	556.4	0.6%	1.0
Amsterdam	41%	50%	1%	0%	7%	89.9	0.0%	0.3
Moerdijk	24%	21%	43%	0%	12%	6.1	0.3%	0.0
Rotterdam	14%	46%	31%	3%	6%	410.4	0.4%	0.6
Vlissingen/Terneuzen	35%	32%	6%	1%	26%	34.5	7.9%	0.0
<b>Belgium</b>	12%	31%	45%	6%	5%	268.5	1.7%	0.1
Antwerpen	6%	33%	56%	2%	4%	206.2	2.6%	0.0
Gent	67%	15%	0%	7%	11%	29.4	0.7%	0.0
Oostende	0%	9%	0%	0%	91%	1.2	-13.1%	0.0
Zeebrugge	5%	38%	14%	36%	6%	31.7	-0.7%	0.1
<b>France</b>	27%	36%	17%	19%	1%	127.6	-1.8%	5.0
Dunkerque	51%	22%	9%	17%	2%	35.0	-0.4%	1.1
Calais	2%	1%	0%	97%	0%	16.4	-0.9%	3.3
Le Havre	4%	59%	36%	0%	1%	48.9	-2.9%	0.0
Rouen	57%	39%	1%	0%	3%	23.4	-1.3%	0.0
<b>Total North Sea TEN-T ports</b>	<b>19%</b>	<b>36%</b>	<b>33%</b>	<b>5%</b>	<b>6%</b>	<b>1179.2</b>	<b>0.5%</b>	<b>14.9</b>

Source: ISL based on Eurostat, 2022

### 2.3 Atlantic

The European Atlantic Basin includes Ireland, Portugal and the western coasts of France and Spain. The most important CNCs connecting the basin's ports with the hinterland are the Atlantic and the North Sea-Mediterranean corridors. The former connects the Portuguese, Spanish and French Atlantic coast core ports with the Madrid area, the Paris area and south-western Germany. It also links the Irish CNC ports (Dublin, Cork and Shannon-Foynes) with the continent. The connections Bilbao-Rosslare and Santander-Dublin are currently a direct link between the Irish ports and the Atlantic coast of the continent – the remaining direct connections are to/from North Sea ports. This is also true for container traffic, where hub ports in the North Sea serve both short sea and feeder traffic from and to Ireland.

The Atlantic corridor stretches into the North Sea basin to Le Havre and Rouen and to Algeciras in the strait of Gibraltar.<sup>23</sup> While there are no direct ro-ro services between these ports, there are several services in parallel to the corridor, for example connecting Leixoes with Rotterdam, Nantes Saint-Nazaire with Vigo, or Bilbao with a ro-ro service to Belgium. There is also a maritime connection between the two corridors: a weekly link between

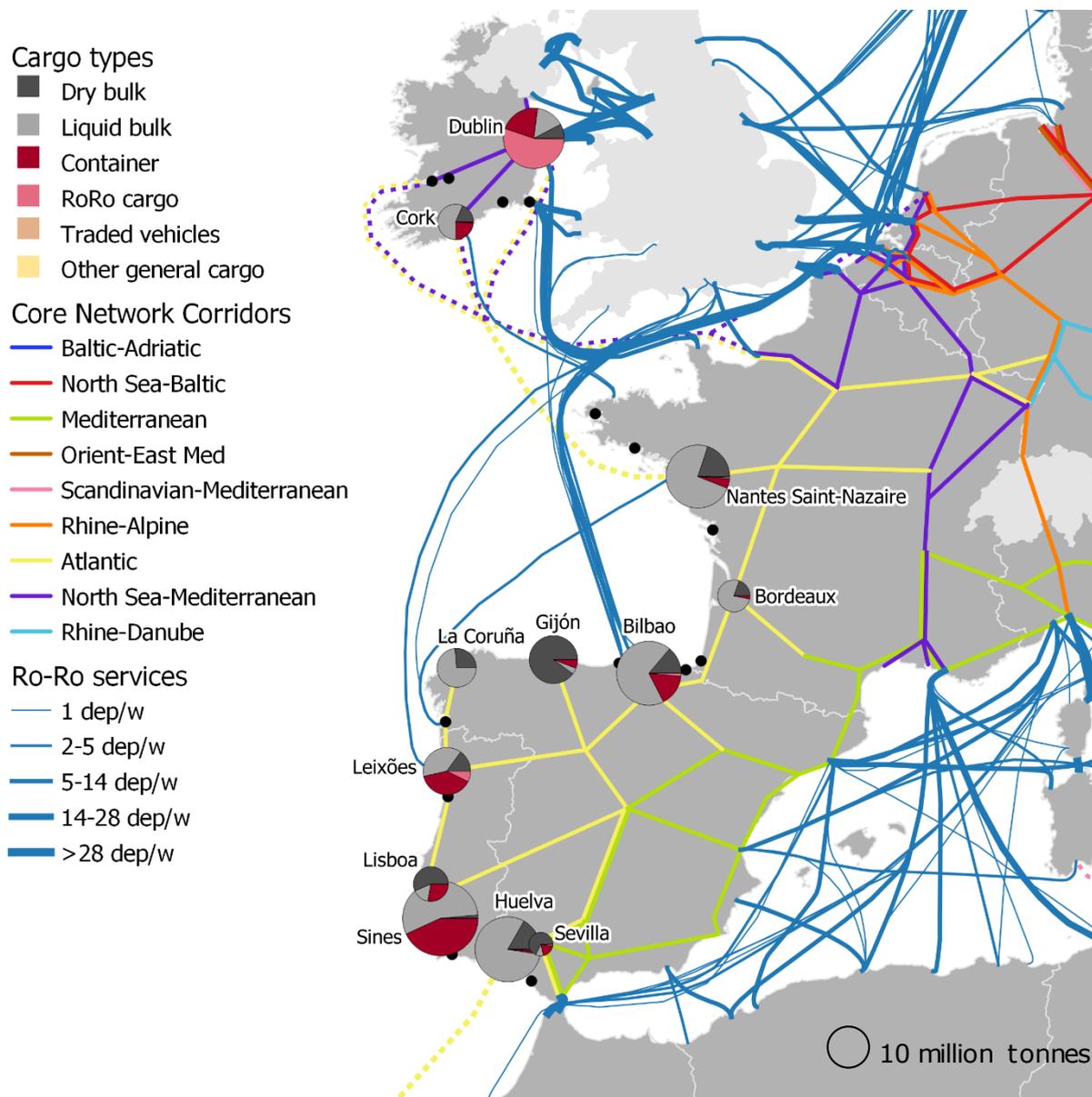
<sup>22</sup> Note that Ghent has merged with Zeeland Seaports (Vlissingen and Terneuzen) to form "North Sea Port".

<sup>23</sup> The port of Algeciras is included in the Western Mediterranean sea basin (see 2.4).

Bilbao, Liverpool, and Dublin. These connections are complemented by connections between Ireland and the continent through comprehensive ports in France and Spain.

The second important corridor for the Atlantic Basin is the North Sea-Mediterranean corridor, more precisely its northern part connecting the Irish CNC ports with the European continent. Before Brexit, the corridor connected Ireland via Great Britain to the continent, but the ro-ro connections in the Irish Sea are now connections with a third country.

Figure 6 Core network corridor ports and regular ro-ro services of EU ports in the Atlantic basin, 2020



Note: International ro-ro shipping routes exclude regular car carriers for traded vehicles  
Source: ISL, 2021

The European Atlantic coast ports play a vital role in connecting outermost regions in the Atlantic (Canaries, Acores, Madeira, Guadeloupe and Martinique) with the continent (compare 2.6). Due to the long distance, container traffic plays an important role for this connection. There are around 50 departures per week altogether to and from these regions (container and ro-ro combined).

Altogether, there are thirteen core ports in the Atlantic basin, the largest ones in terms of tonnes handled being Sines, Huelva, Bilbao, and Dublin. All ports can be classified as medium-sized compared with the major North Range ports or the larger hubs in the Mediterranean.<sup>24</sup>

The cargo profile of the ports is quite diverse (see Table 4), with a focus on liquid bulk in Huelva, Nantes Saint Nazaire, La Coruna and Bilbao, high shares of dry bulk in Gijón and Shannon-Foyes, a strong focus on container traffic in the Portuguese ports and on ro-ro traffic in Dublin.

Table 4 Maritime cargo traffic by type and passenger traffic of TEN-T ports on the Atlantic Coast, 2020

Country/port	Share of cargo segment in %					Million tonnes	Av. annual growth 2010-2020	Million passengers
	Dry bulk	Liquid bulk	Container	Ro-ro freight	Other general cargo			
<b>Portugal</b>	17%	41%	35%	1%	6%	73.6	2.1%	0.0
Lisboa	56%	16%	27%	0%	1%	8.3	-2.7%	0.0
Sines	1%	55%	43%	0%	0%	38.8	4.6%	0.0
Leixoes	14%	36%	36%	7%	6%	15.4	1.3%	0.0
<b>Spain</b>	35%	47%	8%	2%	8%	118.4	0.2%	0.2
Sevilla	57%	9%	16%	2%	16%	3.9	-0.3%	0.0
Huelva	17%	80%	2%	1%	1%	29.3	2.9%	0.0
A Coruña	24%	68%	0%	0%	8%	10.5	-1.2%	0.0
Gijón	85.8%	4%	5%	0%	5%	15.9	0.3%	0.0
Bilbao	13%	64%	15%	1%	7%	28.3	-1.3%	0.0
<b>France</b>	31%	61%	3%	0%	4%	52.9	-0.8%	0.0
Bordeaux	19%	77%	2%	0%	1%	7.1	-1.8%	0.0
Nantes Saint-Nazaire	20%	74%	4%	1%	1%	27.5	-1.0%	0.0
<b>Ireland</b>	28%	21%	17%	33%	2%	46.7	1.3%	0.8
Dublin	8%	15%	22%	55%	0%	25.2	2.6%	0.7
Cork	18%	55%	23%	0%	3%	8.6	0.2%	0.0
Shannon-Foyes	85.8%	11%	0%	0%	3%	9.5	0.3%	0.0
<b>Total Atlantic TEN-T ports</b>	<b>29%</b>	<b>44%</b>	<b>15%</b>	<b>7%</b>	<b>6%</b>	<b>291.7</b>	<b>0.6%</b>	<b>1.0</b>

Source: ISL based on Eurostat, 2022

Compared with other sea basins, the volume of passenger traffic is negligible except for the port of Dublin (passenger traffic to/from Great Britain).

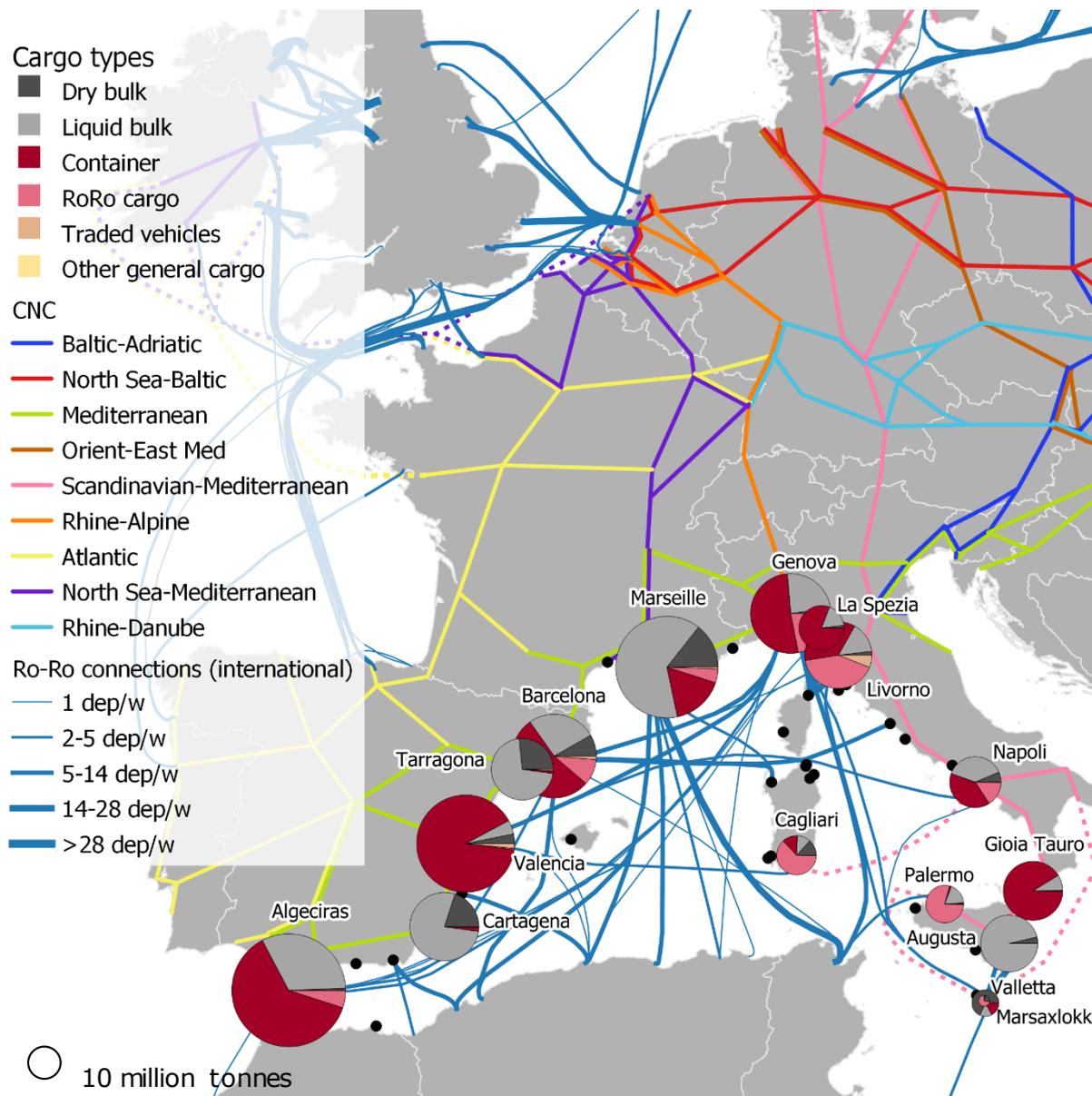
## 2.4 Western Mediterranean Sea

Five CNCs start/end in the Western Mediterranean basin. Four corridors (from east to west: Atlantic, North Sea-Mediterranean, Rhine-Alpine, and Scandinavian-Mediterranean) are north-south corridors linking the different ports of the Western Mediterranean with the European hinterland. The Mediterranean CNC is an exemption: it stretches from the Strait of Gibraltar along the Mediterranean coast to northern Italy and on through Slovenia, Croatia and Hungary to Ukraine.

<sup>24</sup> The largest ports on the Atlantic core network corridor are Le Havre (North Sea basin, see 2.2) and Algeiras (Western Mediterranean basin, see 2.4).

The various ro-ro connections in the Western Mediterranean CNC ports prolong the north-south corridors to North Africa. There is hence an extensive volume transiting between the corridors and maritime short sea services. The port of Algeciras provides the shortest sea distance and high-frequency services to and from Morocco. Valencia, Barcelona, Marseille and Genoa provide numerous longer-distance short sea services to Morocco, Algeria and Tunisia. Malta – the southernmost tip of the Scandinavian-Mediterranean corridor – is connected to the continent via Italian ports. In addition, there are east-west connections between Italy and Spain, a direct alternative to land-based transport.

Figure 7 Core network corridor ports and regular ro-ro services in the Western Mediterranean, 2020



Note: International ro-ro shipping routes exclude regular car carriers for traded vehicles ;  
Source: ISL, 2021

There are sixteen core ports in the Western Mediterranean with a combined handling volume of more than 530 million tonnes per year – the second-largest volume after the

North Sea. The comprehensive ports add another 140 million tonnes. Three single ports handled more than 50 million tonnes each in 2020: Algeciras, Marseille and Valencia.

Table 5 Maritime cargo traffic by type and passenger traffic of TEN-T ports in the Western Mediterranean, 2020

Country/port	Share of cargo segment in %					Million tonnes	Av. annual growth 2010-2020	Million passengers
	Dry bulk	Liquid bulk	Container	Ro-ro freight	Other general cargo			
<b>Spain</b>	11%	33%	46%	5%	4%	298.6	2.7%	7.8
Algeciras	1%	32%	62%	5%	0%	88.4	4.2%	1.5
Cartagena	20%	77%	2%	0%	1%	32.6	5.5%	0.0
Valencia	3%	4%	79%	0%	14%	65.6	2.1%	0.4
Tarragona	25%	67%	1%	0%	7%	26.2	-2.0%	0.0
Barcelona	8%	26%	53%	10%	3%	48.7	3.3%	0.7
<b>France</b>	15%	60%	15%	6%	4%	76.4	-1.4%	3.8
Marseille	14%	62%	16%	4%	3%	71.4	-1.4%	0.7
<b>Italy</b>	5%	37%	28%	26%	5%	292.0	-0.6%	37.0
Genoa	2%	23%	50%	21%	4%	44.1	0.6%	1.4
La Spezia	2%	17%	81%	0%	0%	13.9	-1.5%	0.0
Livorno	2%	15%	35%	40%	8%	30.8	3.1%	1.7
Napoli	6%	36%	37%	15%	6%	18.0	1.9%	5.3
Gioia Tauro	0%	9%	91%	0%	0%	24.2	-3.7%	0.0
Palermo	1%	17%	2%	75%	5%	9.8	4.3%	1.1
Augusta	4%	95%	0%	0%	1%	22.3	-1.4%	0.0
Cagliari	4%	70%	3%	17%	5%	32.4	-0.1%	0.0
<b>Malta</b>	61%	13%	14%	8%	5%	5.7	4.3%	8.0
Marsaxlokk	67%	14%	16%	0%	3%	4.9	10.2%	0.0
Valetta	20%	0%	2%	63%	15%	0.7	-8.9%	0.4
<b>Total West Med TEN-T ports</b>	<b>9%</b>	<b>38%</b>	<b>34%</b>	<b>14%</b>	<b>4%</b>	<b>672.6</b>	<b>0.7%</b>	<b>56.6</b>

Source: ISL based on Eurostat, 2022

The share of container traffic is higher than in any other basin except the outermost regions, reaching 34% on average in the basin. This is partly due to the large transshipment hubs (Algeciras, Gioia Tauro and Valencia),<sup>25</sup> but also due to a high share of containers in regional hinterland traffic. The share of dry bulk, by contrast, is the lowest of all European basins.

In 2019, 216 million passengers embarked or disembarked in the ports of the Western Mediterranean – more than in any other basin. The passenger traffic dropped dramatically in 2020 due to the COVID-19 pandemic.<sup>26</sup> The MoS programme has supported IT tools for trade facilitation that entail digital connections with non-EU countries to accelerate logistics and customs procedures (e.g., the International Fast and Trade Lane project with partners in Morocco, Turkey and Egypt).

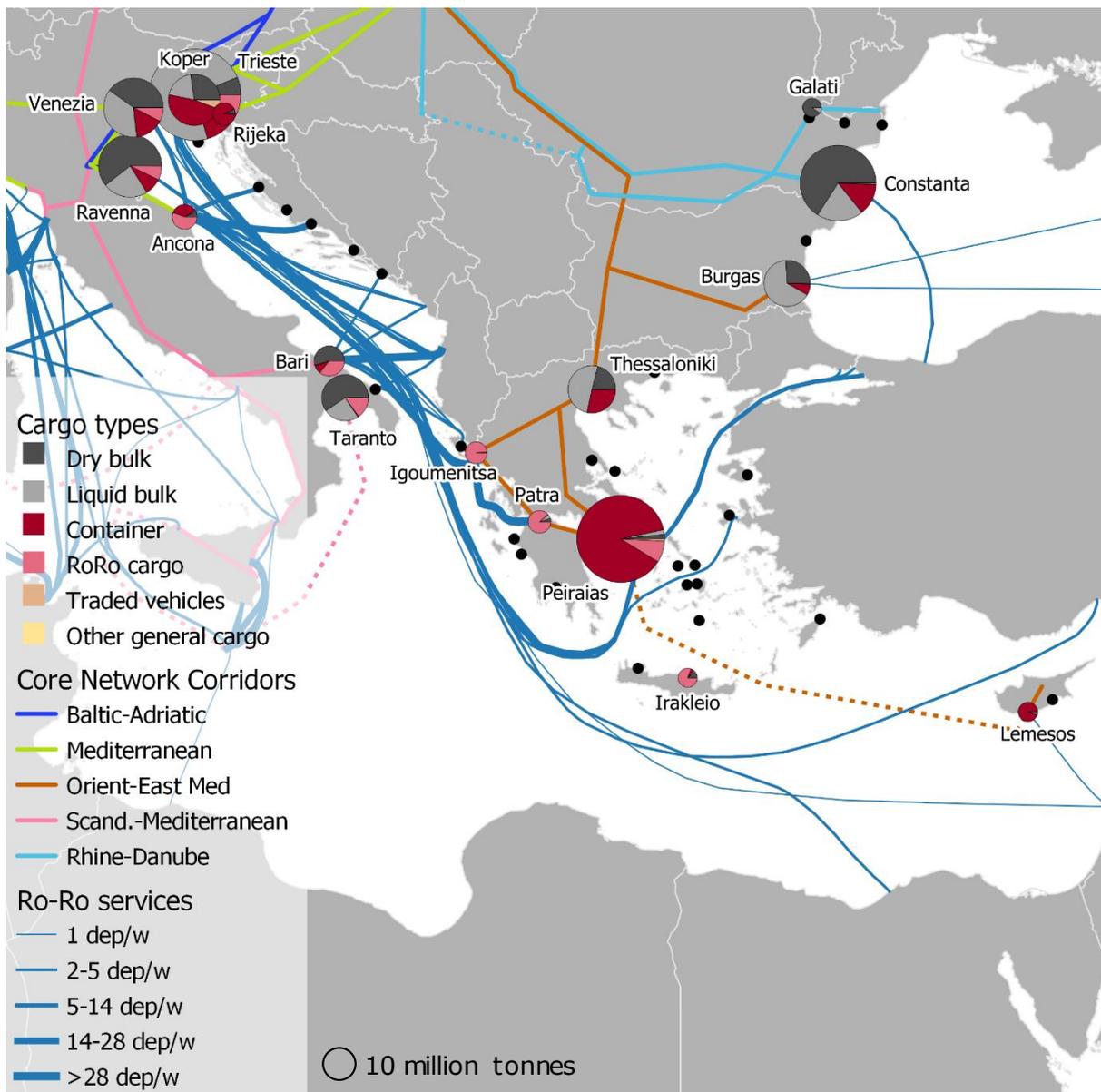
<sup>25</sup> Note that Marsaxlokk Freeport Terminals are not included – they would add roughly 30 million tonnes of container traffic, almost exclusively transshipment.

