Deep desktop review and state-of-art of Atlantic waterborne transportation

D1.1

GRANT AGREEMENT NUMBER	EAPA_0038/2022
PROJECT TITLE	SMARTDEC – Smart Clusters for maritime decarbonisation
DELIVERABLE TITLE	Deep desktop review and state-of-art of Atlantic waterborne transportation
DELIVERABLE NUMBER	D1.1
DELIVERABLE VERSION	Version I
CONTRACTUAL DATE OF DELIVERY	28/06/24
ACTUAL DATE OF DELIVERY	28/06/24
DOCUMENT STATUS	Completed
DOCUMENT VERSION	Final
ONLINE ACCESS	Yes/No
DIFFUSION	Public
NATURE OF DELIVERABLE	Report
WORK PACKAGE	1
PARTNER RESPONSIBLE	CMMA & IMDO
CONTRIBUTING PARTNERS	All partners
AUTHOR(S)	Elizabeth Domínguez Chapman (CMMA) Maria Seco Martin (CMMA) Daniel David Esteban Florido (CMMA) Paul Brewster (IMDO)
EDITOR	All partners
PROJECT OFFICER	Carlos GAREA
ABSTRACT	Deep desktop review and state-of-the-art of the Atlantic maritime transport sector: A state-of-the-art analysis was carried out starting from what has already been done (beyond the proposed research), similar projects already funded, and other similar initiatives at a regional and national level. Picture the status of the

	waterborne transportation sector across the 4 Atlantic area countries involved in the project. Macro-analysis of the existing fleet, ports, shipbuilding industry, marine transport infrastructures, and related organisations in each country
KEYWORDS	Maritime, Transport, Atlantic, Decarbonization, Network, Emissions, Innovations

Background SMARTDEC project

“Smart Clusters for Maritime Decarbonisation”, known as SMARTDEC, is an Interreg Atlantic Area project funded by the European Union. This project aims to create and develop a Network of Atlantic hubs of the maritime transport sector to provide tools, knowledge, and structure needed for an efficient implementation of decarbonisation solutions in maritime transportation.

This objective will be reached with a quadruple helix approach in which research & academia, policymakers, society, and the industry will collaborate to develop common strategies to achieve carbon neutrality in the sector.

SMARTDEC will be implemented through several activities. Firstly, comprehensive research on the waterborne transport sector and its decarbonisation in the Atlantic area, focusing on older initiatives, alongside detailed data and narrative analyses specific to each country, will be made. Such efforts are aimed to know the status of the sector in terms of pollution levels and decarbonisation, making identification of key stakeholders crucial for the Atlantic network.

Subsequently, research on innovation and development of emerging technologies will be conducted, leveraging insights collected from the initial activity's findings, stakeholder input, and research facilities. This research will be a summarised consolidation of workshop outcomes and will provide information about technologies that are under development.

The SMARTDEC network will be implemented and action plans for the stakeholders will be developed. This will pave the wave towards setting up and accelerating promising innovations to decarbonise the maritime transport sector. All outputs and results will be available online via an interactive platform.

List of Figures

List of Tables

Acronyms

EU	European Union
R&D	Research and Development
SME	Small and Medium-sized Enterprises
GHG	Green House Gas
IMO	International Maritime Organization
GT	Gross Tonnages
EU ETS	EU Emissions Trading System
TRL	Technology Readiness Level

Executive Summary

The deep desktop review and state-of-art Atlantic waterborne transportation report aims to, firstly, research completed and ongoing projects from EU programmes such as Interreg Atlantic, Interreg Europe, Horizon, EMFAF, and others, that are within the scope of SMARTDEC. with the objective to analyse and conclude how these projects can be of benefit for the Network and what is currently missing in the Atlantic Area to bring up possible solutions; and, secondly, to present the current status of the maritime transport sector in terms of ship calls, vessel traffic, short sea shipping, ports infrastructures, and best practices in the Atlantic Area.

For the achievement of the results, extensive research was conducted using European Union databases that compile numerous projects, their objectives, and outcomes. Databases such as CORDIS, Keep.eu, Waterborne, and Atlantic Maritime Strategy, contributed to the collection of several projects in the scope of SMARTDEC. These projects were listed in a spreadsheet and relevant information about them was introduced with the objective to analyse their outputs and the Atlantic involvement in projects about decarbonisation of the maritime transport sector. Following this project research, a list of the different national funding instruments currently available in Spain, Portugal, France and Ireland was also provided. The research included a review of the current status of the sector in these four countries, using bibliographic reviews and statistical databases, with contributions from all SMARTDEC partners. Finally, an analysis of the report's contents provided a comprehensive conclusion on the needs, gaps, challenges, and expected impacts.