<sup>26</sup> Figures for 2020 were not yet available at the time of writing.

## 2.5 Eastern Mediterranean and Black Sea

The Eastern Mediterranean ports host five different CNCs, three of which concern ports in the Adriatic Sea: the Scandinavian-Mediterranean, the Baltic-Adriatic and the Mediterranean CNCs. The Adriatic Sea has a dense network of ro-ro services, connecting the east coast of Italy with Croatia and with neighbouring Montenegro and Albania. In addition, there are several services connecting the Adriatic CNC ports with Greece and onwards to Turkey. For cargo coming from Western Europe, they provide an alternative to the land-based Orient-East Med corridor for cargo to Greece. In the Black Sea, there are ro-ro services linking Burgas (Orient-East Med corridor) with Georgia and Constanta (Rhine-Danube corridor) with Turkey.

Figure 8 Core network corridor ports and regular ro-ro services in the Eastern Mediterranean and Black Sea, 2020



Note: International ro-ro shipping routes exclude regular car carriers for traded vehicles;  
Source: ISL, 2021

The Orient-East Med corridor itself connects Central Europe with Greece and on to Cyprus (connected to the EU with container services, among others to and from Piraeus and Thessaloniki). Finally, the Rhine-Danube corridor links the Romanian ports of Constanta and Galati with Central and Western Europe. The Danube is already intensively used for bulk transport while container transport only plays a minor role.

The seventeen core ports of the two basins handled roughly 290 million tonnes in 2020 – slightly more than the ports of the Atlantic basin. There are nine ports with an annual maritime traffic volume of more than ten million tonnes, the largest ones being Trieste, Piraeus and Constanta (see Table 6). About one third of the basin's traffic is handled in the northern Adriatic ports.

Regarding cargo types, the region stands out with a comparatively high share of dry bulk. The port of Constanta is the largest player in this segment with around 24 million tonnes handled in 2020. Ro-ro traffic is also slightly above average, Trieste and Piraeus being the major players. In the Greek ports of Igoumenitsa, Patras and Heraklion, more than three quarters of cargo traffic is ro-ro.

Table 6 Maritime cargo traffic by type and passenger traffic of TEN-T ports in the Eastern Mediterranean and Black Sea, 2020

Country/port	Share of cargo segment in %					Million tonnes	Av. annual growth 2010-2020	Million passengers
	Dry bulk	Liquid bulk	Container	Ro-ro freight	Other general cargo			
<b>Croatia</b>	37%	14%	39%	1%	9%	8.1	-1.4%	6.3
Rijeka	6%	0%	81%	0%	13%	3.5	5.3%	0.1
<b>Cyprus</b>	31%	8%	47%	2%	13%	4.4	-1.5%	0.0
Limassol	1%	0%	82%	3%	15%	2.5	-1.9%	0.0
<b>Greece</b>	13%	22%	50%	13%	2%	101.0	5.4%	13.2
Heraklion	11%	2%	5%	80%	1%	2.5	-2.1%	0.7
Igoumenitsa	1%	0%	0%	98%	1%	3.4	1.8%	1.2
Patras	5%	6%	0%	88%	1%	3.5	-0.5%	0.3
Piraeus	2%	2%	88%	8%	1%	52.4	14.9%	4.4
Thessaloniki	20%	49%	27%	0%	4%	15.6	-0.2%	0.0
<b>Italy</b>	32%	40%	10%	11%	7%	147.5	-0.4%	0.9
Ancona/Falconara Marittir	6%	1%	33%	51%	8%	4.2	-1.7%	0.3
Bari	51%	0%	8%	33%	8%	6.3	5.0%	0.4
Ravenna	55%	21%	8%	7%	9%	27.1	2.1%	0.0
Taranto	58%	24%	1%	15%	3%	14.8	-8.0%	0.0
Trieste	6%	67%	12%	7%	8%	57.8	3.6%	0.0
Venezia	39%	36%	15%	7%	3%	24.3	-0.7%	0.0
<b>Slovenia</b>	26%	18%	44%	0%	12%	18.3	2.3%	0.0
Koper	26%	18%	44%	0%	12%	18.3	2.3%	0.0
<b>Bulgaria</b>	40%	38%	10%	1%	11%	25.3	1.0%	0.0
Burgas	23%	58%	7%	0%	12%	14.7	1.4%	0.0
<b>Romania</b>	63%	18%	12%	0%	7%	41.9	2.7%	0.0
Constantza	62%	19%	13%	0%	6%	39.4	2.6%	0.0
Galati	67%	7%	0%	0%	26%	2.4	3.2%	0.0
<b>Total East Med TEN-T ports</b>	<b>30%</b>	<b>30%</b>	<b>25%</b>	<b>8%</b>	<b>6%</b>	<b>346.4</b>	<b>1.5%</b>	<b>20.4</b>

Source: ISL based on Eurostat, 2022

## 2.6 Outermost Regions

The outermost regions are particularly dependent on their maritime ports and the maritime connections. Due to the long distances, containerised trade is the most effective way of

servicing these regions. Except for the Canary Islands, ro-ro traffic plays no significant role for cargo traffic or only for traffic between neighbouring islands (see Table 7). The share of container traffic, by contrast, is higher than in any other European port range, reaching 44% on average.

Liquid bulk is also more important than on average, particularly for the islands' power supply. Dry bulk, by contrast, is at 9% only as there is little heavy industry in the outermost regions.

Passenger traffic plays a particular role in the outermost regions, both for connecting them with the closest mainland, but also for inter-island traffic.

*Table 7 Maritime cargo traffic by type and passenger traffic of TEN-T ports in outermost regions, 2020*

Country/port	Share of cargo segment in %					Million tonnes	Av. annual growth 2010-2020	Million passengers
	Dry bulk	Liquid bulk	Container	Ro-ro freight	Other general cargo			
<b>Carribbean/South America</b>	22%	27%	34%	12%	5%	5.0	...	...
Guadeloupe	37%	11%	14%	26%	11%	1.9	-4.1%	0.0
Fort de France (Martinique)	14%	39%	42%	5%	0%	2.3	-2.3%	0.0
Cayenne (French Guiana)	9%	32%	56%	1%	1%	0.8	...	...
<b>Acores</b>	27%	20%	52%	0%	2%	1.4	-1.0%	...
Ponta Delgada	27%	20%	52%	0%	2%	1.4	-1.0%	...
<b>Madeira</b>	8%	25%	63%	0%	3%	1.0	-0.8%	...
Canical	8%	25%	63%	0%	3%	1.0	-0.8%	...
<b>Canary Islands</b>	3%	41%	41%	14%	1%	26.6	-0.6%	9.8
Las Palmas	2%	41%	48%	9%	1%	18.7	1.1%	2.8
Santa Cruz de Tenerife	5%	41%	27%	25%	1%	8.0	-4.5%	7.0
<b>Reunion</b>	25%	17%	57%	1%	1%	4.7	1.1%	0.0
Port Réunion	25%	17%	57%	1%	1%	4.7	1.1%	0.0
<b>Total outermost</b>	9%	35%	43%	11%	2%	<b>38.7</b>	-0.8%	...

Source: ISL based on Eurostat and Guyane Port, 2021

## 3 The European Maritime Space in an evolving context

Complementary to the analysis of the maritime traffic data in Chapter 2, Chapter 3 presents an analysis of the continually evolving geopolitical context and legislative environment. The first section of this chapter presents current megatrends with a global impact, such as population growth, climate change or technological developments affecting the world economy. These megatrends play a role in the current and future needs of the maritime transport sector as a whole. The second part covers trends at the European level in terms of regulatory and policy developments. These trends allow us to forecast what the future needs of the EMS might be, and where the future investments could go.

### 3.1 Megatrends

#### 3.1.1 Population growth and demographics

World population is rapidly growing and ageing. Over the next 30 years, it is expected to increase by 2 billion people, reaching 9.7 billion in 2050<sup>27</sup>. At the same time, population growth is expected to slow down in developed countries, which will lead to an increasingly ageing population. These demographic changes are expected to have a significant impact on economic factors such as supply and demand, and thus on the maritime sector as a whole. Firstly, an ageing population means that those that can work are slowly becoming outnumbered by those less capable of working, shifting internal economic balances.

In addition, as population grows, so does economic activity. Several countries are expected to contribute to almost half of the global population growth up to 2050, with India projected to overtake China as the most populous country in the world by 2027. Furthermore, the population of Sub-Saharan Africa is projected to double by 2050, meaning that it will gradually replace Asia as the region with the highest growth rate and will increase its middle-class population. This will ultimately mean that there will be a significant increase in consumption in these regions, which will boost maritime trade between developing countries and the rest of the world.

In that respect, although African GDP shrunk by 2.1% in 2020 due to the COVID-19 pandemic, it is expected to have rebounded by 4% in 2021. With a current population of 1.2 billion (January 2022) that is set to increase even further, there are important opportunities to be seized for the maritime sector. In this context it can be noted that the Mediterranean and North African countries could serve as gateways to Africa for Europe.

In addition to Africa's importance as one of the fastest-growing economies in the world, strong links should also be maintained with other countries and regions. Strong benefits can certainly be reaped from closer ties with Asian countries, in particular through the Black Sea basin. Equally, establishing regular SSS shipping links with non-African Mediterranean neighbours, such as Turkey, Israel, Lebanon, Egypt, i.a. can present significant advantages for the European maritime industry.

Despite strong population growth rates in Africa, the world's economic centre of gravity is shifting from the West towards Asia. Asia still has the highest population growth rate and is already well developed economically. By 2030, it is expected that Asia will represent

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<sup>27</sup> World Population Prospects 2019 Report, United Nations, [https://population.un.org/wpp/Publications/Files/WPP2019\\_Highlights.pdf](https://population.un.org/wpp/Publications/Files/WPP2019_Highlights.pdf)

66% of the global middle-class population, which will provide a basis for economic progress by driving consumption and domestic demand on a regional level.

However, it is also important to note that because of prolonged tensions between the US and China, and the COVID-19 pandemic, traditional trade intensity from East to West is slowing down quite significantly, which negatively affects the global economy<sup>28</sup>. Close attention will be needed on geopolitical developments and the evolutions of the East-West trade, to ensure that Europe remains well connected to Asia.

Finally, another trend in global demographics is ever-increasing urbanisation, which is set to reach approximately 60% by 2030 (from 55% today)<sup>29</sup>. This implies that ports near cities with high concentrations of population must be efficiently connected, to keep up with economic growth, as well as the need to ensure and maintain territorial cohesion with islands and peripheral regions.

### 3.1.2 Climate change

The consequences of climate change affect national economies and the lives of all citizens. Warmer temperatures, changing weather patterns, and rising sea levels result in more extreme weather conditions. The impact of climate change is being felt by all economic actors, the shipping sector and its operations included.

Sea storms are becoming more severe and frequent, which in turn requires ships to re-route to longer but less storm-prone routes, causing potential economic losses for shipping companies. With these harsher weather conditions, ships will need to be built more robustly to withstand extreme weather conditions. Polar glaciers are slowly retreating, opening up a potential utilisation of new accessible polar routes for ships. Navigating in such fragile environments requires special measures to mitigate and prevent harm to these fragile ecosystems. This also poses new concerns for navigational safety, as the extreme weather conditions in these parts of the world are especially harsh. Such harsh conditions also pose a threat to the well-being of seafarers, both physically and mentally. As a result, technical preparedness and crew training are considered to be of paramount importance.

With regard to SSS, a raised awareness of the impacts of climate change can especially have consequences on the volume of traffic. A shift towards shorter supply chains and locally produced goods can increase the importance of SSS for the transport of original manufacturer equipment (OEM) and local goods. On the same note, as a relatively carbon efficient mode of transport, the increasing prominence of sustainability issues open the door for the further development of SSS. The modal shift of cargo from road to sea through the development of SSS links can unlock substantial environmental and social benefits, and could thus become a key solution for climate change mitigation, amongst other benefits, at a time where solutions are needed.

The negative impacts of climate change are increasingly met with political action on a global scale, including concerning the maritime sector. For example, the recent COP 26 in

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<sup>28</sup> UN World Economic Situation and Prospects  
<https://www.un.org/development/desa/dpad/publication/world-economic-situation-and-prospects-september-2019-briefing-no-130/>

<sup>29</sup> UN news  
<https://news.un.org/fr/story/2018/05/1014202>

Glasgow led to the adoption of the Clydebank Declaration<sup>30</sup> for green shipping corridors. This declaration, signed by 22 countries (including France, the UK, Germany, Belgium, Denmark, Finland, Ireland, Italy, the Netherlands, Spain, Sweden, Japan and the USA) supports the establishment of green shipping corridors, i.e. zero-emission maritime routes between two ports, and commits the signatories to develop at least 6 of these by 2025. A “declaration on Zero Emission Shipping by 2050”<sup>31</sup> was also signed by 14 countries, pledging to push the IMO to adopt a zero GHG target for international shipping by 2050.

### 3.1.3 Exogenous Shocks

The acceleration of globalisation and the increasing frequency of climate-related incidents have increased the occurrence and gravity of exogenous shocks. These have significantly affected the maritime sector on a global scale and have underlined the crucial need for resilience.

The COVID-19 pandemic has had wide-ranging repercussions and led to a 10% decrease in maritime traffic in the EU in 2020<sup>32</sup>. It has raised awareness about both the consequences of anthropogenic destruction of our environment, and the vulnerability and interconnectedness of our systems. It has led not only to the accelerated deployment of new technologies that answer the short-term problems created by the pandemic (digital tools to reduce in-person contact for example), but it has also affected our approach to long-term planning. Resilience and climate change mitigation/adaptation are now key considerations, at least at the EU level, in policymaking and project development. NextGenerationEU, the EU’s recovery plan from the COVID-19 pandemic, for example underlines that post-COVID Europe will need to be “greener, more digital and more resilient”. This holds particularly true for the maritime sector, which has been significantly affected by the crisis.

This resilience mindset is further reinforced when the vulnerabilities of the international trade system are revealed. This occurred in March 2021, when the Ever Given super container vessel<sup>33</sup> blocked the Suez Canal for several days. This incident shed a bright light on the shortcomings of the system, the dependency on specific trading partners (China in this case) and led to shortages in crucial products. Diversifying supply chains, introducing more flexibility and bolstering resilience to similar shocks is of crucial importance to build a maritime system capable of facing future challenges.

At the time this DIP was written, Russia’s war of aggression of Ukraine had begun, and economic sanctions had been imposed by many countries, including the USA and the EU, on the Russian Federation and on Belarus. While reminding us that military aggressions could still take place, the war also revealed vulnerabilities of the European maritime sector. Many ships were stranded in Ukrainian ports, with several hundreds of seafarers onboard, as ongoing military operations prevented their safe passage. Economic sanctions also had significant impacts on maritime transport: some countries across the world banned Russian vessels from their ports, whilst major shipping companies halted their services towards the

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<sup>30</sup> <https://www.gov.uk/government/publications/cop-26-clydebank-declaration-for-green-shipping-corridors/cop-26-clydebank-declaration-for-green-shipping-corridors>

<sup>31</sup> <https://em.dk/media/14312/declaration-on-zero-emission-shipping-by-2050-cop26-glasgow-1-november-2021.pdf>

<sup>32</sup> EMSA Impact of COVID-19 on the Maritime Sector in the EU  
<http://emsa.europa.eu/publications/item/4436-impact.html>

<sup>33</sup> I.e. a container ship with a capacity of over 14,501 TUE.

Russian mainland. This disruption to global trade lanes meant undelivered goods piled up in alternative ports, such as Constanta (Romania), Bremen (Germany) or Rotterdam (Netherlands), where they awaited to be transloaded on smaller ships destined to Russia. In that respect, it is noteworthy to underline that in May 2022, the EU set out an action plan<sup>34</sup> to establish "Solidarity Lanes" to ensure flows of vital goods, including grain, could continue flowing in and out of Ukraine. The "Solidarity Lanes" action plan includes an assessment by the Commission on how to offer increased connectivity between the EU and Ukraine as well as with Moldova, as part of the ongoing TEN-T revision. The invasion also led to a strong hike in prices for maritime fuels, and revealed Europe's dependency on Russia exports of fossil fuels. Although not much can be done to prevent the impacts of military aggression, the Russian invasion did exacerbate the importance of diversifying supply chains, especially when it comes to energy. Further yet, it underlined the importance of the TEN-T: the multitude of interlinked ports ensures that goods and people can continue moving, even when parts of the network are incapacitated.

To diversify the supply chains, investments in port infrastructure will be highly needed in the future to meet the increased demands on the transport sector. Ports will continue to play an important role as energy hubs, and will contribute to the security of energy supply to the EU.

### 3.1.4 Technological developments

Digitalisation is ever increasing and has become an essential part of any business today. As such, the maritime sector must ensure it assimilates the newest technological developments in a timely manner to stay competitive and attractive, both to businesses and passengers, but also to seize the opportunities these new tools can offer.

Digital tools do indeed bring forward significant benefits. The development of data analytics, artificial intelligence or machine learning for example could help optimise processes by calculating the best route for ships, optimise docking in ports based on the estimated time of arrivals of various ships, or accelerate cargo management. Further yet, artificial intelligence and automation could help increase the efficiency of operations both onboard ships and within ports and optimise links with the hinterland. It could also decrease the risk for human error. Not only do these numerous applications help reduce costs, they can also bring forward significant environmental benefits, for example via energy efficiency gains.

However, to capture these gains, a significant amount of investment is needed, both to deploy the necessary infrastructure, and help workers develop the appropriate skills. It is particularly important to ensure the workforce can successfully master these new tools.

With this additional attention to workers' skills also comes a need to develop infrastructure, both to enable the deployment of these technologies on board ships and on land, but also to ensure their resilience in the face of cybersecurity risks. Indeed, throughout the COVID-19 crisis, cybersecurity attacks on ships significantly increased, and this trend is likely to continue. As a result, ensuring port and ship infrastructures are sufficiently developed to face such threats is of key importance to prevent what can be catastrophic disruptions.

In addition, the deployment of digital technologies will also require a greater level of harmonisation between maritime actors to facilitate processes, ensure economies of scale and avoid the emergence of silos. At the European level for example, the development of

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<sup>34</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0217>

digitally based customs documentation has reduced transaction costs and accelerated procedures, compared to its paper-based predecessor. To capture the full potential of this evolution however, as well as avoid fragmentation and a higher burden on maritime operators, it is crucial to put in place a harmonised interface for the exchange of information. The same holds for data, which when pooled together under a common framework, such as the European Common Data Spaces, can deliver greater benefits through economies of scale. Further work will thus be needed to ensure harmonisation across different European actors. The European Maritime Single Window environment is in that aspect a good step forward.

### 3.1.5 Emerging threats to safety and security

Finally, another issue of great importance in the maritime sector is safety. Although safety has always been of the utmost importance, the maritime sector is increasingly moving towards a zero tolerance for maritime accidents and incidents. At the same time however, the global maritime environment is more and more challenging.

For one, new shipbuilding technologies continue to allow naval architects and shipbuilders to increase the size of vessels and the industry has experienced container ship capacities increasing from 2,400 TEU (240m long) to the latest generation of ships crossing the mark of 20,000 TEU (400m long). In 2021, the world's largest ship is HMM Algeciras with 24,000 TEU (399.9m long).

This trend affects port facilities as container terminals have historically built berths between 300 and 360m, implying that the new generation of ships may have become too large for contemporary berths. Thus, the ports that serve international trade require continuous investments to keep up with the ever-larger vessels and increased volumes of goods. In addition, the size and engine power of these vessels exacerbates the difficulties of slow-speed handling; an issue that should be reflected in pilotage practices through the safe and efficient navigation of ships. It also emphasises the importance of using sufficiently powerful and manoeuvrable tugboats during docking operations.

In addition, the maritime industry is also obliged to keep up with the newest developments in container shipping. Some types of cargo, such as fuel or radioactive materials being transported on increasingly larger ships present serious concerns to safety. Furthermore, major fires on container vessels are one of the most significant safety issues. Inadequate firefighting capabilities of ships and crew, and other causes such as mis-declaration of dangerous cargo, significantly increases safety risks. It is thus crucial that updated risk management procedures be promoted vis-à-vis seafarers, to ensure they can face such incidents.

Another navigational safety issue relates to the Arctic Route. Due to global warming, the Central Arctic Ocean's ice is melting at an unprecedented rate, opening new possibilities for transport. Given the increasing interest in exploring and navigating in Arctic waters, navigational safety is a key area to be considered. As a particularly sensitive sea area, technical and operational preparedness in case of oil spill, and crew training to withstand harsh conditions are considered to be of paramount importance.

Finally, cybersecurity risk mitigation should also be included in safety training. Linking back to the deployment of digital tools, cybersecurity policies should be introduced providing employees with the necessary skills to safeguard sensitive information and defend operational systems. Failure to react accordingly to cyber security threats may result in serious incidents, such as traffic disruption and loss of life at sea. Safety concerns should also be addressed on the landside since cybersecurity is also a major issue for port infrastructure and operations.

## 3.2 An evolving European regulatory landscape

The European regulatory landscape is continuously evolving. Through the adoption of new policies and legislation, the EU sets rules and standards aimed to drive change in the sectors it targets. While the future of the SSS sector (its ports and vessels) will in part be driven by market trends, the regulatory context within which it evolves will also play an important role.

For this reason, after having looked at global megatrends affecting the sector, the following sections provide an overview of the current and evolving European maritime legislative framework. Such an overview is necessary when determining the investment needs of the sector, and thus the strategic objectives of the EMS.

### 3.2.1 The revision of the TEN-T Regulation

As a start, while the legal basis for the MoS funding programme is currently contained in Article 21 of the TEN-T Regulation (EU) 1315/2013, on 14 December 2021, the European Commission adopted a legislative proposal for a revised Regulation for the development of the TEN-T<sup>35</sup>. The proposal builds upon a comprehensive evaluation of the existing legal framework, extensive consultations with Member States and stakeholders and an in-depth assessment of the impacts of the changes proposed. The revised TEN-T Regulation shall contribute to the objectives of the EGD and of the SSMS. The proposal includes an update of the 2013 TEN-T planning methodology, a report on the implementation of TEN-T during the years 2018 and 2019 as well as a communication on the extension of the TEN-T network to the EU neighbouring third countries.

To adequately address the objectives of the EGD and SSMS, the revision of the TEN-T Regulation aims at reinforcing the contribution of the TEN-T to the decarbonisation and digitalisation objectives of transport policy. In particular, the proposed revision of the Regulation aims to make sure that an appropriate infrastructure basis to alleviate congestion and reduce GHG emissions is provided. To that end, the revised TEN-T Regulation includes firm incentives to shift transport demand towards more sustainable modes of transport, including towards SSS. The aim is two-fold: a) to increase the number of passengers travelling by rail through the development of a competitive and seamless high speed rail network throughout Europe; and b) to shift a substantial amount of freight onto rail, inland waterways, and SSS.

The overall objective is to develop and complete a competitive and interoperable TEN-T at highest standards, which is gradually developed in three steps: the core network by 2030, the extended core network by 2040 and the comprehensive network by 2050.

To that end, the proposal to revise the TEN-T Regulation introduces a number of new or reinforced infrastructure requirements, which promote the development of infrastructure of sustainable forms of transport.

With regards to rail transport, the proposal foresees the requirement to enable the P400 loading gauge on the entire network and the extension of existing core network requirements to the entire comprehensive network (22.5 tons axle load, 740 m train

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<sup>35</sup> Proposal for a Regulation on Union guidelines for the development of the trans-European transport network, amending Regulation (EU) 2021/1153 and Regulation (EU) No 913/2010 and repealing Regulation (EU) 1315/2013

<https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM%3A2021%3A812%3AFIN>

length) or to the extended core network (100 km/h line speed)<sup>36</sup>. In addition, a minimum line speed of 160 km/h is introduced for passenger lines of the core and the extended core network and the installation of ERTMS on the entire network by 2040 while decommissioning existing national class B systems is made mandatory. In terms of waterborne transport, the revised Regulation defines a “good navigation status” through minimum requirements (2.5 m navigable channel depth and 5.25 m height under bridges) that shall be complemented by specific requirements per river-basin. SSS shall be promoted in a wider perspective by integrating all components of the maritime dimension into the European Maritime Space (replacing the current MoS concept). In the field of road transport, the focus is on improving the quality of roads to increase road safety and to augment the number of resting areas and safe and secure parking along the TEN-T. Finally, the proposal will lead to an increase of multimodal freight terminals on the TEN-T to promote multimodality as well as the inclusion of all EU urban nodes of at least 100.000 inhabitants into the network. This also ensures that each NUTS-2 region is represented by an urban node. For the latter, the requirement to implement a Sustainable Urban Mobility Plan (SUMP) and the development of transshipment facilities (multimodal freight terminals and passenger hubs) is imposed.

To achieve the targets and to fulfil the objectives of the EGD and the SSMS, an intermediary deadline of 2040 is proposed for the new standards on the core network and for advancing the compliance of the existing standards on the comprehensive network, and in particular the deployment of ERTMS.

One major new element will be the integration of the nine core network corridors with the eleven rail freight corridors in a common set of “European Transport Corridors”. The alignments are defined in the TEN-T Regulation repeal the existing alignments of corridors in the CEF II Regulation. While striving for maximum stability of the existing TEN-T, this merger brings certain changes, such as the identification of an extended core network that fully integrates the corridors.

Similarly, it has been proposed to revise the current system of European Coordinators and reinforce their prerogatives. Based on their work plans that shall be developed every four years, the Commission would adopt an implementing act for each work plan, setting clear milestones to be implemented by the respective Member States. The elaboration of the work plans would be complemented by annual status reports. Finally, the role of the European Coordinators as observers in single entities for the implementation of cross-border projects would be institutionalised.

The proposal is now being negotiated with the European Parliament and the Council for a possible entry into force in the course of 2023.

### 3.2.2 Decarbonisation and alternative fuels

Environmental issues have been and will continue to be a top priority for the EU. Addressing climate change is a key priority for the current European Commission. It is pursuing an ambitious programme to tackle the issue with the implementation of the flagship initiative: the European Green Deal (EGD). Presented in December 2019, the EGD is an ambitious strategy that aims to enable European citizens and businesses to benefit from the sustainable green transition.

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<sup>36</sup> With some exceptions, such as isolated rail networks.

Prior to the EGD, the EU had developed a consequent body of law to put Europe on a path of decarbonisation, however no specific pieces of legislation targeted the reduction of GHG from ships. One step in this direction was nevertheless the adoption of Regulation 2015/757 on monitoring, reporting and verification (MRV) of carbon dioxide emissions from maritime transport<sup>37</sup>. It requires ships to annually report their GHG emissions.

One of the cornerstones of the EGD Deal is the European Climate Law, adopted in June 2021. With this law, the EU legally commits itself to reduce its GHG emissions by at least 55% by 2030 as compared to 1990, and to reach net-zero GHG emissions by 2050. All sectors of the economy, including the transport sector, are expected to contribute with their share. According to the Commission, a 90% reduction of GHG emissions from transport will be needed to reach this goal.

To specifically address how the various modes of transport should achieve their green (and digital) transformation, the Commission adopted in December 2020 its Strategy for Sustainable and Smart Mobility (SSMS). This strategy lays out the EU's future plans in the field of transport, setting a number of milestones to be achieved in the decades to come. Of specific interest to maritime transport is the milestone to increase SSS by 25% by 2030 and by 50% by 2050 compared to the levels of 2015.<sup>38</sup> Another objective is to have zero-emission marine vessels market-ready by 2030. Both of these milestones have an impact on the investment needs of the EMS going forward.

To help achieve these milestones, the Commission plans a number of legislative initiatives, many of which will have to be implemented through significant investments, onshore and on-board. Looking specifically at reducing emissions of GHG in shipping, the Commission put forward in July 2021 14 proposals as part of the "Fit for 55" climate package. This included the inclusion of maritime transport in the EU's the Emissions Trading System (EU ETS)<sup>39</sup>, the setting of GHG intensity targets for maritime fuels<sup>40</sup>, and new rules to ensure appropriate alternative (i.a. marine) fuel infrastructure<sup>41</sup>.

While these legislative initiatives will be subject to changes as they go through the EU's legislative process in the months and years to come, their analysis is useful. Indeed, the far-reaching proposals (even if modified slightly in substance) will undoubtedly have an impact on the future investment needs of the SSS sector, onshore and on-board.

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<sup>37</sup> Regulation (EU) 2015/757 of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, and amending Directive 2009/16/EC  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R0757&from=EN>

<sup>38</sup> According to Eurostat, these milestones set by the EU would translate in an increase of tonnage volumes from 1.6 billion tonnes (2015), to 2 billion (2030) and 2.5 billion tonnes (2050), respectively.

<sup>39</sup> Proposal for a Directive amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757  
[https://ec.europa.eu/info/sites/default/files/revision-eu-ets\\_with-annex\\_en\\_0.pdf](https://ec.europa.eu/info/sites/default/files/revision-eu-ets_with-annex_en_0.pdf)

<sup>40</sup> Proposal for a Regulation on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC  
[https://ec.europa.eu/info/sites/default/files/fueleu\\_maritime\\_-\\_green\\_european\\_maritime\\_space.pdf](https://ec.europa.eu/info/sites/default/files/fueleu_maritime_-_green_european_maritime_space.pdf)

<sup>41</sup> Proposal for a Regulation on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU of the European Parliament and of the Council  
[https://ec.europa.eu/info/sites/default/files/revision\\_of\\_the\\_directive\\_on\\_deployment\\_of\\_the\\_alternative\\_fuels\\_infrastructure\\_with\\_annex\\_0.pdf](https://ec.europa.eu/info/sites/default/files/revision_of_the_directive_on_deployment_of_the_alternative_fuels_infrastructure_with_annex_0.pdf)

## EU ETS

In the proposal to include maritime transport in the EU ETS, the Commission suggests covering GHG emissions from ships above 5000 gross tonnes when sailing within the EU and when at berth. The proposal therefore covers a substantial amount of intra-European SSS voyages, as well as 50% of extra-EU voyages (starting/finishing in a European port). To ensure a smooth transition, ship owners would have to surrender allowances for only a portion of their emissions during an initial phase-in period from 2023 to 2025. But as of 2026, shipping companies would be required to surrender allowances for an amount equal to all of their emissions reported in the preceding year. By putting in place this market-based mechanism that puts a price on GHG emissions from ships, the Commission is putting pressure on the shipping industry to decarbonise. Substantial investments will be needed for this, both when it comes to vessels and infrastructure.

## FuelEU Maritime

A key way for the shipping sector to reduce its GHG emissions will be to use renewable and low-carbon fuels. To encourage the uptake of such fuels, the Commission has proposed a legal act entitled "FuelEU Maritime". This is a proposal for a new Regulation on the uptake of renewable and low-carbon fuels in maritime transport. The overall aim is to stimulate the demand for cleaner shipping fuels by putting requirements on the carbon intensity of fuels used on-board. The Commission has taken a goal-based approach with this Regulation rather than setting obligations on the specific types of fuels to be used by ship owners. The aim is for renewable and low-carbon fuels to represent 6% to 9% of the international maritime transport fuel mix in 2030, and 86% to 88% by 2050. At the time this DIP was written, the maritime fuel mix almost entirely relied on fossil fuels<sup>42</sup>.

The scope of the Regulation as proposed is the same as the one for the EU ETS, covering, i.a. the GHG intensity of fuels used by ships above 5000 gross tonnes when sailing in the EU and when at berth, as well as 50% of the energy used for extra-EU voyages (starting/finishing in an EU port). It lays down GHG intensity limits of energy used on-board ships, getting gradually stricter over time, from 2025 until 2050. Also of interest is a requirement for passenger ships and container ships to connect to OPS while at berth as of January 2030.

## Alternative Fuel Infrastructure Regulation

While the FuelEU Maritime Regulation addresses the demand for alternative fuels for maritime transport (e.g. mandatory OPS for certain ships), the Commission has also proposed a legal act addressing the availability of an appropriate network of alternative fuels infrastructure throughout the EU. This proposal for a Regulation<sup>43</sup> would replace the existing Directive 2014/94/EU on the deployment of alternative fuel infrastructure<sup>44</sup>. According to the 2014 Directive, Liquefied Natural Gas (LNG) refuelling facilities should be available in all core network ports by 2025 and in all comprehensive network ports by 2030. In addition, according to the same Directive, OPS should be available in all core network ports by 2025.

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<sup>42</sup> [https://ec.europa.eu/info/sites/default/files/fueleu\\_maritime - green\\_european\\_maritime\\_space.pdf](https://ec.europa.eu/info/sites/default/files/fueleu_maritime - green_european_maritime_space.pdf)

<sup>43</sup>

[https://ec.europa.eu/info/sites/default/files/revision\\_of\\_the\\_directive\\_on\\_deployment\\_of\\_the\\_alternative\\_fuels\\_infrastructure\\_with\\_annex\\_0.pdf](https://ec.europa.eu/info/sites/default/files/revision_of_the_directive_on_deployment_of_the_alternative_fuels_infrastructure_with_annex_0.pdf)

<sup>44</sup> Directive 2014/94/EU of 22 October 2014 on the deployment of alternative fuels infrastructure <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=en>

In the proposal for a new Regulation on Alternative Fuels Infrastructure (AFIR), some of these targets have been modified. As regards OPS, Member States would be required to ensure that ports of the TEN-T are equipped to provide shore-side electricity to passenger ships and containerships while at berth by January 2030. Taking into account the individual nature of each port, ports would be required to cover at least 90% of the relevant port calls. The proposal also establishes targets for supply of LNG in maritime ports, whereby Member States must ensure that an appropriate number of refuelling points for LNG are put in place at designated TEN-T core maritime ports by January 2025. Member States<sup>45</sup> are asked to establish their national designated core ports taking into account actual market needs and developments, and must cooperate with neighbouring Member States to ensure adequate coverage of the TEN-T core network. Refuelling points include LNG terminals, tanks, mobile containers, bunker vessels and barges. It is worth mentioning here that LNG is considered a transitional solution: in the long term, it is expected to be replaced by zero or low-carbon fuels.

Under the proposed AFIR, Member States would also be required to submit by January 2025 draft national policy frameworks to the Commission for the development of the market as regards alternative fuels in the transport sector and the deployment of the relevant infrastructure. These national policy frameworks should contain, i.a., national targets for supply of LNG and OPS in their ports, but also a deployment plan for alternative fuels infrastructure in maritime ports other than for LNG and shore-side electricity supply for use by sea-going vessels in line with expected demand for various non-fossil fuels and in close coordination with operators of regular short sea shipping services.

These new ambitious initiatives stemming from the EGD are aimed at pushing the shipping industry on the path of decarbonisation, contributing their effort towards the EU's overall objective of being carbon neutral by 2050. International objectives have also been set by the IMO through its initial GHG emissions reduction strategy<sup>46</sup>. This strategy adopted in 2018 aims to reduce GHG emissions from shipping with at least 50% by 2050 compared to 2008 levels, and peak GHG emissions as soon as possible. It also includes a list of potential short, mid- and long-term further emission reduction measures to achieve such objectives. It will be revised in 2023 and current discussions point to the possibility of an agreement for a net-zero target for shipping by 2050.

### EU taxonomy

Efforts to decarbonise the sector will need to be supported by significant levels of investment. Much of it cannot be borne through public spending alone. To respond to this step-change, the Commission is putting in place a legislative framework to foster private investment into sustainable economic activities. The cornerstone of this framework is Regulation 2020/852 on the establishment of a framework to facilitate sustainable investment (EU Taxonomy Regulation)<sup>47</sup>.

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<sup>45</sup> It should be noted that in certain Member States, the responsibility for development of infrastructure in sea (and inland) ports can rest with federal or regional authorities (e.g. in Germany)

<sup>46</sup> IMO Initial Strategy on reduction of GHG emissions from ships and existing IMO activity related to reducing GHG emissions in the shipping sector  
[https://unfccc.int/sites/default/files/resource/250\\_IMO%20submission\\_Talanoa%20Dialogue\\_April%202018.pdf](https://unfccc.int/sites/default/files/resource/250_IMO%20submission_Talanoa%20Dialogue_April%202018.pdf)

<sup>47</sup> Regulation (EU) 2020/852 of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0852>

The EU Taxonomy establishes a classification system for sustainable economic activities, articulated around six environmental objectives ((1) climate change mitigation, (2) climate change adaptation, (3) water and marine resources, (4) the transition to a circular economy, (5) pollution prevention and control, and (6) biodiversity). The aim is to provide investors and companies with a common language, reinforcing trust and transparency on what are to be considered “green” activities.

Sustainable economic activities are to be assessed through the adoption of Technical Screening Criteria (TSC). The first set of TSC was adopted by the Commission in April 2021. Established TSC for the first two environmental objectives entered into force on the 1 January 2021. A second set, covering the remaining four environmental objectives is expected to be adopted in 2022, and should apply as of 1 January 2023.

Under the first TSC<sup>48</sup>, shipping is considered a transitional activity, meaning the Commission has acknowledged that there are currently no technologically and/or economically feasible carbon-neutral alternatives to shipping yet, but that it still supports and strives towards the transition to a climate-neutral economy. As a result, sustainable maritime activities are either those that can achieve climate neutrality (for example zero-emission ships, or infrastructure to support their operation), or those that achieve the best environmental performance in the industry, which for now has been defined as achieving emissions 10% below the Energy Efficiency Design Index (EEDI) threshold. The Taxonomy also includes Do No Significant Harm criteria vis-à-vis the overall environmental impact of ships, including water emissions from scrubbers, particle emissions or negative impacts on marine ecosystems. These TSC will apply up until 2025, after which another set, updated to reflect the technological evolutions of the industry, will come into force. Importantly, the EU Taxonomy does not set an obligation for companies to become sustainable. However, as private investors are increasingly seeking sustainable investments, maritime economic activities that are or strive to be Taxonomy-aligned will benefit from more abundant and cheaper sources of financing.

### 3.2.3 Air pollution

While there is currently a big focus on GHG emissions, air pollution has been an area governed by EU regulation for quite some time. Since the early 1970s, the EU has been working continuously to improve air quality by controlling emissions of harmful substances into the atmosphere. It has done this by improving fuel quality and by integrating environmental protection requirements into the transport and energy sectors. When it comes to controlling the emissions of sulphur from ships, the main piece of EU legislation is Directive 1999/32/EC as regards the sulphur content of marine fuels; the so-called “EU Sulphur Directive<sup>49</sup>”. This Directive has been revised a few times, the latest in 2012. This revision aimed at implementing into EU law the far-reaching emission limits agreed at IMO in 2008. Among other things, this revised Directive enshrined into EU law the 0.10% Sulphur Emission Control Area (SECA) limit as of 2015, which applies in the EU in the

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<sup>48</sup> Commission Delegated Regulation of 4.6. 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives

[https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI\\_COM:C\(2021\)2800](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM:C(2021)2800)

<sup>49</sup> Directive (EU) 2016/802 of 11 May 2016 relating to a reduction in the Sulphur content of certain liquid fuels <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L0802&rid=7>

Baltic Sea, the North Sea and the English Channel. The Directive also implemented the global 2020 limit of 0.5%. The EU continues to seek to strengthen air emission rules, e.g. by supporting the establishment of new Emission Control Areas in European waters (Mediterranean Sea, Black Sea).

Currently there are no rules at EU level specifically regulating the emissions of Nitrogen Oxides (NO<sub>x</sub>) from shipping. Limits are set at international level through the IMO's MARPOL Annex VI. Of relevance for ships operating in European seas is the designation of the Baltic Sea and the North Sea as NO<sub>x</sub> Emission Control Areas (NECAs)<sup>50</sup> back in 2016. This requires that all vessels built after 2021 and operating in these areas must demonstrate their compliance with NO<sub>x</sub> emissions reductions of 80% compared to the emission level of 2016.

### 3.2.4 Marine Environment

As a key principle, the EU aims to encourage the development of its maritime economy while protecting its marine environment.

Of interest to the EMS are rules put in place by the EU to ensure adequate waste reception in European ports with Directive (EU) 2019/883 on port reception facilities (PRF) for the delivery of waste from ships<sup>51</sup>. The Directive defines criteria for adequate PRF in Europe based on "the types and quantities of waste from ships normally using the port". The aim of the Directive is to reduce waste from vessels into the marine environment and to facilitate maritime transport services through reduced administrative requirements. The Directive tackles the adequacy of PRF based on demand, the delivery of waste from ship to shore through economic incentives, as well as the provision of coherent and equal administrative procedures. Of particular importance are the principles for the cost recovery systems through a transparent system of fees and costs, and the calculation of significant contributions from the port users. It allows a differentiation of fees based on categories, types, sizes and traffic types; this in turn provides incentives to reduce waste. Vessels that produce reduced quantities of waste and manage waste in a sustainable and environmentally sound manner will be rewarded accordingly.

In addition, according to the Directive, an information, monitoring and enforcement system is to be developed and applied by ports – supported by an inspection regime. Exemptions are e.g. to be based on ships with regular and frequent port of calls, evidences for arrangements for waste delivery, electronic reporting procedures or paid fees in ports within the vessel's service route. Implementing Acts have been adopted in relation to the calculation of sufficient on-board storage capacities, criteria for on board waste management, a risk-based targeting mechanism and a methodology for reporting passively fished waste.

Protection of marine biodiversity, including limiting the spread of marine invasive species, is also an issue of relevance. It is for the time being mainly addressed by the IMO through the Ballast Water Management Convention<sup>52</sup>. Nevertheless the EU regulates this issue

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<sup>50</sup> The Baltic Sea area (Regulation 14.3.1 of MARPOL Annex VI and Regulation 1.11.2 of MARPOL Annex I), The North Sea area (Regulation 14.3.1 of MARPOL Annex VI and Regulation 1.14.6 of MARPOL Annex V)

<sup>51</sup> Directive (EU) 2019/883 of 17 April 2019 on port reception facilities for the delivery of waste from ships, amending Directive 2010/65/EU and repealing Directive 2000/59/EC  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0883&from=EN>

<sup>52</sup> IMO Ballast Water Convention  
<https://www.imo.org/fr/OurWork/Environment/Pages/BWMConventionandGuidelines.aspx>

through Regulation (EU) 1143/2014 on the prevention and management of the introduction and spread of invasive alien species (IAS). Up until now the Regulation has focused on land based IAS, but an upcoming review of the law might include marine species within its scope. This would mean that action might be required to be taken by Member States to prevent, minimise and mitigate the adverse effects of certain marine invasive alien species.

The EU Water Framework Directive (2000/60/EC), which commits European Member States to achieve good qualitative and quantitative status of all water bodies (including marine waters up to one nautical mile from shore), is also of particular relevance in the EMS context. The Directive mandates Member States to protect territorial and marine waters, including by preventing and eliminating pollution of the marine environment from discharges, emissions or losses of hazardous substances. The Directive commits Member States to take the necessary measures not to increase pollution of marine waters, including in the development of maritime routes and infrastructure. At international level, work is also ongoing at the IMO to further strengthen rules on the harmful discharge into the marine environment.

Similarly, the Natura 2000 Network bears relevance to the development of the EMS, as it regroups over 8% of the European maritime territory under a common network of protected areas. The aim of the network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats, listed under both the Birds Directive<sup>53</sup> and the Habitats Directive<sup>54</sup>. Importantly however, the network is not a system of strict nature reserves from which all human activities is excluded. Member States must however ensure that the sites are managed in a sustainable manner, both ecologically and economically, and thus another key aspect to take into account with regard to SSS.

The EU also adopted a Directive on Maritime Spatial Planning (MSP)<sup>55</sup> in 2014. MSP is “a process by which the relevant Member State’s authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives”. The MSP Directive foresees the adoption of national maritime spatial plans through which, Member States shall take into consideration relevant interactions of activities and uses such as maritime transport routes and traffic flows. These plans can be of relevance to the development of the EMS.

### 3.2.5 Digitalisation

As digitalisation becomes more widespread across all transport modes, including shipping, the EU has so far mainly focused its legislative efforts on administrative simplification. This was first addressed in 2010 through the adoption of Directive 2010/65/EU on reporting formalities for ships arriving in and/or departing from ports of the Member States<sup>56</sup>. These

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<sup>53</sup> 2009/147/EC of 30 November 2009 on the conservation of wild birds

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02009L0147-20190626&from=EN>

<sup>54</sup> Council Directive of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01992L0043-20130701&from=EN>

<sup>55</sup> Directive 2014/89/EU of 23 July 2014 establishing a framework for maritime spatial planning <https://eur-lex.europa.eu/eli/dir/2014/89>

<sup>56</sup> Directive 2010/65/EU of 20 October 2010 on reporting formalities for ships arriving in and/or departing from ports of the Member States and repealing Directive 2002/6/EC

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0065&from=en>

rules banned the use of paper forms and introduced electronic single windows to fulfil reporting formalities. Given shortcomings with this Directive, which included an uneven and unsatisfactory implementation by Member States, the EU adopted in 2019 Regulation 2019/1239 establishing a European maritime single window environment<sup>57</sup> (“EMSWe”). This Regulation replaces the 2010 Directive and creates a framework for a technologically neutral and interoperable digital environment. It establishes harmonised interfaces for exchanging information related to ship reporting obligations between public authorities and the maritime industry to facilitate maritime transport and trade. The Regulation also allows relevant part of the collected data to be exchanged with other transport modes to facilitate multimodal transport. It should be implemented by 2025 at the latest.

More recently, and as a part of the EU’s alignment with recent digital developments, the EU adopted in July 2020 Regulation (EU) 2020/1056 on electronic freight transport information (eFTI)<sup>58</sup>. The aim is to simplify and optimise communication between transport operators and authorities. It does this by putting in place a uniform legal framework requiring authorities to accept freight transport information in electronic form on goods travelling within the EU hinterland. Maritime transport is excluded insofar as relevant maritime transport information is already covered by the EMSWe Regulation provisions. However, the eFTI Regulation is of high relevance as it will boost harmonisation and interoperability across the multimodal logistic chain of which SSS is part.

In addition, together with the EGD, one of the top priorities of the European Commission for 2019-2024 is creating a “Europe fit for the digital age”. When it comes to shipping, an increased focus is being put on looking into the use of automation. So far, the Commission is actively following the work being done by the IMO and has not initiated regulatory work at EU level on this issue.

Furthermore, the European Union, in the face of an increasingly challenging global environment, released in December 2020 a Cybersecurity Strategy<sup>59</sup>, setting out how it plans to shield its people, businesses and institutions from cyber threats. Alongside the Strategy, the Commission released two proposals for Directives which directly impact the maritime sector: the NIS 2.0 Directive<sup>60</sup> and the resilience of critical entities<sup>61</sup>. Both Directives essentially create cybersecurity requirements (such as applying minimum security elements, establishing a risk management plan or reporting on cybersecurity incidents) for businesses that are listed as “critical entities”, which includes transport “Inland, sea and coastal passenger and freight water transport companies, (...) not including the individual vessels operated by those companies”. These initiatives are expected to apply by 2024.

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<sup>57</sup> Regulation (EU) 2019/1239 of 20 June 2019 establishing a European Maritime Single Window environment and repealing Directive 2010/65/EU

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1239&from=EN>

<sup>58</sup> Regulation (EU) 2020/1056 of 15 July 2020 on electronic freight transport information

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R1056&from=EN>

<sup>59</sup> JOIN(2020) 18 final

<https://digital-strategy.ec.europa.eu/en/library/eus-cybersecurity-strategy-digital-decade-0>

<sup>60</sup> Proposal for a Directive on measures for a high common level of cybersecurity across the Union, repealing Directive (EU) 2016/1148

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2020:823:FIN>

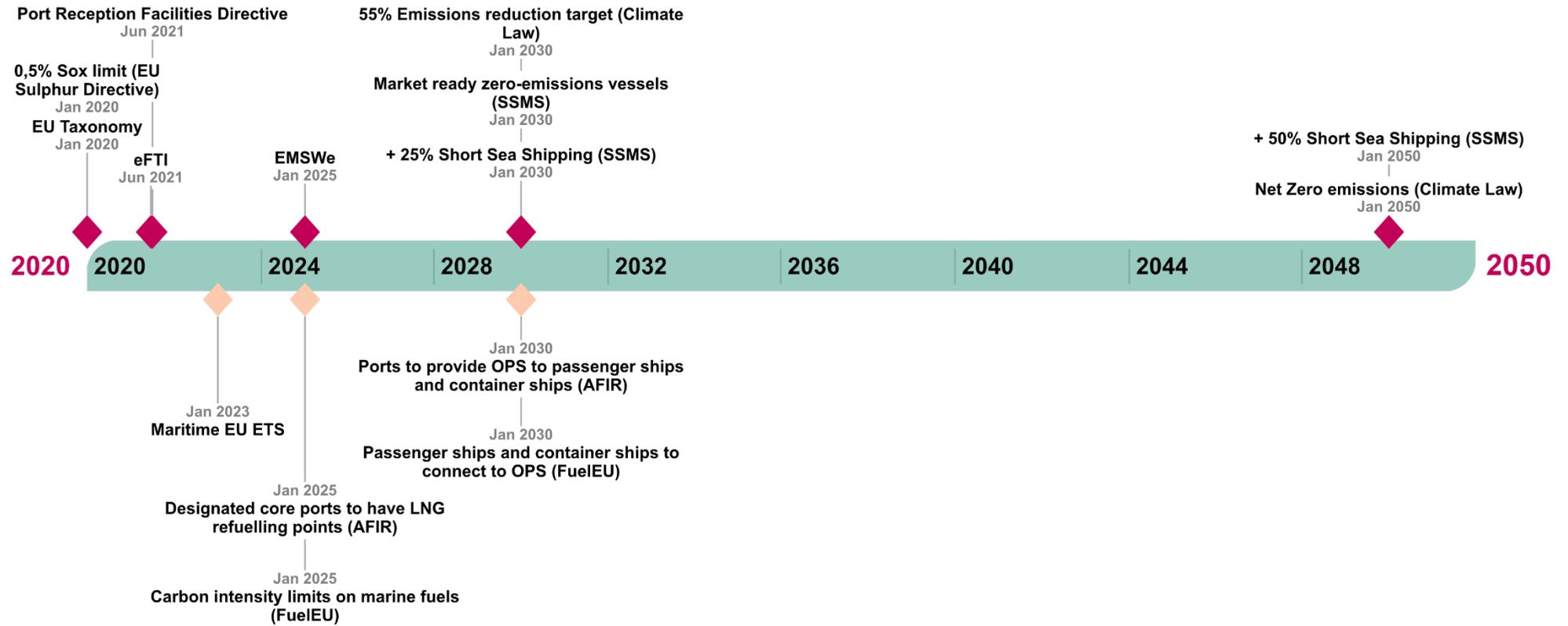
<sup>61</sup> Proposal for a Directive on the resilience of critical entities

[https://ec.europa.eu/home-affairs/system/files/2020-12/15122020\\_proposal\\_directive\\_resilience\\_critical\\_entities\\_com-2020-829\\_en.pdf](https://ec.europa.eu/home-affairs/system/files/2020-12/15122020_proposal_directive_resilience_critical_entities_com-2020-829_en.pdf)

To summarise and better visualise the various legislative drivers that will impact the investment needs of the maritime sector in the years to come, a timeline has been put together (Figure 9). Given the importance of some of the current – not yet adopted- proposals as regards decarbonisation and alternative fuels, these are also represented in the timeline (in orange). It is however important to bear in mind that the dates of application might be modified during the legislative process.

The dates indicated in the timeline correspond to the entry into force of the legislation in question.

Figure 9 Timeline of legislative drivers



Adopted legislation represented in red, to be adopted in orange

## 4 Towards a sustainable, smart, seamless and resilient European Maritime Space

The vision for SSS is to be a climate-neutral, clean transport mode that is seamlessly integrated in the European transport network. This cannot be reached by any segment of the industry alone, and all players must play their part (shipbuilders, ship owners, ports and logistics operators, class societies, etc.).

Ports in particular, play a major role in ensuring the adequate provision of high-quality port and hinterland infrastructure needed by the shipping sector. This includes the provision of alternative fuels and refuelling possibilities, shore-side electricity, digital infrastructure, waste management infrastructure as well as a qualified workforce for the port and the logistics sector. The full integration of SSS within logistics chains requires cooperation with the ports and beyond, e.g. with forwarders and cargo owners.

In some fields of action, targets for SSS are clearly set by the legislative drivers and megatrends (section 3). In other areas, the necessary or desirable change must be identified based on an analysis of market demand. By comparing the status quo with these targets, one can see where we stand today: i.e. the current "degree of adequacy" of European SSS and the gap that needs to be filled to reach the vision of a sustainable, smart, seamless and resilient European Maritime Space. This is what is being addressed in Chapter 4, taking in section 4.2 a sea basin approach.

Based on this analysis, Chapter 5 focuses on these gaps, identifying the total investment costs needed to move from the status quo towards the EMS vision. It does this by defining intermediate goals that can be considered as the adequate state at certain points in time (2025/2030/2050).

### 4.1 The European Maritime Space up until 2050: defining the adequate intermediate steps

In order to reach the long-term vision of an EMS that is sustainable, smart, seamless and resilient, a number of intermediate steps are needed. These current and future steps can be spelled out, and the adequate intermediate steps defined. Some of these intermediate steps are already clearly defined by the legislative drivers, while others need to be defined based on the existing legislation against the background of recent developments both within and outside the sector.

#### 4.1.1 Environmental stakes

As has been detailed in section 3, there is a general political consensus at international and European level that the transport sector – including the shipping sector – must increase its efforts to decrease its GHG emissions. This is also true at national level, with some Member States addressing shipping in their national plans to reduce emissions. Shifting transport from road to sea has long been considered as a means to decarbonise transport, and has a role to play in reducing other negative externalities such as congestion and traffic

collisions.<sup>62</sup> In order to promote such shifts, SSS must be made more attractive to shippers and forwarders. At the same time, it has to be more sustainable.

To work towards reaching the goals set by the IMO and at EU level, besides operational measures such as slow steaming or route optimisation, the focus ahead will naturally be on ship propulsion and ship efficiency (in terms of CO<sub>2</sub> equivalents per tonne-kilometre). These measures are the main factors affecting GHG emissions in maritime transport. As a first step, Regulation 2015/757 on the monitoring, reporting and verification (MRV) of carbon dioxide emissions from maritime transport<sup>63</sup> requires ship owners to monitor and report CO<sub>2</sub> emissions from larger vessels. To significantly reduce CO<sub>2</sub> emissions and the emissions of other GHG, the development of new propulsion techniques must be accelerated. Currently, it is not clear which type of zero-carbon fuels will be the best solution for large-scale long-distance shipping (e.g. hydrogen or hydrogen-based synthetic fuels, ammonia, biofuels, methanol, electricity or other).<sup>64</sup> However, **by 2030 the latest, zero-emission vessels must be commercially viable** and subsequently become the standard for new orders. This adequacy target is a direct consequence of the IMO target set for 2050<sup>65</sup>. To halve the emissions from shipping, a large share of the fleet must be close to carbon neutrality by then. More ambitious targets would need an even quicker uptake of zero-carbon fuels and vessels. In order to achieve strong CO<sub>2</sub> reductions, incentives for zero-emission vessels and disincentives for carbon-intensive propulsion would be needed.

Two lines of action must be pursued to reach this 2030 target. First, to achieve reductions quickly, existing technical and operational energy efficiency solutions like hull design optimisation, weather routing, etc. must be adopted on as many vessels as possible. Shipyards and owners must also make sure that new vessels' propulsion is compatible with the latest state-of-the-art technology in terms GHG reductions and air pollutants. The issue of methane slip from LNG engines is already being addressed in research,<sup>66</sup> but given the significant impact of methane, it should also be addressed by new regulations.<sup>67</sup>

Second, research and innovation on more environmentally friendly shipping must be intensified. As ships have an average lifetime of more than 20 years (some ship types even much longer), vessels built in 2025 will still be sailing in 2050. To reach more ambitious objectives beyond 2030, new concepts and innovations are hence needed quickly. There may be a dual strategy, with some alternative fuels being favoured for existing vessels (either with existing engines or cost-effective retrofitting solutions) and others being favoured for newbuildings.

An intermediate target, i.e. **the adequate state for 2030, would be to have at least 10% of intra-European shipping services using more environmentally friendly fuel types**, other than Heavy Fuel Oil (HFO) or Diesel.<sup>68</sup> By 2035, all newbuildings should

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<sup>62</sup> COM(2011)144 final  
<https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:en:PDF>

<sup>63</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R0757&from=EN>

<sup>64</sup> Only fuels that are climate neutral also during the production process should be considered

<sup>65</sup> "Peak GHG emissions from international shipping as soon as possible and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008"

<sup>66</sup> E.g. MariGreen project "Methane catalyst for LNG engines"

<sup>67</sup> Methane and other greenhouse gases are not covered by the current MRV Regulation

<sup>68</sup> Many dual-fuel engines actually still use MDO

be using zero- or low-carbon non-fossil fuels. As regards research and innovation, a **carbon-free pilot vessel of medium or large size adapted to intra-European shipping (several hundred nautical miles) should be ready within four to five years**, also addressing the issue of bunker availability at the large scale needed for shipping. In order to guarantee a level playing field, there should be uniform incentives across EU ports applying to all vessels calling there ports, hence independently of the flag or owner country. As transshipment traffic may evade EU ports to avoid stricter regulation, a coordinated approach with neighbouring countries – particularly in the Mediterranean and the English Channel – should be envisaged.

The ports must enable these changes, e.g. by providing bunkering facilities for alternative fuels or charging facilities with low-carbon electricity, in order to facilitate the move towards alternative propulsion techniques as described previously. Ports and terminal operators shall of course also contribute directly by continuing to focus on energy efficiency and low-carbon terminal equipment despite their rather limited share in the total transport chain's emissions.

As previously mentioned, specific targets have already been set in law for the provision of an appropriate number of refuelling points for LNG at maritime ports to cover core network ports by 2025, and comprehensive network ports by 2030<sup>69</sup>. This does not mean that the "adequate state" requires all these ports to have an LNG terminal. It is possible to serve several ports in a range from the same LNG terminal, using a fleet of LNG bunkering vessels to serve nearby ports. The key condition set in the rules is to "enable navigation of LNG vessels throughout the core network". With the evolution of non-fossil propulsion technologies, a similar regulation may be necessary in the future for new alternative fuels as ship operators can only invest in alternative ship propulsion if they are sure that the fuel is available where it is needed. Such rules have not been proposed as part of the revision of the current rules.

Waste reception is another essential environmental issue that needs to be addressed by ports. As previously detailed, Directive (EU) 2019/883 on port reception facilities (PRF) for the delivery of waste from ships<sup>70</sup> defines criteria for an adequate state for PRF in Europe. The previous Directive on PRF (2010) acknowledged the fact that not all waste categories are relevant for all ports. PRF shall be "adequate to meet the needs of the ships normally using the port" so a port-by-port analysis of traffic structures is necessary to clearly identify the needs in each port based on the analysis of the concerned ship traffic and other relevant influencing factors.

Local air emissions, which are generally of less relevance for global climate change, but very important for the health of the population in the port vicinity, are also an important issue to highlight. This is particularly important for the so-called "city ports" which are situated in densely populated areas. EU-wide legislation has started to address port air emissions through rules on the Sulphur content of marine fuels and OPS, and the sector should be aware of the high importance of local pollutants with regard to the acceptance and hence the sustainability of port activities.

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<sup>69</sup> According to Directive 2014/94/EU on the deployment of alternative fuel infrastructure (currently being revised)

<sup>70</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019L0883&from=EN>

According to current EU rules<sup>71</sup>, OPS shall be available in all core network ports and other ports by 2025 if costs can be justified by potential demand. A port-by-port analysis is hence necessary to identify the actual needs and define the adequate state. So far this has led to limited deployment of OPS in EU ports<sup>72</sup> due to a lack of demand in the shipping sector. Under the proposal to revise the current rules, it is suggested that by 2030, TEN-T ports are equipped to provide OPS to 90% of port calls by passenger ships (including passenger ferries and cruise vessels) and containerships, that will be required to connect while at berth as of 2030 (according to proposed AFIR and FuelEU Maritime Regulation which are being negotiated at the time of publication of the DIP). In the long term, other means can be used to reach the same goal – namely a reduction of noise and air emissions – e.g. fuel cells on the ships. But even then, connecting vessels directly to power grids will most likely be more energy-efficient than the use of, e.g., synthetic fuels as their production and use involves high energy losses.

With regard to reducing air and noise emissions, immediate priority should be given to OPS installations in terminals in densely populated areas with a significant amount of ship calls of at least two hours wherever feasible.<sup>73</sup>

A second local issue is land use. Cities are growing and land is becoming scarce and expensive in the cities. The reconversion of previous port areas into residential or commercial areas can be observed in many cities. The increased competition for land makes efficient land use paramount in urban areas. In the future, port authorities and terminal operators should prioritise possibilities to increase the land efficiency of ports and terminals (e.g. cargo handled per hectare, differentiated by cargo type) before developing new terminal areas. In order to limit environmental impacts related to the construction of new terminals, it is proposed here that **by 2030, ports planning new terminals should strive to reach at least the current industry standard** (e.g. 8<sup>th</sup> decile) of the existing terminals for the same kind of cargo (unless particular circumstances limit terminal efficiency). At the same time, in order to improve the ports' own environmental performance, fossil-fuelled terminal equipment should be phased out in the long run.

Finally, apart from the ports' role as nodes in maritime transport chains, ports also play an important role for facilitating the construction and maintenance of offshore wind farms. To enable the planned expansion of offshore wind energy production, capacities for handling wind turbines and bases for maintenance operations must be provided in maritime ports close to existing and planned wind farms.

#### 4.1.2 Integration of maritime transport in the logistics chain

Maritime transport is virtually always part of a multimodal transport chain. Maritime transport is the most cost-effective transport mode for large volumes of cargo, but cargo can be transported only between ports or other places with sea-side cargo handling facilities (e.g. industries with own quay walls and cargo-handling equipment). Hence, the attractiveness and competitiveness of maritime transport chains heavily depends on the **efficient integration of maritime and hinterland transport**.

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<sup>71</sup> Directive 2014/94/EU on the deployment of alternative fuel infrastructure (being revised at the time of writing this DIP)

<sup>72</sup> <https://www.eafo.eu/shipping-transport/port-infrastructure/ops/data>

<sup>73</sup> Most cargo terminals have a mix of ships from different parts of the world, so standardisation issues prevail.

European ports are at the crossroad of the logistics supply chain, bringing together all modes of transport. They do not only include maritime infrastructure components, but also transport infrastructure such as roads, bridges, tunnels, junctions, parking areas, freight terminals and logistic platforms, railway tracks, sidings and marshalling yards. In addition, European ports are often also hubs of energy production, import, storage and distribution, serving energy-intensive industries in the port vicinity or in the hinterland. In the past, handling and storage of fossil fuels was concentrated in and around seaports. In the future, they will most likely also be hubs in the handling, storage and distribution of green fuels. Finally, ports are also increasingly transforming into digital hubs at the service of the entire transport and logistic chain, e.g. via port community systems and other trade facilitation mechanisms.

A prerequisite for this integration is the physical infrastructure in the ports, including sea terminals, intermodal facilities, and the connections with the hinterland network. The terminals must provide enough capacity to assure the loading operations between seagoing vessels and the different hinterland modes in line with demand. Both intra-European short sea container traffic and ro-ro traffic did not grow at the same pace as container deep-sea traffic during recent years, so the need for capacity expansion is rather limited. However, there has been considerable demand-based growth in some sea basins such as Black Sea and Eastern Mediterranean, indicating a possible need for additional handling capacities (see 2.5). But there are also quite dynamic port ranges in other sea basins, e.g. Poland/Lithuania in the Baltic Sea.

The rail, road, inland waterway and pipeline connections must assure the smooth transfer of volumes between the ports and the hinterland transport network. As this is a demand-side indicator, the adequate state can only be defined on a case-by-case basis. Each seaport knows the gaps and bottlenecks in its respective hinterland quite well. A particular challenge for future investments is a neutral, demand-based identification of the most urgent bottlenecks concerning port-hinterland infrastructure. As a first step, indicators like traffic density per rail track, road lane, quay metre or per hectare of terminal area could be collected and compared as a basis for benchmarking and best practices. These will show the possible productivities with existing technology. Ports that are far below these benchmarks will have to identify the reasons for the lower productivity and – if possible – solve them. Only beyond these thresholds, there is a need to invest in new terminal areas and/or quay walls.

The hinterland network must provide the necessary capacity for transport between the ports and importers or exporters. The necessary capacity depends, of course, on the size of the port that needs to be connected. Here again, the planning must be done port by port and region by region. The CNC ports' adequate hinterland connections are essential for the functioning of the TEN-T as a whole. This includes links to the extended gateways and on intermodal terminals in the hinterland. Links with the comprehensive network and its ports should be improved according to demand, too. This will also improve the resilience of the TEN-T (see 4.1.4).

#### 4.1.3 Streamlining and digitalising procedures

Besides the physical infrastructure, smart administrative procedures are important for the competitiveness of maritime logistics chains. A disadvantage of SSS vis-à-vis land transport is the requirement to do customs declarations for non-regular routes. The number of players involved in the transport of cargo – each with specific data needs – is also much higher. For road transport, the cargo is in the same hands from door to door. Maritime transport involves at least one shipping company, two terminals and two hinterland transports.

Maritime single windows are a first step to simplify the procedures for maritime transport, but other players should be connected to these systems (e.g. via port community systems, if existing) in order to avoid unnecessary duplication of data. The European Maritime Single Window environment (EMSWe) as a one-stop-shop for all transport-related reporting formalities for ships should be ready and implemented by 2025 the latest. In addition, the new Regulation (EU) 2020/1056 on electronic freight transport information (eFTI) aims to ensure data interoperability with the EMSWe environment to facilitate re-use and cargo information exchange along the entire logistics chain within the hinterland<sup>74</sup>. An adequate state at port level could be seen in setting up different kind of systems (Terminal Operating Systems, Port Community Systems or Port Single Windows), interoperable with the EMSWe, the National Customs Single Windows and the related architecture as well as with the eFTI systems. This interoperability, that should be reached in all the core and comprehensive ports in 2030 should be based on the federated systems approach (conceived within the Digital Transport and Logistic Forum<sup>75</sup>), including the integration with other maritime and land intelligent transport systems and considering the undergoing work of projects such as Fenix and Federated.

Digitalised solutions to streamline the port call process should be supported, where the information exchange is still to a large extent analogue. Increased real-time information sharing also improves the conditions for more optimised port calls and a more effective traffic management at sea, which then improves the conditions for reduced emissions and climate impact.

#### 4.1.4 Resilience of maritime transport chains

Given the importance of maritime transport for the European economy, disruptions of maritime transport chains can have severe impacts leading to shortages of industrial and consumer products.

A number of events in the recent past have demonstrated the importance of resilience of maritime transport chains. In early 2020, the outbreak of the COVID-19 pandemic led to a sudden standstill of port activities in China. Even though traffic resumed quickly, considerable delivery delays were caused in Europe. However, given the long travel times and related stock-keeping, the delays did not lead to large-scale production disruptions. Still, many industries and trading firms experienced the limits of their stocks and urgently required replenishment. By the fourth quarter of 2020, container traffic was already above the pre-pandemic levels in most European ports. Volumes continued to grow in 2021 and reached new all-time highs.<sup>76</sup>

In March 2021, another event showed the importance of resilient maritime transport chains. The 20,000 TEU vessel "Ever Given" grounded in the Suez Canal and blocked it for almost a week. Virtually all traffic between Asia and Europe passes through the Canal, so the impact was even stronger than the temporary shutdown of Chinese ports. Some ship operators decided to take the route around Africa to limit the impact.

Both events have put the dependence of Europe on imports from Asia in many segments – including medical products – on the political agenda. Initiatives to change production patterns in critical industries have been launched. In the short term, however, due to the

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<sup>74</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R1056&from=EN>

<sup>75</sup> <https://www.dtlf.eu/>

<sup>76</sup> See ISL Monthly Container Port Monitor, 4/2021

strong interdependence between Europe and other continents, only the resilience of maritime transport chains can secure the supply of goods and prevent production disruptions. This does not only concern deep-sea traffic, but also European short sea traffic.

The seaports play a crucial role for the entire European logistics and production chains. Often, due to a lack of spare capacity (or overcapacity, as some may say), many logistics chains cannot be re-routed via other ports, especially not overnight. If a seaport, its sea approach or hinterland connection is blocked for a few days, this can create serious disturbances in industrial production. Therefore, the resilience of transport chains must be checked (e.g. using simulations with digital twins) and event management plans for emergencies must be developed, e.g. a quick re-routing of vessels and related hinterland traffic if a certain port is blocked. Here again, the characteristics of different ports must be taken into account. In some regions, shippers and importers can choose between several core network ports and the re-routing of cargo is – in principle – possible. The extent to which a re-routing is possible merely depends on the available capacity of ports, terminals and their hinterland connections. By contrast, the supply of islands or peripheral regions sometimes relies on a single port, making resilience of that port a prime issue. It is therefore proposed here that **a resilience plan for all core ports and their hinterland network should be developed by 2030**, possibly involving cooperation agreements between ports or Member States representing also the other actors along the concerned supply chains. **For comprehensive ports, a resilience check is proposed**, including the impact of disruptions on the local population and industry. For future pandemics, quarantine plans for all ports should be included. Selected cruise ports around Europe should also have the capacity to provide quarantine accommodation for passengers and crew of large cruise vessels.

## 4.2 Current gaps in the European Sea Basins

As the analysis has shown so far, the needs of ports depend very much on the volume of both cargo and ship traffic, and its structure. OPS, for example, brings particularly high effects on cruise vessels and on container ships, especially if there is a high number of active reefer containers on-board. In ferry ports, with very high frequencies and short berthing times, other technical solutions (e.g. using batteries while at berth) may actually be easier to implement. In general, OPS and other means to reduce local air and noise emissions have the highest impact in densely populated areas and should be an immediate priority there.

The quest for alternative ship propulsion techniques and fuel types is ongoing. Both port and ship operators are currently hesitating to invest until it becomes clearer which engines and fuels will be tomorrow's solution for maritime transport. The investment volume also depends on the fuel types (liquid or gaseous, under pressure or not, with or without cooling, etc.). Some alternative fuels also present the potential advantage of being able to transit on already existing networks, facilitating their deployment. Others require completely new infrastructure. Any assessment of the investment needs regarding future fuels can hence only be preliminary.

The need for additional terminal capacity dedicated to short sea traffic is limited, as growth of maritime traffic was driven by deep-sea traffic during the past decades. However, some regions have seen a considerable expansion of short sea traffic volumes so that there may be a need for capacity expansion. In particular, the Black Sea (+ 4.4% per year on average between 2008 and 2019) and the Eastern Mediterranean (+ 2.0%) are way above the cargo volumes reached before the financial crisis. Apart from the aforementioned basins, there may be a need for additional capacity in certain port ranges with above-average growth and related capacity shortages.

Table 8 Total short sea cargo traffic increase/decrease in core network corridor ports, 2010-2019 and 2019-2020

Basin	(Average) annual growth/decrease			
	Short sea cargo traffic		Total passenger traffic	
	2008-2019	2019-2020	2008-2019	2019-2020
Baltic Sea	+1.0%	-7.8%	+1.1%	...
North Sea	+0.9%	-16.3%	-0.3%	...
Atlantic	+1.6%	-11.2%	+0.5%	...
Western Mediterranean	+1.1%	-20.5%	+1.4%	...
Eastern Mediterranean	+2.0%	-13.8%	+0.7%	...
Black Sea	+4.4%	-9.6%	-12.1%	...

Note: TEN-T ports including UK

Source: ISL based on Eurostat

In some cases – such as the development towards a European Maritime Single Window or the development of new ship propulsion technologies – adequacy can only be defined for the European port landscape as a whole. These pan-European gaps are addressed at the end of this chapter.

#### 4.2.1 Baltic Sea

The Baltic Sea has been at the forefront of technological innovation for environmentally friendly shipping. One driver was probably that it was the first SECA area worldwide. LNG propulsion was identified as one possibility to reduce the sulphur content, and other options like electric ferries are being explored. For instance, electric ferries are already in use on the Helsingør-Helsingborg connection. In addition to this, hybrid-ferries have also been developed, for instance on the Fehmarn Belt between Denmark and Germany.

As it is not clear which fuel types will prevail, the **infrastructure for alternative non-fossil fuels** still has to be developed. For the transitional period, there are LNG bunkering possibilities in all major coastal areas and further LNG terminals are planned. The onward distribution from the existing terminals is done by seagoing LNG bunker vessels that can serve ports in the respective neighbouring areas. This concept – and also the infrastructure – can possibly be used for future non-fossil fuels.

**OPS**, on the other hand, relies mostly on fixed installations that can only be used in one port. A number of ports in the Baltic Sea have already introduced OPS solutions or are planning to do so.<sup>77</sup> These systems are particularly advantageous for cruise ships (long berthing times, very high energy consumption), large container ships (very long berthing times, high energy consumption) and ro-pax vessels (medium berthing times, medium energy consumption). Dry bulk carriers, in contrast, benefit much less. The development of OPS in cruise ports situated close to city centres is well under way in the Baltic Sea.

There are six major cruise ports in the Baltic Sea, all of which are core network ports, with the exception of Kiel: Rostock-Warnemünde, Kiel, Copenhagen, Stockholm, Lübeck-Travemünde and Tallinn. Almost all cruise terminals that are located close to city centres are equipped with OPS already. For ro-ro ships, the case for OPS is less clear. They do not stay very long in one port, so they benefit less. However, the same ships call regularly in

<sup>77</sup> Partly financed by CEF funds, e.g. project "Onshore Power in Baltic Seaports"

the same ports, so the issue of standardisation is comparatively easy to handle. Several ro-ro ports in the Baltic Sea have already installed OPS.

The issue of **local pollution** has been addressed in various ways in the Baltic Sea basin, e.g. by using OPS systems (see preceding paragraphs on OPS) or environmentally friendly terminal equipment such as autonomous electric terminal tractors. Another way of reducing the impact of port operations is to move operations away from the city centres to other port areas, giving space to new housing and moving polluting activities (also caused by hinterland transport) out of the city centre. The ports of Malmö and Riga for example, have moved cargo operations away from the city centres to new locations outside the cities.

Though there was a strong growth of container traffic during the past decade in the Baltic Sea, this growth did not come unexpectedly and there is still spare **terminal capacity**. Capacity expansion plans are under way in many ports – both increasing the efficiency of existing terminals and constructing new terminals. However, it must be noted that the volume and growth is mostly related to feeder traffic to/from North Range ports and deep-sea direct calls in the Baltic Sea rather than intra-European short sea trade. Ro-ro traffic reached new record highs two years in a row in the Baltic Sea's core and comprehensive ports in 2017 and 2018, but volumes were only 3% higher overall in 2018 than they were in 2007.<sup>78</sup> In 2019 and – due to the COVID-19 pandemic – in 2020, volumes declined. After the Russian invasion of Ukraine in February 2022, it is likely that transit traffic to and from Russia will continue to be subdued in the long term. Hence, there is no widespread need for additional terminal capacity, even though there may be single ports facing capacity limits.

As regards the **rail connection** and onward transport, it has to be noted that a large part of rail traffic in EU ports in the Gulf of Finland and Latvia is transit traffic. While in all other EU coastal areas, the bulk of hinterland traffic stays in the country or goes to other EU countries, a large share of hinterland traffic in these ports as well as some Lithuanian and Polish ports has origin or destination in Russia, Belarus and Ukraine. In order to optimise these transport chains, EU standards promoted on the CNCs, such as track gauge or minimum train length, cannot be introduced easily. Instead, the cooperation with the neighbouring states is necessary to define standards and make these transports as efficient as possible.

The density of the network of maritime ro-ro services is very high in the southern part of the Baltic Sea (see Figure 4), which means that the discontinuation of a specific service or the temporary closure of a port leaves shippers and forwarders with alternatives. Many operators can offer alternative lines, e.g. for traffic between Germany/Poland and Sweden. Therefore, the conditions for a **resilient maritime transport system** are favourable. The Gulf of Bothnia, by contrast, has a rather low density of ports and maritime services and ice-breaking is needed during wintertime. Therefore, assessing the resilience of maritime transport in the Gulf of Bothnia and in the Gulf of Finland in different scenarios seems advisable. The **reliability of ice-breaking** must be assessed and assured while at the same time, analysing alternative (possibly land-based) routings in certain scenarios may be part of future resilience plans.

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<sup>78</sup> For comparison: container traffic exceeded 2007 volumes by 74% in 2018.

## 4.2.2 North Sea

The North Sea is among the busiest shipping regions in the world, particularly the English Channel and off the coasts of France, Belgium, the Netherlands and Germany. Due to the high volumes, traffic density and population density, environmental issues are of particular importance. For a transitional period, there are various functioning **LNG terminals** in the area covering all major shipping areas except the German Bight.<sup>79</sup> This gap could be closed with the planned terminals in Brunsbüttel or Stade.

The development of **OPS installations** in the North Sea is quite advanced compared to other sea basins. Five major container ports (Rotterdam, Antwerp, Hamburg, Bremen/Bremerhaven and Haropa) have agreed to make OPS available to all Ultra Large Container Vessels (ULCV) in the ports by 2028. Furthermore, the issue of acceptance by the vessel operators is under discussion. In Germany, measures to reduce the tax burden for OPS have been taken to narrow the price differences between diesel and shore-side electricity, the latter still being more expensive. Port investment costs and demand for shore-side electricity in terms of vessels with plug-in are further obstacles that also need to be addressed in other sea basins.

The ports in the North Sea have quite diverging structures. Some are close to city centres and hence particularly keen on reducing **local emissions**. In order to increase acceptance, various measures have been introduced to reduce such emissions. This includes the use of more silent terminal equipment or electric yard equipment to reduce local air emissions. In addition to the impact of port operations, local administrations also target hinterland transport.

Similar to the Baltic Sea, container traffic in the North Sea is mainly related to deep-sea traffic and the related feeder traffic. Before the financial crisis of 2008-2009, many ports initiated **terminal capacity** expansion plans and a new container port was built in Wilhelmshaven to cope with expected capacity issues (which did not materialise). Therefore, there is currently still considerable free container terminal handling capacity and no need for further capacity expansion.<sup>80</sup> Even after Brexit, ro-ro traffic concentrates on traffic between the UK and ports on the European mainland. Trade is likely to be negatively affected by Brexit in the long term so a need for further terminal capacity is unlikely. Transit traffic to and from Ireland will also be affected. The cross-Channel traffic and the level playing field between EU and UK ports will be an issue during the next years, particularly in the case of transshipment traffic as it can be handled on both sides of the Channel. In the meantime, the capacity and frequency of direct services between the continent and Ireland has been strengthened considerably.

As regards the **rail connection** of ports and terminals, standards are very good in the North range ports and in container ports around the North Sea where integrated rail terminals exist. Intermodal traffic has a considerable share (between 25% and 60%) in the major container ports with larger hinterland outreach. When interpreting these figures, it is again important to consider the differences between ports. Ports with a high volume of local traffic (e.g. Antwerp or Hamburg) will naturally have more truck traffic than ports focusing on long-distance traffic such as Bremerhaven or Koper. In ro-ro terminals, the situation is different. Some terminals do not have a direct rail connection and the majority

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<sup>79</sup> Current plans for new terminals are focused on energy imports, but bunkering facilities have been included in plans for terminals in Brunsbüttel and Stade.

<sup>80</sup> However, additional areas may be needed for customs clearance in some ports.

of hinterland traffic is road traffic with rail traffic concentrating on longer distances (e.g. North Sea-Italy). Compared with container traffic, there is thus a higher shift potential from road to rail on medium distances. Concepts for trailers that are not suitable for craning are increasingly popular in this context.

Most ports in the Hamburg-Le Havre range also have a well-developed **barge connection**. The most urgent issues are in the hinterland, i.e. guaranteeing the necessary water depth for inland navigation. For container traffic, bridge heights in the hinterland are an issue as many of the canals have originally been built for dry bulk and liquid bulk transport.

### 4.2.3 Atlantic

Except in the Irish Sea, the Atlantic Sea basin is characterised by long sailing distances – even for SSS – and ports generally have a high share of deep-sea shipping. No Emissions Control Area (ECA) was established or even discussed so far. These factors explain the modest progress for the use of alternative fuels in the area.

The landside infrastructure for **LNG provision** is rather well developed. There are various LNG terminals along the French, Spanish and Portuguese Atlantic coasts, so this part of the Atlantic basin is well covered for the transitional period to non-fossil fuels. LNG bunkering is limited to the ports with LNG terminals. This seems appropriate for the aforementioned coastal areas because vessels can include additional bunkering stops on long distances. The Irish Sea, by contrast, is not yet covered, even though there are many regular short sea ro-ro services within the area – a good basis for potential future demand. Due to the high number of relevant ports on both sides of the Irish Sea and the short distances, mobile LNG bunkering facilities (e.g. a seagoing bunkering vessel) combined with a larger-scale LNG terminal seem to be the best option for providing LNG.

There has also been increasing pressure in the Atlantic area to reduce **emissions in ports** – particularly with regard to cruise vessels. The use of **OPS** will be required from cruise vessels in an increasing number of ports because of their impact on local air quality in port cities.

A similar future-related development can be observed in the Spanish ports. An OPS Master Plan for the supply of onshore power to ships at berth in Spain was developed, preparing the ground for 20 future OPS facilities in Spain. The OPS Master Plan is co-funded by the Connecting Europe Facility (CEF).<sup>81</sup> Within the project, pilot cases with OPS installations were also provided in Santa Cruz de Tenerife, Las Palmas and Palma de Mallorca.

Container traffic grew strongly in the area during recent years, but this was mostly due to deep-sea traffic. Ro-ro traffic mainly concentrates on the Irish Sea as Ireland is connected to the European continent in large part via the UK. Brexit gave new impetus to direct services between Ireland and the continent as transit traffic has become more complicated due to customs procedures. Due to the longer sea distances, part of the current truck and trailer ferry traffic could shift to container traffic and new container **terminal capacities** may be needed. For ro-ro traffic, short sea distances are preferred so the southern Irish ports – which saw their ro-ro traffic with the continent double – could need capacity expansions. Traffic between the UK and the port of Dublin, by contrast, decreased due to the shift of traffic.

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<sup>81</sup> <https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/2015-eu-tm-0417-s>

As shown in 2.3, the ports in the Atlantic are of medium size, making it relatively difficult to reach the critical volume for **rail services**. Also, their hinterland is less populated and has less industries than the hinterland of the North Sea basin. Despite these demand-side limitations and some infrastructure limitations, rail services are well developed, and some ports are integrated in the rail freight corridors. Even the port of Dublin has developed regular rail connections despite the fact that all potential destinations are within a radius of 300 km.<sup>82</sup> **Barge traffic** is only available in a few Atlantic ports and on shorter distances.

#### 4.2.4 Western Mediterranean Sea

The Western Mediterranean has many ro-ro services with medium to long distances and few international short-distance services. The shortest routes are between southern Spain and Morocco. Discussions on an ECA are advancing well and market players have started to prepare for such plans.

The major ports in the Western Mediterranean either have their own **LNG terminals** or are within the reach of a neighbouring port's terminal so the transitional period to non-fossil fuels is well covered. Likely due to the crucial role of cruise shipping for many ports in the Western Mediterranean, **OPS** has become already an essential technology for reducing local air emissions from the shipping sector. Just like in the North Sea and Baltic Sea, there are several implemented OPS installations in the Western Mediterranean, but coverage is much lower than in the Baltic Sea. The Spanish OPS Master Plan (see 4.2.3) also covers Spanish ports in the Western Mediterranean. The plans are in line with the goal to implement OPS solutions in the CNC ports by the end of 2025.

The Western Mediterranean is an attractive market for transshipment traffic and for deep-sea traffic in general. Short sea trade in the area is mostly ro-ro traffic between the EU and North Africa. This traffic grew strongly before and after the financial crisis 2008-2009, but it is stagnating since around 2011 due to political instability in North African countries. In the long term, economists see a growth potential in the region when the political situation stabilises, so additional **terminal capacities** for ro-ro traffic may be needed in the more distant future, also in the Adriatic Sea where various services connect Italy to Western Balkan countries.

**Rail connections** are particularly important for ports serving a wider hinterland, i.e. the Spanish, French and northern Italian CNC ports. All these ports are connected to the network and most have regular rail services. Due to their geography, some ports (e.g. on islands like Malta or Sicily) do not have a need for rail connection because their hinterland traffic concentrates on a rather small area. Other ports would benefit from an upgrade of the rail infrastructure for extra-regional traffic.

For inland waterway transport, the most important **barge connections** are Rhone and Saône between Marseille and Lyon and onwards which already have regular container lines and are well connected to the main container terminals in Fos-sur-Mer.

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<sup>82</sup> The cost advantage of rail services compared with road haulage increases with distance so the average distance of such services in continental Europe is much longer.

#### 4.2.5 Eastern Mediterranean and Black Sea

While there are advanced discussions about an Emission Control Area (ECA) in the Mediterranean, the Black Sea is for the time only alluded to in these discussions. Therefore, while ports and ship operators are preparing for a Mediterranean ECA, there is no activity yet in the Black Sea.

This is also reflected in the **LNG terminal** coverage. There are installations in the Northern Adriatic and plans for installations in Southern Adriatic and in Greece, but no advanced plans in the Black Sea. Due to the lower traffic density and a high share of bulk traffic (i.e. irregular calls of different ships that make investments in LNG propulsion less likely), it is a challenge to develop a sufficient LNG demand in the region to justify the construction of a new LNG terminal. A solution involving LNG bunkering vessels to/from Marmara (Turkey) or Yuzhnyi (Ukraine) seems to be a more efficient solution, if needed.

The provision of **OPS systems** in the Eastern Mediterranean is still underdeveloped, despite the impacts from vessels berthing in ports on local air quality (particularly cruise ships) being widely acknowledged. The problems to be tackled in the other EU sea basins, i.e. high investment costs for ports in OPS infrastructures including the sometimes necessary power grid upgrade, the low number of vessels geared with technical equipment for using OPS and the price drawbacks for shore-side electricity are also essential obstacles in the Eastern Mediterranean and Black Sea.

In the Eastern Mediterranean and Black Sea ports, the infrastructure for **rail traffic** exists in most ports. The most intensive use of rail traffic is made in the Northern Adriatic ports as they serve a wider hinterland including Austria, Slovakia and Hungary. The port of Constanta has both rail and **inland waterway** traffic as it is connected to the Danube River by a canal. The Bulgarian Black Sea ports rely solely on truck and rail. Most Greek ports – even those situated on the mainland – currently do not have sufficient demand for rail hinterland services. A notable exception are regular container rail services of the port of Piraeus serving Western Balkan countries, Hungary, the Czech Republic and Austria. Thessaloniki is also well situated for rail services to North Macedonia, Serbia and Western Bulgaria.

The need of **additional terminal capacity** for SSS could become particularly important for the Eastern Mediterranean and Black Sea as the area faces the strongest growth of cargo traffic among all European regions.

#### 4.2.6 Pan-European gaps

The most obvious pan-European gap is the way towards the **European Maritime Single Window** and the EU-wide acceptance of **Electronic Transport Documents**. By 2018, only two Member States had put in place regulations and pilot projects to accept Electronic Transport Documents and the EU-wide use was close to zero. This contrasts with more than half of the 21 Member States having similar regulations in place for air transport where the use was already widespread (around 40%). Maritime transport ought to make efforts to catch up because road transport has much lower administrative burdens.

While the issue of **PRF** is covered by Directive 2019/883/EU, the adequacy of these facilities is mostly a question of demand. As the Directive itself notes, the demand for reception facilities depends very much on the ship types calling in a port. For example, cruise ships have a strong demand due to the high number of persons staying on the ships, and tankers have particular demands for residuals from tank cleaning.

The development of alternative **ship fuels and propulsion technology** towards less polluting ones is a European and even a global issue. The search for the least-polluting economically viable alternatives is ongoing. This search must also take into consideration

a “well-to-propeller” approach, i.e. the polluting effects from the energy source to the ship’s propeller. While electric vessels are emission-free in a “tank-to-propeller” approach and certainly good for the local environment, the actual impact on global climate change depends on the way the energy is produced. In addition, due to the low energy density of today’s battery packs, they are not an option for long-distance transport yet. The quest is hence open and, in addition to drop-in fuels that can be used in existing vessels and infrastructure (such as bio- or e-fuels and gases), it currently includes exploring new alternatives such as ammonia or hydrogen. The production of hydrogen or hydrogen-based fuels involves high energy losses and demand for green hydrogen will be much higher than supply for at least a decade or two.

**Outermost regions’** ports are the main entrance for freight on these territories. Regional cooperation is a way of development in the strategy of the European Commission for the outermost regions. Maritime links with close third countries (in America or West Africa for outermost regions of Atlantic Ocean or in East Africa, Asia or Australia for outermost regions of Indian Ocean) should be encouraged where links to the European mainland are not feasible.

## 5 Investment needs

To reach an “adequate” sustainable flow of goods (and data) along maritime transport chains, certain investments will be needed in the physical and digital infrastructure of ports, the hinterland and the fleet. Cranes and other terminal equipment only play a minor role with regard to CO<sub>2</sub> emissions, but it is an important source of local air and noise pollution. To combat global climate change, the focus must be on transport means (e.g. vessels) and the necessary infrastructure (e.g. provision of alternative fuels).

The investment needs faced by the sector in its transition towards an adequate state can be estimated by looking at existing gaps (section 4), the number of projects needed to fill these gaps and the average cost (in 2021 prices) for each project. The number of necessary projects is estimated based on the definition of the adequate state (section 4) and a detailed assessment of the status quo in the respective areas. If not stated otherwise, the cost per project has been estimated based on an analysis of past projects (both from CNCs, past MoS programme and private investments).

The port infrastructure analysis focuses on SSS, which is why issues like dredging or construction of new large-scale container terminals play a minor role, although they are, of course, important for many of the major ports, particularly those engaged in Far East container traffic.<sup>83</sup> A review of past port investment projects revealed that few investments in the construction of new terminals were related to demand in the short sea sector.<sup>84</sup>

The hinterland infrastructure (intermodal terminals and hinterland connections) is shared by short sea and deep-sea traffic. Short sea and deep-sea containers often share the same train or barge. Due to this high integration, it is not possible to distinguish between “short sea” and “deep-sea” investments here, which is why they are fully included in the assessment.

A similar approach is taken towards investment needs in the European short sea fleet. While research on new fuel types and ship propulsion is fully taken into account because it benefits both deep-sea and SSS, investments in vessels (e.g. reconversion of existing vessels) are only taken into account where they are necessary for European SSS. Finally, the digital infrastructure and dual use facilities are shared domains and fully considered.

The needs are estimated independently of the potential financing tools. In other words, the investment needs below are not matched with a potential eligibility or non-eligibility under the Connecting Europe Facility (CEF) or other funding means. The needs thus address all funding and financing instruments, including investments by the private sector.

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<sup>83</sup> [https://www.espo.be/media/Port%20Investment%20Study%202018\\_FINAL\\_1.pdf](https://www.espo.be/media/Port%20Investment%20Study%202018_FINAL_1.pdf)

<sup>84</sup> The analysis was based on port development plans and port websites and hence includes projects independently of their co-funding by the EU.

## 5.1 Port investment needs including sea-side and land-side infrastructure and superstructure

As it has been noted in a ship operator survey conducted in 2017,<sup>85</sup> the sea approach (draught and maximum ship size) is not a major issue for SSS.<sup>86</sup> There are, however, capacity issues for developing rail and barge services. The necessary infrastructure needs to be upgraded in line with demand. Though barges can be handled at the same quays as seagoing vessels, the latter always have priority. When capacity is scarce, barges can face severe issues and delays, which is why the port of Antwerp has recently urged the major container terminals in the port to provide separate barge facilities at each terminal. In general, it is estimated that there is currently a limited need to build **new sea terminals** for intra-European shipping beyond the ones that are already planned or under construction.<sup>87</sup> In fact, out of the 292 TEN-T seaports, only 62 ports handled higher short-sea volumes in 2018 or 2019 than in the period 2006-2017 so the majority of ports did have spare capacity even before the COVID-19 pandemic. During the next 30 years, new terminal capacities may be needed in regions with significant growth of intra-European shipping, but the increase of efficiency and reconversion of existing terminals should be prioritised over new terminal constructions. A KPI- or benchmark-based approach should be taken to appraise the potential of efficiency measures.

Based on the development of short sea traffic volumes, it is estimated here that no more than five new dedicated short sea terminal constructions or large-scale terminal extensions will be needed, resulting in an investment need of up to EUR 400 million.<sup>88</sup> These investments will focus on core ports as the growth in comprehensive ports was lower than in core ports. The **efficiency upgrade of existing port infrastructure and superstructure** holds a lot of potential for sustainably increasing port capacity, particularly in ports with relatively small investment budgets. This often concerns comprehensive ports due to their smaller revenue and ports in countries with a lower GDP per capita (e.g. Bulgaria and Romania). Also, ports with limited space for expansion must opt for efficiency measures to cope with demand growth. Reconversion of underused or unused terminals may also free up capacities.<sup>89</sup> The cost per project depends on the type of upgrades that are necessary (e.g. upgrade of quay wall vs. new terminal equipment). Assuming that additional capacity is needed in approximately 50 ports up until 2050 (excluding those counted previously with new sea terminal investments) and an average project cost of EUR 10 million, the total investment needs related to capacity expansions increases to EUR 900 million (including new terminals mentioned previously).

Similarly, **facilities for combined transport** need to expand based on demand. Depending on the development of demand in the ro-ro and container sector, the total

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<sup>85</sup> See European Commission: Detailed analysis of ports and shipping operations. Annex to Motorways of the Sea Detailed Implementation Plan, April 2018, pp. 16-18

<sup>86</sup> See Detailed analysis of ports and shipping operations, Annex to Motorways of the Sea Detailed Implementation Plan, April 2018

<sup>87</sup> If demand for shortsea shipping is to grow in line with the targets set out in the Sustainable and Smart and Mobility Strategy, additional capacity would be needed.

<sup>88</sup> Many multipurpose terminals in European ports are already underused and the expected decline of coal and oil imports will free further infrastructure with good nautical conditions. In the container sector, former deep-sea terminals can be converted into short sea terminals, as was the case for Rotterdam Short Sea Terminals.

<sup>89</sup> In 2019, more than 80 million tonnes of coal have been handled in the EU TEN-T ports. With the move to renewable, non-fossil fuels, the related terminals – often constructed for large bulk carriers – can be reconverted for other cargo types.

necessary investment cost for such terminals up until 2050 is estimated to reach between EUR 200 and 500 million (between five and fifteen new terminals or major upgrades). This will concern mostly CNC ports, though there may also be single instances in larger comprehensive ports. The **hinterland infrastructure** – including road, rail and inland waterway connections of the port with the main networks, but also parking areas, railway sidings and marshalling yards – must be developed in line with demand of both deep-sea and short sea traffic in each port. For quayside infrastructure and superstructure, it means that the current or future vessel types *relevant for the port* must be accommodated, rather than some standard vessel size across all ports.

The investment needs in the ports that will be necessary to achieve environmental objectives are noticeably higher. Given the uncertainty about future maritime fuels, LNG has been proposed as a transitional fuel. The focus is hence on LNG infrastructure as a transitional solution. To cover all major port ranges in Europe as foreseen by Directive 2014/94/EU, three regions would need new **LNG terminals**: the Irish Sea, the German Bight and the Black Sea. Plans in the German Bight are ongoing while the Port Meridian project in the Irish Sea does not seem to progress, just as the Ukraine LNG Terminal that was originally planned in Yuzhnyi Port, Ukraine, had already been halted before the military invasion of Russian troops in February 2022. In the Black Sea, the demand from the shipping sector would be quite low and vessels operating between the Black Sea and the Mediterranean pass by LNG terminals in Turkey and Greece, so an LNG terminal in the region neither seems to be economically viable nor necessary. Hence two large-scale projects – estimated to cost 400 million to 600 million each – would yet have to be constructed to comply with the targets of Directive 2014/94/EU, adding to an investment need of EUR 1 billion. The distribution of LNG for bunkering needs either **LNG bunker vessels** (also necessitating the respective regulation in ports that allows ship-to-ship bunkering) or small-scale LNG tank storage. These would be particularly needed for short sea services as these cannot move their vessels to ports that are a few hundred nautical miles away only for bunkering. Deep-sea vessels, by contrast, can include calls in one of the major LNG terminals just as they already do bunker calls today for HFO or Diesel. The LNG bunker vessel fleet has been increasing rapidly during recent years and more tonnage is on order. Given that the uptake of LNG as a bunker fuel is progressing slowly, it is assumed that only a few additional vessels and small-scale LNG tank storages will be necessary after 2021. The total cost is estimated to reach EUR 400 million.<sup>90</sup> Due to the uncertainty concerning **future alternative non-fossil fuels** like ammonia and hydrogen, the related investment costs cannot be assessed yet. LNG is currently considered as an intermediate option for addressing the requirements at present, but it will have to be phased out in the long term. Whether the existing and planned storage and bunkering infrastructure can be used for future fuels beyond the fossil LNG remains to be seen and it is a currently open discussion among the concerned actors.

The same uncertainty holds for **imports of non-fossil energy products** via ports which may need additional handling facilities. It seems very likely that the volume of dry bulk imports will shrink considerably as coal is phased out while the volume of imported liquid energy products may rise. The total investment costs related to the energy transition may hence very well be much higher than indicated previously.

The development of **PRF** in EU ports is an issue for both short sea and deep-sea shipping. Concerning investment costs, the adequacy relates on the one hand to operational conditions to match the requirements of vessels without hampering their operational

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<sup>90</sup> The cost for a single seagoing bunker vessel is in the range of 50-100 million Euro.

process while using waste reception facilities – while on the other hand also considering the environmental management of the facilities through ports.

Looking at the operational conditions for waste reception facilities by ships, it is essential to acknowledge that the provision of facilities does not by itself necessarily fulfil the adequacy of vessels' requirements. For instance, inadequate locations not easily and at-all-times accessible, complicated administrative procedures and non-transparent and/or high fees for waste handling services might be factors for creating obstacles in using waste reception facilities. It could encourage illegal/inadequate waste disposal.

The revised EU Directive on PRF mandates that waste reception services be conveniently located and easy to use to receive any kind of waste defined in the Directive. To assess port investment needs, it is essential to analyse properly the adequacy of existing PRF and the requirements for an enforcement system to be applied. Transparent calculations of cost recovery systems (implementing the "polluter pays" principle) and the required waste reception capacities are to be provided by the responsible port organisation. Additionally, exemptions to be applied for the individual ports are to be considered for the investment cost. The costs for PRF and services are difficult to estimate and concern not only the ports, but also the local administrations that need to provide the necessary infrastructure. Compared with the aforementioned investment needs and the uncertainty around them, the total budget for PRF will be almost negligible and will have to be covered by fees.

The use of **OPS** systems and other zero emission technologies at berth to reduce local air and noise emissions – particularly in densely populated areas – must quickly be made available in seaports across Europe. In order to cover all core and comprehensive ports falling under the criteria of the AFIR, an investment need of about EUR 5.3 billion (CAPEX) has been estimated.<sup>91</sup> To include as many vessels as possible, the issue of standardisation and integration of older vessels must be studied in each port beforehand. Though it is yet unclear which fuel types will be used in future for carbon-free vessels, it is very likely that providing OPS from renewable resources will be much more energy-efficient than the using electricity and entailing energy losses.

The need to invest in more silent and less polluting **terminal equipment** is difficult to capture as it depends on the impact of terminal activities on the local population. Investments in "green" terminal equipment can contribute both to lower local air emissions and less CO<sub>2</sub> equivalents. Local authorities can require terminal operators to respect certain limits regarding air and noise emissions. The awareness of ports and terminal operators has increased and the costs for less polluting terminal equipment will be considerable in some ports. However, these costs will stretch over a long period of time and hence over the lifecycle of existing investments. Therefore, no additional investments are calculated for terminal equipment except for the budget related to capacity expansions through terminal modernisation described previously.

## 5.2 Investment needs concerning the European short sea fleet

Probably the most crucial investment of the coming decade will be to develop renewable fuel types and propulsion technologies that are compatible with the needs of maritime transport. At this point in time, it is difficult to appraise the total investment needed as **research and development** is an open process and may go in different directions.

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<sup>91</sup> See Impact Assessment accompanying the Proposal for a Regulation on the deployment of alternative fuels infrastructure, <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021SC0631>, page 62

Assuming approximately three to five new engine types or vessel pilots, the total cost could reach EUR 500 million for the development of pilot vessels alone. The research on new fuels and propulsion technologies is a worldwide quest to which Europe must contribute. As no clear solution is on the horizon yet, the costs for this contribution are difficult to estimate. If marketable solutions are developed in Europe, this will give the European ship supplier industry a competitive advantage in the global shipbuilding market.

The costs for the uptake of new technologies will have to be borne mostly by the ship operators and are difficult to estimate beforehand. It is not unlikely that the investment costs in new vessels will not be significantly higher than today if certain synthetic fuels are used. It will then rather be a question of operating costs due to higher costs for these fuels. However, if new fuel types which are not compatible with existing engines are to be introduced quickly, the costs for **reconversion of existing vessels** – if possible at all – could reach up to EUR 1 billion (around 50 conversions of younger vessels in the current short sea fleet). This also entails investments needed for compatibility with OPS systems. The earlier zero-carbon engines are market ready, the lower the need for reconversion of vessels ahead of 2050.

### 5.3 Investment needs concerning digital infrastructure and services

The physical infrastructure for **digital services** is already in place and part of the general infrastructure. For logistical services such as electronic transport documents and Maritime National Single Windows, the focus should be on complete interoperability between the different national, regional and EU systems.

The investment lies first and foremost in the development of standards and programming, more precisely in the development of interoperable interfaces between the different systems (e.g. XML, AS4, APIs, JSON) that make information sharing an automated process without the need to enter information manually more than once. The number of these projects, fully compatible with the technical standards of the EMSWe Regulation and building on existing systems (PCS, NSW, TOS etc.) will be quite high (at least 200), but the cost per project at the local level will be rather low compared with other investment categories. The real cost of interoperability varies depending on the configuration of existing systems and can be considered in a range between EUR 500.000 to EUR 2 million. These investments should also take account of and be coordinated with the technical requirements resulting from the implementation of the eFTI Regulation and possible future environment of the federated network of platforms as developed by the DTLF.

Besides the aforementioned digital services, some particular cases can be mentioned such as:

- more reliable information on under-keel clearance is needed both for security and efficiency reasons. Improved hydrographic surveys and providing the relevant GIS data may require additional investments in some ports;
- although it is a requirement coming from the rail regulation<sup>92</sup>, the implementation of the TAF-TSI standard (Technical Specification for rail Interoperability relating to Telematics Applications for Freight services) may impact port related actors. This includes shunting companies and Port Authorities as Infrastructure Managers. It could require investments concerning digital infrastructure and services to drive

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<sup>92</sup> Regulation (EU) 454/2011 on the technical specification for interoperability relating to the subsystem "telematics applications for passenger services" of the trans-European rail system  
<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011R0454&from=EN>

- communications between railway undertakings, infrastructure managers, rail service providers and the aforementioned port actors;
- standardised and harmonised implementation of sea and vessel traffic systems and platforms for real-time exchanges of information to improve capacity, transport quality, maritime safety and more sustainable shipping through optimised port calls and sea traffic management systems;
  - specific digital interoperability across door-to-door logistic chains and specifically support for synchromodality between the different modes.

#### 5.4 Upgrade of ports for resilience purposes

There are more than a thousand operational cargo terminals in core and comprehensive network ports. This large terminal capacity offers the potential to reroute traffic in exceptional situations, e.g. natural disasters, accidents or other events that block neighbouring ports, or to accommodate the transport of exceptionally high or heavy cargo, projects or military equipment.

To estimate the investment needs, the potential demand and the necessary infrastructure for such exceptional traffic situations must be analysed. For all European regions, resilience plans concerning the access to maritime transport should be developed, identifying alternative seaports for a given cargo type and their hinterland connections with the given region. These plans also need to take into account the vessel sizes on the normal routes that need to be handled in the alternative ports in emergencies. The costs for such plans – which could take the form of working groups or studies – are rather limited compared with the other investment needs identified previously. Resilience against climate change and disruptions will be of increasing importance, so assessing the needs is a first step to take in the near future.

Besides alternative routing, special cargo types and transports (e.g. elements of wind turbines, special aggregates or military equipment) should be possible across the EU. Given the privileged position of maritime transport for these types of cargo, maritime ports and terminals (and also inland waterways) should form the cornerstones of such a “resilience network”. This work can build on the work of the European Commission in the context of the Military Mobility Action Plan, but should take a broader focus in order to include other exceptional traffic. A gap analysis will then be able to show investment needs in certain sea basins and coastal areas. The analysis must cover terminals and the relevant hinterland connection.<sup>93</sup>

#### 5.5 Summary of investment needs

As far as they can be assessed today, the total investment needs up until 2050 amounts to around EUR 9.5 billion. The infrastructure costs for future alternative, non-fossil fuels could not be assessed as it is yet unclear which fuel type(s) will lead the way in the transition to carbon-free maritime transport. The total costs for maritime ports related to the energy transition may hence be much higher than indicated in the following table, and would add to the total costs. Further, the investment needs for a resilient maritime transport network need to be assessed in future studies.

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<sup>93</sup> Projects with civilian-military synergies may be eligible for co-financing under the Military Mobility Action Plan (see 6.2).

Table 9 Summary of estimated budget for investment needs

<b>Investment category</b>	<b>Estimated budget*</b>
<b>Sea-side and land-side port infrastructure</b>	<b>7.8-8.1**</b>
New seaport terminals	0.4
Terminal efficiency upgrades	0.5
New intermodal facilities	0.2-0.5
Onshore power supply installations	5.3
LNG terminals and bunker vessels	1.4
Future alternative fuels	unknown
<b>European short sea fleet</b>	<b>1.5</b>
R&D on alternative propulsion	0.5
Reconversion costs	1.0
<b>Digital services/European Maritime Single Window</b>	<b>0.2</b>
<b>Resilience and dual use</b>	<b>to be assessed</b>

\* billion EUR, capital expenditure only

\*\* excluding investment needs related to alternative fuels

Source: ISL

There is also uncertainty about the necessary capacity increases in ports, terminals, and hinterland connections. On the one hand, volumes have been more or less stable since more than a decade now and some major cargo segments – such as fossil fuels – will lose significance in the long term. On the other hand, whether the construction of new terminals beyond the ones currently planned and under construction is needed, or whether efficiency gains or reconversions of existing terminals would be sufficient to provide the capacity increase, must be analysed case by case. As an order of magnitude, the total investment need related to capacity increases in seaport and intermodal terminals is estimated at EUR 1.1-1.4 billion.

The cost for the construction of new OPS facilities in line with requirements of the AFIR is estimated to EUR 5.3 billion. This is by far the largest investment in the list. However, contrary to the terminal capacity investments described previously, OPS installations will serve both short sea and deep sea shipping. Around EUR 1.4 billion is needed for the accomplishment of the LNG bunkering infrastructure. According to the assessment, two major European port regions – the Irish Sea and the German Bight – still need to be covered. The fleet of LNG bunkering vessels is growing quickly, but further units will be needed, particularly in the regions that are not yet covered.

Research, development and reconversion of the short sea fleet will also need large investments of around EUR 1.5 billion. The reconversion costs are quite uncertain as they depend on future fuel types and how much is needed to upgrade a vessel. The research costs are also high and insecure, but they are actually shared with deep-sea shipping globally.

Finally, taking into account the already mentioned costs of interoperability and focusing on core ports, the digital infrastructure in Europe needs around EUR 200 million to create or upgrade interoperable federated systems between the different actors.

When including LNG infrastructure, the decarbonisation of ship propulsion and OPS together, around EUR 3.3 billion (equal to around two thirds of the total investment needs) are related to improving the environmental performance of SSS. Additional investments will most likely be needed in the future for new bunkering infrastructure for non-fossil fuels. The remaining investments – generating new capacities or improving the competitiveness

of maritime transport – will also have a positive impact on the environmental performance of the transport sector as a whole as long as shipping continues to be the most energy-efficient mode of transport.

The total investment needs include – but are not limited to – investment categories of the CEF II programme. Most notably, they include investments in basic port infrastructure worth EUR 1.1-1.4 billion, shore-side electricity supply worth EUR 5.3 billion and infrastructure providing or improving road/rail access (here: intermodal terminals) worth EUR 0.2-0.5 billion.

The CNCs are also used for port hinterland traffic. Therefore, any improvement on these corridors will also be to the benefit of maritime transport chains. In general, the impact on ports and maritime transport will be the greater the closer the improvements are to the ports. Especially for port hinterland traffic by road, the share of hinterland traffic quickly decreases with distance to the port terminals and hence also the significance of measures for port hinterland traffic. By contrast, a large share of traffic on inland waterways is port hinterland traffic even in the hinterland, while rail traffic – particularly where passenger and freight traffic use the same tracks – is somewhere in between. Compared with road traffic, the share of port hinterland traffic is much higher on longer distances. Therefore, improvements of the rail infrastructure may have a direct impact on the attractiveness of transport chains involving maritime transport, even if they occur hundreds of kilometres from the coast. The impact of measures concerning urban passenger transport or airports, by contrast, will not have significant repercussions on maritime transport.

## 5.6 Meeting the investment needs

Thus, overall, the total investment needs related to achieving a sustainable and smart European Maritime Space (excluding resilience and dual use, to be analysed subsequently) are estimated to reach almost EUR 10 billion.<sup>94</sup>

The largest degree of uncertainty relates to the necessary capacity increases that are needed in ports, terminals and hinterland connections. On the one hand, future market growth is always subject to uncertainty. On the other hand, whether the construction of new terminals beyond the one currently planned and under construction is needed, or whether efficiency gains would be sufficient to provide the capacity increase, must be analysed case by case to assess the exact investment needs. Consequently, the overall investment needs estimate shows a wide span from around EUR 200 million to more than EUR 5 billion (see previous section).

Significant investments will be needed to achieve an adequate state of the EMS. Public financing tools are no longer sufficient to complete the development of a sustainable, smart, seamless and resilient EMS. A coherent mix of public funding and private financing remains the way forward for a successful completion of the whole TEN-T. Moreover, the increased salience of foreign financing in transport and infrastructure projects, and fierce competition from non-EU entities are two factors of growing concern for many European stakeholders. As a result, one of the objectives of this DIP is to present a wide range of funding possibilities and innovative financial schemes, to continue supporting the development of the EMS. Below is an overview of the TEN-T and CEF funding allocated to the maritime portfolio so far.

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<sup>94</sup> This excludes investment needs exclusively or mainly related to deep sea traffic such as deepwater container terminals.

## TEN-T and CEF funding allocated to maritime projects so far

Under the CEF programme (2014-2020), the full maritime portfolio as of November 2021 comprises 190 Actions of a total of more than EUR 1.62 billion. Out of these, 56 MoS Actions were co-funded for a total of EUR 435.5 million of CEF grants, making the Motorways of the Sea funding priority one of the most important instruments in financing maritime interventions in maritime ports, European vessels, hinterland services and other economic actors.

### 1. CEF maritime project portfolio

CEF Call Priority	Priority	Actions	EU Contribution
Motorways of the Sea (MoS)	Motorways of the Sea (MoS)	56	435,533,271.68
Multimodal logistics platforms	Multimodal logistics platforms	16	55,668,165.52
New technologies and innovation	New technologies and innovation	23	87,881,120.58
Nodes of the Core Network	Nodes of the Core Network	2	1,018,675.16
Pre-identified projects on the core network corridors	Maritime Ports	53	857,707,953.19
Pre-identified projects on the other sections of the Core Network	Maritime Ports	14	168,522,332.07
Projects on the Core and Comprehensive Networks	Maritime Ports	21	45,243,684.88
Transport-Energy Synergy Call	Synergy	4	8,510,072.35
Safe and secure infrastructure	Safe and secure infrastructure	1	2,051,476.00
<b>Total</b>		<b>190</b>	<b>1,662,136,751</b>

Source: CINEA, Status November 2021

### The Connecting Europe Facility<sup>95</sup>

In the current multi-annual financial period, the MoS programme will continue to be co-funded as part of the Connecting Europe Facility 2021-2027 (CEF II), and therefore the CEF will remain the key financial tool to co-fund **MoS projects**. The CEF II is endowed with a total of EUR 33.71 billion over the 2021-2027 period, of which EUR 25.81 billion will be dedicated to transport. The CEF II covers a wide range of calls and topics for implementing the core and comprehensive networks. Funding is available for core and comprehensive maritime ports under different topics such as (1) maritime ports, (2) the Alternative Fuels Infrastructure Facility, (3) roads, rail - road terminals and multimodal logistics platforms, (4) the MoS programme, (5) smart application for transport - Vessel Traffic Monitoring and Information Systems (VTMIS), (6) telematic applications for

<sup>95</sup> [https://cinea.ec.europa.eu/connecting-europe-facility/transport-infrastructure\\_en](https://cinea.ec.europa.eu/connecting-europe-facility/transport-infrastructure_en)

transport - European Maritime Single Windows and (7) telematic applications for transport - ITS.

Funding dedicated to MoS projects will fall under the “modernisation of the existing TEN-T network” pillar of the CEF II, which will receive 40% of the transport envelope (EUR 10.251 billion). These funds will however be shared with other funding priorities and not solely be allocated to the MoS. MoS projects will benefit from 30% to 50% co-funding for works and 50% co-funding for studies.

Falling under the same programme, the **CEF Alternative Fuel Infrastructure Facility** (AFIF) will support three key areas: renewable energy, green hydrogen and circular economy. Specifically, endowed with EUR 1.5 billion from 2021 to 2023, AFIF will provide funding for three types of recharging & refuelling infrastructure, including LNG, electric and hydrogen refuelling infrastructure. Interestingly, AFIF will cover port and vehicle equipment, as well as SSS vessels “if it is demonstrated that an initial number of vessels is needed to kick-start the use of the supported recharging infrastructure.” As such, it can provide funding for the retrofitting of main propulsion systems for ships. The eligible cost shall be limited to the difference in costs between a fossil-fuel vessel/equipment and the zero-emission vessel/equipment as regards the propulsion system. Given that under recent CEF calls, co-funding for vessels has been scarce, this instrument is a useful tool to green European SSS fleets.

While public financing will be key to boost investments, the CEF cannot and should not substitute private investment instruments. CEF grants should address funding and financing gaps that cannot be easily financed by other means, such as those arising in innovative projects, connectivity projects involving island and outermost regions, etc.

To ensure predictability, facilitate long-term planning of investments and to better promote synergies between different funding instruments, a stable and predictable publication of calls for proposals is preferable. Given that a move towards a zero-carbon future for SSS will require significant investments, including as regards vessels, it could also be useful for mobile assets (i.e. vessels) to benefit from a certain level of support from the CEF. In a blended format and following certain criteria, this is already the case under the AFIF, as mentioned previously.

Also worth mentioning under CEF is the **Action Plan on Military Mobility**. With this Action Plan the Commission is working to improve movements of military forces by addressing shortcomings in the transport infrastructure. Under the military mobility envelope of the CEF 2021-2027, the Commission will co-fund transport infrastructure built or upgraded for both civilian and military purposes (so-called dual-use infrastructure). It is a win-win initiative for both defence and civilian transport in the sense that it will allow improved mobility of armed forces within and beyond the EU while contributing to the completion of the TEN-T. This envelope could be of interest for infrastructure investments in ports and thus serve the interests of the EMS in terms of an improved hinterland connection too. The Military Mobility envelope is endowed with EUR 1.69 billion in current prices.

In addition to projects funded by grants (or a mix of grant/loans) as detailed previously, actions should be complemented by the EIB, other international financial institutions and national promotional banks’ financing opportunities from the private sector. Listed below are several instruments and opportunities that can serve this purpose.

## The European Investment Bank<sup>96</sup>

In 2020 the European Investment Bank (EIB) published **the Climate Bank Roadmap<sup>97</sup>**, outlining its bold ambitions for climate finance to back the European Green Deal and make Europe carbon-neutral. The EIB Group Climate Bank Roadmap is the Bank's five-year plan to ensure that all investments are in line with the Paris Agreement.

As Europe's Climate Bank, the EIB aims to unlock EUR 1 trillion for climate action and environmentally sustainable investment in the decade leading to 2030 and to gradually increase the share of its financing for climate protection and environmental sustainability to 50% by 2025, maintaining this level afterwards.

The EIB supports the decarbonisation and depollution of the European shipping sector, including short sea shipping. The Climate Bank Roadmap clearly **prioritises the financing of sustainable infrastructure, the electrification of the transport sector and the use of other sustainable fuels**. It affirms the Bank's support to port and inland waterway infrastructure and related facilities (with the exception of facilities dedicated to the transport and storage of fossil fuels). It also affirms the support for a transition of marine and inland waterway fleets running on low- and zero-carbon fuels through financing of both newbuilds and the retrofitting of existing vessels.

In addition to grants managed by the European Commission, the EIB has implemented the CEF Debt Instrument (CEF DI). It is a risk-sharing facility supporting projects in the transport, energy and digital sectors. CEF DI is used to address specific market needs where there is insufficient private finance to support investment. CEF grants and CEF DI can be combined where needed to support projects.

Under the CEF DI, **Future Mobility (FM)** supports clean, digital and automated transport investments. It backs projects that reduce carbon emissions, increase energy efficiency and boost technological innovation. FM is another possible financing source for eligible shipping investments, with co-financing rates up to 50% debt financing for both new vessels and the retrofitting of existing ones.

## The InvestEU Programme<sup>98</sup>

The **InvestEU Programme**, will run between 2021 and 2027. It aims to build on the success of the Juncker Plan's European Fund for Strategic Investments (EFSI). InvestEU will provide an EU budget guarantee to support investment and access to finance in the EU with the objective of triggering EUR 372 billion in additional investment. To do so, the InvestEU will mobilise private and public investment through an EU guarantee of EUR 26 billion to back the investment projects of European partners (EIB, EBRD, World Bank, Council of Europe Bank, and pillar-assessed NPBs). The programme will support four policy areas of which two are of interest for the maritime sector: sustainable infrastructure (EUR 11.5 billion) and research, innovation and digitalisation (EUR 11.25 billion). These two policy areas present synergies with the objectives of the EMS. InvestEU projects will need to address market failures or investment gaps and be economically viable, help meet EU policy objectives and achieve a multiplier effect to be eligible. Although both mobile assets and landside infrastructure projects are eligible under this instrument, it is noteworthy to

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<sup>96</sup> <https://www.eib.org/en/index.htm>

<sup>97</sup> <https://www.eib.org/en/publications/the-eib-group-climate-bank-roadmap>

<sup>98</sup> [https://europa.eu/investeu/home\\_en](https://europa.eu/investeu/home_en)

underline that maritime stakeholders have stressed that they did not make much use of funds under the previous EFSI programme, as it was deemed too difficult to access.

### The Innovation Fund<sup>99</sup>

The **Innovation Fund** is another potential financing option for maritime projects. Using funds gathered under the EU ETS, it will provide around EUR 20 billion of support over 2020 - 2030 (depending on the carbon prices) for the demonstration of innovative low-carbon technologies, including in the maritime sector<sup>100</sup>. The fund will focus on highly innovative technologies and projects with European value added that can bring on significant emission reductions. The Innovation Fund supports up to 60% of the additional capital and operational costs linked to innovation. In the first wave of projects selected in the framework of the EU Innovation Fund, the EU is investing EUR 118 million into 32 small innovative projects located in 14 EU Member States, Iceland and Norway. Several waterborne transport projects were selected as part of this first wave, focusing on electric propulsion for a ferry, low-carbon bio liquefied natural gas (bioLNG) for maritime transport, as well as wind assisted propulsion for a cruise ship and the use of green hydrogen from renewable sources for a zero-emission vessel. Further calls will be published on a regular basis until 2030.

### Horizon Europe<sup>101</sup>

The **Horizon Europe** Programme will provide EUR 95 billion in co-funding for research and innovation projects, part of which will be dedicated to resource-efficient transport projects that respect the environment. With particular focus on both decreasing the ecological impact of vessels, such as developing retrofitting solutions and Next Generation Propulsion for Waterborne Transport (through the increased use of alternative fuels for example) and developing a more effective intermodal logistics chain, it provides an additional opportunity for co-funding shipping projects. It is however noteworthy to add that whereas the CEF focuses on deployment, the Horizon Europe programme focuses on research and innovation. Under cluster number 5 "Climate, Energy and Mobility"<sup>102</sup> specifically, the Horizon Europe programme will aim to make the transport sector (including maritime) more climate and environment-friendly, more efficient and competitive, smarter, safer and more resilient. In addition, the Horizon Europe programme will be focused around five great thematic missions to increase the effectiveness of funding by pursuing clearly defined targets. Mission #4 in particular presents strong synergy potential as it will focus on Healthy oceans, seas, coastal and inland waters. The overarching aims of the mission will be to reduce marine pollution, adaptation and mitigation of pollution and climate change in the ocean or the transition to a blue economy. As part of this overarching mission, the European Commission has set up the "Zero-Emission Waterborne Transport"<sup>103</sup> (ZEW) Partnership, which brings together the Commission and private and public partners to address some of Europe's most pressing challenges through concerted research and

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<sup>99</sup> [https://ec.europa.eu/clima/eu-action/funding-climate-action/innovation-fund\\_fr](https://ec.europa.eu/clima/eu-action/funding-climate-action/innovation-fund_fr)

<sup>100</sup> With the possible inclusion of maritime transport in the EU ETS this may further increase

<sup>101</sup> [https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe\\_en](https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en)

<sup>102</sup> [https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/cluster-5-climate-energy-and-mobility\\_en](https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/cluster-5-climate-energy-and-mobility_en)

<sup>103</sup>

[https://ec.europa.eu/info/sites/default/files/research\\_and\\_innovation/funding/documents/european\\_partnership\\_for\\_zero-emission\\_waterborne\\_transport.pdf](https://ec.europa.eu/info/sites/default/files/research_and_innovation/funding/documents/european_partnership_for_zero-emission_waterborne_transport.pdf)

innovation initiatives. The ZEWT Partnership will focus on developing the first sea-going, zero-emission vessel by 2030, by supporting projects that aim to develop on-board energy storage, alternative fuels, fleet retrofitting, etc. Calls under this partnership will focus on vessels rather than port infrastructure.

Some of the investment instruments discussed previously, such as Horizon Europe programme or the InvestEU Fund, support investments in the waterborne, transport, energy and digital sectors. Thus, these instruments also enable the maritime technology sector to receive necessary financing support.

#### Climate Bonds Initiatives<sup>104</sup>

To leverage private funds, the option of issuing green **bonds** is also viable. The current EU Taxonomy for “green” bonds, as defined by the **Climate Bonds Initiative**, requires at least 95% of the proceeds to be dedicated to assets that are defined as “green”. This green label can provide issuers with much needed finance and signal sustainability aspirations, enabling access to a wider investor base. On the other hand, the label also reassures investors and allows them to easily identify sustainable bonds. In 2018, the labelled green bond market represented over EUR 353 billion. However, bonds issued under this label were in the great majority short term, with tenors no more than 10 years. On the same topic, the European Commission published in July 2021 a proposal for a Regulation establishing an EU Green Bond Standard, which, based on the EU Taxonomy, aims to create a credible and trustworthy framework for financial institutions and companies to release sustainable bonds. Importantly, only economic activities that are 100% aligned with the EU Taxonomy will be eligible to receive proceeds from bonds labelled under the EU Green Bond Standard. This includes several maritime activities, both landside infrastructure and vessels.

#### Next Generation EU<sup>105</sup>

In addition, in the wake of the COVID-19 pandemic, the European Commission has announced a EUR 750 billion recovery instrument: **Next Generation EU**. This instrument will supplement the 2021-2027 EU Budget to help Europe recover from the pandemic and support the transition towards a green and digital economy. The largest share of funding under the Next Generation EU instrument will be allocated to the Recovery and Resilience Facility (EUR 672.5 billion). This facility will provide EUR 360 billion in loans and EUR 312.5 billion in grants to European Member States so they can support the recovery of their economies. Access to funding will be conditional on National Recovery and Resilience Plans (NRRPs), which were submitted by Member States for approval by the European Commission. These NRRPs define Member States’ strategies to relaunch their economies and will need to follow the European Commission’s main priorities: at least 37% of the funding will need to be allocated to climate objectives, while 20% will need to be allocated to the digitalisation of the economy. As such, these NRRPs can provide interesting sources of financing for the maritime sector. It is important to note however that NRRPs are designed to support the economy as a whole, and dedicated funding for the maritime sector will depend on country-by-country political will. For example, France has allocated EUR 200 million to the greening of ports under “France Relance”. Eligible projects will need to develop OPS, increase intermodal infrastructure and develop alternative fuels bunkering infrastructure in French ports. In the same vein, Germany has developed a response plan specifically dedicated to its maritime sector, which aims to “strengthen, modernise and

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<sup>104</sup> <https://www.climatebonds.net/>

<sup>105</sup> [https://ec.europa.eu/info/strategy/recovery-plan-europe\\_en](https://ec.europa.eu/info/strategy/recovery-plan-europe_en)

digitise shipping as a climate-friendly means of transport". The EUR 1 billion plan will provide EUR 219 million to support the building of LNG bunkering vessels, EUR 36 million to support shore side electricity and EUR 5 million for the promotion of innovative port technologies. Similarly, Italy allocated part of the RRF to the digitalization of the logistics systems and developed a strategic financial programme with a budget of around EUR 130 million dedicated to OPS, and to new or refitted existing fleets with state-of-the-art generation/propulsion systems able to reduce or eliminate the environmental footprint. Furthermore, Spain has allocated EUR 120 million for eco-incentives for maritime and rail freight services, as well as a EUR 460 million call for proposals on sustainable and digital transport, including alternative fuels infrastructure and clean propulsion technologies for maritime transport. As a result, in the wake of the COVID-19 pandemic, through the recovery instrument, additional funding resources will potentially be made available for the maritime industry, albeit on a local scale, and in varying proportions in Member States.

### Eco-incentives

Finally, further development of **eco-incentive measures** can also provide an additional form of financing. Eco-incentives follow a goal-based approach to measure and monetise the socio-environmental benefits resulting from projects encouraging environmentally sustainable activities. For example, under the "Med Atlantic Ecobonus" CEF project, a common methodology was proposed for eco-incentive schemes pursuing the development of sustainable freight transport services within the EU. This methodology is valid for all modes of transport and incentivises the actual and demonstrated socio-environmental benefits achieved by the beneficiaries regardless of the costs incurred for it. Such eco-incentives could help to bridge funding gaps, thus allowing for the development of innovative, sustainable maritime projects (such as projects that reduce road congestion, deploy alternative propulsion systems or facilitate intermodality). However, to become a real operational scheme, the Med Atlantic Ecobonus methodology still requires consensus at EU level. The development and implementation of the EU Taxonomy and the Commission's Handbook of External Costs of Transport to the eligibility criteria for the eco-incentives could greatly contribute to a harmonised implementation approach across all sea basins. Building upon these two documents, eco-incentives could be potentially used for complementing the enforcement of environmental targets.

All these funding and financing instruments are great enablers to complete infrastructure projects. Member States have a choice of financing methods: either to opt for appropriations on state budget or to choose alternative sources of co-funding provided by these instruments.

## 6 Recommendations and outlook by the European Coordinator - investment priorities for the future

**Sustainable. Smart. Seamless. Resilient.** I present these four pillars in my second DIP as European Coordinator for Motorways of the Sea. They reflect my vision for the EMS as the cornerstone of the TEN-T policy, and to help achieve a barrier-free European maritime sector. They are the way forward to support the competitiveness and long-term viability of the EU maritime sector.

Based on a wide stakeholder dialogue and analyses of transport data, legislative drivers and emerging trends, I would like to propose the following investment priorities and needs under the four pillars. They are all closely interlinked and present important synergies amongst them. For the short-term perspective, this evaluation considers the current financing tools while in the long-term perspective, the results may also give an indication for proposals to amend and streamline the different financing possibilities for ports and ship operators.

### 6.1 Sustainable: fighting climate change, improving air and water quality

To **fight global climate change**, a reduction of GHG – measured in CO<sub>2</sub> equivalents – is needed. The main source of CO<sub>2</sub> in maritime transport is, of course, the vessels.

	Short term (-2025)	Medium term (-2030)	Long term (to 2050)
High impact	Piloting new, low to zero emission ship types Piloting retrofits for conventional engines	Port infrastructure for alternative fuels Retrofitting of existing ships	Fleet renewal
Medium impact		Renewable energy for port activities/in port area	
Low impact			

Source: ISL, 2021

In the short term, the most urgent need is the development of market-ready zero or low emission ship propulsion. Only very large ship operators have the budget to invest in high-risk experimental ship types. Most European short-sea operators, however, are reluctant to invest in pilot vessels and retrofitting solutions. Making use of the Horizon Europe programme, and in particular the Zero-Emission Waterborne Transport Partnership, could be beneficial here. Funding is indeed available to support pilot projects aiming to develop or demonstrate innovative solutions for alternative fuels and low-emission vessels. Further yet, the CEF Alternative Fuels Infrastructure Facility, which aims to support the deployment of alternative fuels in the transport sector (including the maritime transport), could be used to access financing for the deployment of vessels that operate on alternative fuels.

The following investment steps related to carbon-free transport can only follow once various ship types have been commercially tested and compared (including partner ports providing the refuelling or recharging infrastructure). In the end, an evaluation of different propulsion and fuel types will reveal the most viable solutions for different ship types and routes. It is hence proposed in this DIP that the respective bunkering/recharging infrastructure should be developed in line with expected demand – possibly involving the provision of various alternative fuel types in ports (typically core ports) with a wide traffic profile. At the same time – as today – ports are vital for the imports, exports and storage of energy products. Depending on the type of future fuels, this might require new handling and storage infrastructure, particularly if liquefied hydrogen will play an important part. Other non-fossil fuels like, e.g., many synthetic fuels will not require specialised infrastructure.

Starting from 2025, retrofitting will be key to achieving a substantial reduction of GHG emissions from shipping in Europe. Financing retrofitting through private investments will only be possible if ship operators can refinance these investments by increasing prices. In order to do so, there must be a level playing field for European and non-European ship owners, e.g. by requiring certain emission standards. At the same time, shipping must not lose competitiveness in comparison to other modes of transport. Several instruments can be used to support these efforts. Here, the CEF II, including the Alternative Fuels Infrastructure Facility, can once again play a role, by facilitating access to finance and reducing the cost of retrofitting vessels. Furthermore, the EU Taxonomy has classified retrofitting of vessels as a “transitional economic activity”, which means that this activity could access more and cheaper financing, given the increasing private demand for sustainable investments. The establishment of the EU Green Bond Standard will further ease this process. Furthermore, several initiatives launched by the European Investment Bank, such as the Clean Transport Facility or the CEF DI can help unlock capital for the retrofitting of vessels and could be used in this context. On a final note, the deployment of eco-incentives, which can be used to measure and monetise the socio-environmental benefits resulting from projects encouraging environmentally sustainable activities, should incentivise the retrofitting of vessels to achieve a higher environmental performance.

In the long term, as part of the regular fleet renewal, new vessels shall be required to respect new emission standards and eventually zero emissions. Ideally, the EU shall work together with the IMO to achieve worldwide minimum standards. If additional costs for new ship types are much higher than for conventional ships, it must again be made sure that shipping does not lose competitiveness vis-à-vis other transport modes or non-European ship owners.

Emissions related to terminal operations and transport within the port area are of a much smaller magnitude. Still, using renewable energy and investing in more energy-efficient terminal equipment can make a difference with regard to the climate impact. When it comes to infrastructure for the provision of alternative fuel types in ports, there may be synergies between maritime transport, land transport and the local industry. Ports play an important role as hubs for the transition to green energy. To provide the necessary infrastructure as quickly as possible, ports should be in direct contact with both the industry and with ship operators.

**Air and noise pollution**, is in this context a local issue and hence relates to the port-city relationship. If port activities lead to a strong degradation of air quality in urban areas, this will reduce the acceptance of port activities and may eventually lead to the non-sustainability of port activities in the area.

	Short term (-2025)	Medium term (-2030)	Long term (-2050)
High impact	OPS for cruise and container vessels in "city ports"	Modal shift or bypass roads	OPS for other ship types (port stays >2h)
Medium impact		"Green" terminal equipment	
Low impact			

Source: ISL, 2021

On average, cruise and container vessels have the largest impact due to high power needs and long port stays. Some special ship types like LNG tankers also fall in this category. Providing OPS for these vessels should hence be a priority in the short term. In the long term, OPS should cover all vessels contributing to air pollution or noise emissions above a certain threshold. Under the CEF II programme as well as under the InvestEU programme, funding could support the deployment of sustainable infrastructure. Furthermore, the EU Taxonomy establishes that the deployment of OPS, alongside other port infrastructure that supports zero-emission vessels is a sustainable activity, which once again should facilitate and reduce the cost of access to financing for such activities. On a final note, the recently released proposal for a FuelEU Maritime Regulation will impose the use of OPS for all container and passenger vessels by 2030. This regulatory measure, if adopted, will further stimulate demand for the deployment of OPS infrastructure across Europe, as established in the AFIR proposal. This could in turn potentially encourage the use of public funding for the deployment.

Besides activities in the port area, hinterland transport also generates significant air and noise emissions. In some cases, the impact on the local population can be relieved by modal shifts from road to rail and inland waterway, by building bypass roads or by installing noise barriers.

The improvement of **water quality** is also mostly a local issue, though in certain areas with rare species, it may link to biodiversity. Shipping and ports affect water quality in various ways. The construction of new terminals and dredging are reducing the space for marine life. Dredging may also lead to the release of toxic substances from contaminated sands. Vessels may contaminate the water due to eroding ship paints, oil slip from the propeller, contaminated ballast water, ship waste, marine litter or contamination related to accidents. The most relevant pollutants depend on the traffic structure of each port.

	Short term (-2025)	Medium term (-2030)	Long term (-2050)
High impact	Regulation and enforcement	Need to assess possible modernisation before new construction	
Medium impact			
Low impact			

Source: ISL, 2021

The regulation of contaminating substances (ideally at the IMO level) and of ship waste and ballast water treatment should be continuously evaluated and enforced. As regards additional terminal capacity, a benchmark- or KPI-based approach should be developed to assess the need for new terminal capacity. Modernisation or reconversion of existing facilities should be prioritised.

## 6.2 Seamless: improving connection with TEN-T network, peripheral and outermost regions

The European sea routes connect European markets with each other and with the rest of the world. 22 out of 27 Member States have coastal areas and seaports. From a transport network perspective, the sea can be regarded as the largest transport infrastructure. It connects to the land-based infrastructure in the 292 maritime TEN-T ports and hundreds of smaller seaports.

With the revision of the TEN-T Regulation and the establishment of the European Maritime Space as the maritime dimension of the TEN-T policy, the sector is being put on an equal footing with other sustainable modes of transport. The promotion of SSS and better hinterland connectivity has been reinforced. With more flexibility and better possibilities for the EU and the Member States to support core as well as comprehensive ports financially, there is an untapped potential in the maritime sector and what it could achieve in view of the objectives in the EGD and the SSMS.

	Short term (-2025)	Medium term (-2030)	Long term (-2050)
High impact	Connection between core ports and CNCs	Connection between TEN-T ports and the hinterland network  Connecting peripheral and outermost regions	
Medium impact	Safety trainings	Ice-breaking	Develop shortsea terminals in line with demand
Low impact			

Source: ISL, 2021

However, the connection between core and comprehensive ports and the hinterland network is the most urgent issue for a seamless European-wide multimodal transport system including maritime transport. The connection between core ports and the CNCs has been a main focus of CEF funding so far. Therefore, this should be extended to connections of both core and comprehensive ports with the hinterland network, as traffic on CNCs is only a small part of the ports' hinterland traffic. In parts of the Baltic Sea, reliable ice-breaking is needed to ensure year-long maritime transport. This is even more important in view of broken supply chains and resilience needs following the several exogenous shocks since 2020 until the present point in time.

In the long term, further terminal capacity may have to be developed in line with demand.

At the same time, a seamless transport system must include all modes of transport, and efforts will also be necessary to ensure intermodal connections are smooth, in particular regarding last mile connections.

To promote cohesion and the integration of outermost and peripheral regions, eligibility for funding of projects with two ports in the same Member State should be granted<sup>106</sup>. Subsidies for such services by Member States should be linked to public calls for proposals to operate the respective connection.

In addition to the CEF II, which can play a key role in supporting the connection between core ports and the CNCs, the InvestEU fund can be used here. Under its "Sustainable Infrastructure" programme, it will allocate EUR 11.5 billion to leverage private funding for infrastructure projects that are more efficient.

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<sup>106</sup> The proposal adopted by the Commission on the 14 of December 2021 on the revision of the TEN-T Regulation does not set out eligibility criteria for future calls but future work programmes of the CEF 2 could potentially include intra-national eligibility: [https://eur-lex.europa.eu/resource.html?uri=cellar:7b299e69-5dc8-11ec-9c6c-01aa75ed71a1.0001.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:7b299e69-5dc8-11ec-9c6c-01aa75ed71a1.0001.02/DOC_1&format=PDF)

### 6.3 Smart: improving digital communication

Digital solutions can contribute to the strategic objectives of the EMS. They can help ship operators to save fuel through Intelligent Vessel Traffic Management, they can make shipping safer through improved traffic control and collision warning, and they can help improving the integration with land-based transport modes via simplified electronic data exchange.

	Short term (- 2025)	Medium term (-2030)	Long term (- 2050)
High impact	Data exchange standards and harmonised tools along maritime transport chains (including multimodal land transport)		
Medium impact		Digital solutions for sea and vessel traffic management (route optimisation, safety)	
Low impact			

Source: ISL, 2021

The European-wide data exchange standards and solutions for shipping and hinterland transport using an international fast trade lane approach shall be developed quickly. This should implement logistic and customs corridors across the door-to-door logistic chain with implementation of solutions based on the “federated systems” approach as defined by the Digital Transport and Logistic Forum. This will strongly improve the competitiveness of maritime transport chains vis-à-vis purely land-based transport, particularly for intra-EU transport.

The safety and efficiency of shipping can also be improved, e.g. through cloud-based data exchange or data analytics for route optimisation.

Several financial tools can be used to enable the deployment of digital solutions in the maritime sector. Firstly, the CEF II, in addition to its transport dimension, has a digital connectivity dimension deploy digital solutions. In addition, under its “Research, innovation and digitalisation” pillar, the InvestEU programme will provide EUR 11 billion to leverage private funding to support projects that aim to enable the deployment of digital solutions across the European economy, including in the shipping sector. Thirdly, the EIB’s Future Mobility Facility can provide up to 50% co-funding for the deployment of new technologies on-board vessels. Finally, under the Resilience and Recovery Facility, 20% of the total funds allocated to Member States for their National Recovery Plans must be allocated to digital projects, albeit these funds will not necessarily be allocated to the maritime sector.

## 6.4 Resilient: preparing to face exogenous shocks

The resilience of maritime transport has recently been challenged at various occasions. The COVID-19 pandemic, the Suez Canal blockage and the Russian invasion of Ukraine have put the maritime transport system under severe stress. Other risks related to climate change – e.g. flooding and extreme weather events – are to be considered, even though they have not yet shown a vast impact like in other regions of the world. Finally, there are also risks that parts of the EU maritime transport infrastructure are blocked for a certain period of time.

	Short term (- 2025)	Medium term (- 2030)	Long term (- 2050)
High impact	Develop resilience plans for all European regions	Initiate cooperation between ports and along the transport chain for alternative emergency routings	
Medium impact			Provide terminal and hinterland capacity for high & heavy freight in all European port ranges including peripheral and outermost regions
Low impact			

Source: ISL, 2021

The resilience of the transport system has only recently received due attention. A quick assessment of its resilience across all transport modes is necessary, i.e. by means of stress test simulations. The results of such analyses must be translated into a resilience plan involving new infrastructure, but also cooperation between different stakeholders along the transport chain. For maritime transport, ports within a port range or regional port clusters may cooperate to assess alternative routes in case one port becomes non-operational.

In the long term, new infrastructure for high and heavy freight may be needed for the transfer of heavy machinery between regions. Maritime transport will be particularly important for islands and coastal peripheral and outermost regions.

The emergence of the COVID-19 pandemic and the increasing emergence of exogenous shocks has reinforced the awareness of the need for resilience, and several financial tools are now available to bolster it. First and foremost, under the Recovery and Resilience Facility, national Recovery Plans need to integrate resilience at their core. Although the allocation of funds to the maritime sector will vary between Member States, they are key sources of funding to strengthen the resilience of the sector. The InvestEU programme also integrates such considerations under its “Sustainable Infrastructure” pillar, whereby sustainable includes resilience over time, and should also be used in this context. Finally, in the context of the EU Action Plan on Military Mobility, dual- use transport infrastructure projects integrate a resilience dimension, given the importance in strategic terms.

## 6.5 Key Recommendations

Overall, building on these aforementioned investment priorities, there are 9 recommendations I would like to make to enable the development of a sustainable, smart, seamless and resilient EMS. During my term as European Coordinator for the maritime pillar of the TEN-T policy, I will seek to monitor how progress is being made on these recommendations:

**Green the fleet:** Most emissions from the maritime sector come from vessels. As such, it is fundamental that we invest in pilot projects to develop new types of propulsion systems, and new types of ships that can achieve low to zero emissions.

**Deploy the infrastructure:** In line with the Alternative Fuels Infrastructure Directive (and the proposal for a new Alternative Fuels Infrastructure Regulation), it is crucial that we provide funds to deploy alternative fuel infrastructure and OPS across European ports, both in core and comprehensive, to enable the deployment of low to zero emission vessels.

**Green the ports:** Another side of the coin is the greening of ports. If vessels generate the biggest part of emissions (through the fuels they use), ports are at the forefront of maritime transport, and the most visible part. They should improve their own environmental performance, e.g. by phasing out equipment using fossil fuels and greening terminals, but also facilitate vessels' access to alternative fuels. Ports also play a key role for the operation of offshore wind farms. Finally, they can play an important role for the import and export of non-fossil energy products.

**Modal shift:** The highest benefit SSS can bring is by enabling the modal shift of freight from road to sea. Incentives to shift transport demand towards SSS should therefore be further encouraged.

**Foster connectivity:** At the heart of the TEN-T is the idea of fostering connectivity between European Member States. As such, investment should be targeted towards enhancing links between TEN-T ports and the CNCs, as well as peripheral and outermost regions and neighbouring countries.

**Digital Data Exchange:** Digital tools can bring many benefits to the maritime industry, including reducing the administrative burden for ship operators. To facilitate the exchange of data between operators and authorities, it is important to support the development harmonised/standardised exchanges of information and data across the entire door-to-door supply chain.

**Sea and Vessel Traffic:** Looking forward, digital tools, namely machine learning and data analytics have a strong role to play in optimising processes, including sea and vessel traffic. Such use of data can reduce emissions and increase safety by selecting the best routes, or allow for more efficient processes in ports (e.g. just-in-time arrivals). It is thus important to support the development of such tools that can make the maritime sector truly seamless.

**Resilience Plans:** it is suggested that funds are allocated to establish resilience plans, to increase preparedness in the face of the unexpected, and the emergence of exogenous shocks with global impacts. Similarly, putting in place emergency routing solutions will ensure goods can continue to flow, despite future external shocks.

**Climate Adaptation:** The negative impacts of climate change are expected to become more and more prominent in today's world. Maritime infrastructure, especially in peripheral and outermost regions, is particularly exposed to worsening meteorological conditions. It is important to deploy infrastructure that is designed to face such conditions.



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