The final findings of the report highlighted several key points. There is a notable lack of involvement from the Atlantic region in engineering and deep tech projects focused on decarbonization. In contrast, EU funding programs such as Interreg North Sea Region have a higher number of R&D projects dedicated to decarbonizing waterborne transportation when compared to Interreg Atlantic. Alternative fuels are still in the very early stages of development, and ships continue to rely heavily on high fuel consumption and fossil fuels. Additionally, logistical management is crucial for reducing emissions in ports, and there is a pressing need for investment and research into charging stations for ports. The high initial costs of implementation of new sustainable technologies at the full value chain scale also presents a significant barrier. Lastly, partnerships and agreements between stakeholders from different categories are essential for advancing these initiatives.

1. Analysis of the Atlantic Maritime Transport Sector

Overview of maritime decarbonisation in Europe

The regulatory context that surrounds green shipping is highly dynamic. In the Communication from the European Commission in 2013 about integrating policies for reducing the maritime transport GHG emissions, it was decided to set 3 key actions:

1. Implementing a monitoring system since large ships in EU ports were required to monitor, report, and verify their CO2 emissions.
2. Targeting GHG reduction for the maritime transport sector.
3. Implementing additional market-based measures.

The implementation of Regulation (EU) 2015/757 in April 2015 was the initial step for monitoring, reporting, and verifying CO2 emissions from maritime transport, known as the EU MRV Regulation.

From 2018, businesses were required to monitor fuel consumption and other parameters for vessels exceeding 5 thousand gross tonnages (GT) on voyages to and from EU ports. Subsequently, these companies had to develop emissions reports to the European Commission and relevant flag State authorities, encompassing annual CO2 emissions and other pertinent data for the preceding calendar year.

Since then, the European Commission kept implementing new strategies and improving the regulation for a successful reduction of the GHG emissions such as the European Green Deal with the well-known Fit 55 and FuelEU Maritime policies. The European Green Deal is the strategy that shows the commitment of Europe to achieve climate neutrality by 2050, and for this reason, fit 55, to reduce the GHG emissions to at least 55% by 2030, and FuelEU Maritime, to boost the adoption and regular usage of renewable and low-carbon fuels, were implemented as well to achieve the reduction of GHG emissions from the waterborne transport sector.

Additionally, and as a first milestone, the EU ETS system that contributes to the Fit55 was established under the European Climate Law. This system was launched in 2005 and it operates in trading phases. The EU ETS is a 'cap and trade' system that limits greenhouse gas emissions from certain sectors. The cap is reduced annually to ensure emissions decrease over time. Emission allowances are used, where one allowance equals one tonne of CO2. Companies must match their emissions with allowances, buying or trading them as needed, or face fines. This system has helped reduce emissions by 37% since 2005 (European Commission, 2021-2030).

At the International level, the International Maritime Organization (IMO) has recently adopted a revised GHG reduction strategy for global shipping at the MEPC 80, which includes ‘an enhanced common ambition to reach net-zero GHG emissions from international shipping close to 2050, a commitment to ensure uptake of alternative zero and near-zero GHG fuels by 2030, as well as indicative check-points for 2030 and 2040. This is a significant acceleration in the reduction of emissions compared to the strategy agreed only 5 years ago.

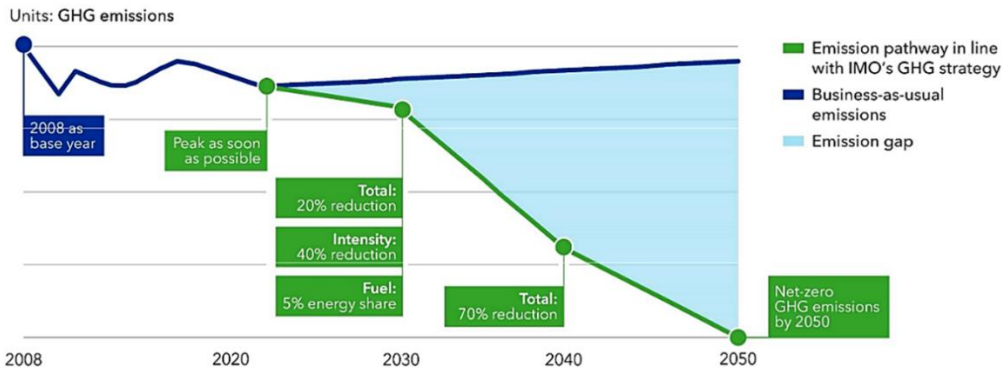


Figure 1 *– Outline of ambitions and minimum indicative checkpoints in the revised IMO GHG strategy*
Source: IMO

Amendments to MARPOL Annex VI, effective from November 1, 2022, were developed under the 2018 IMO Strategy on GHG Emissions Reduction. These changes mandate that ships enhance their energy efficiency to cut greenhouse gas emissions. From January 1, 2023, ships must calculate their Energy Efficiency Existing Ship Index (EEXI) to assess energy efficiency and begin collecting data for the annual operational Carbon Intensity Indicator (CII) and its rating. The goal is to reduce ships' carbon intensity by 40% by 2030 compared to 2008 levels.

Figure 2 *- EEXI infographics*
Source: IMO

The EEXI measures a ship's energy efficiency against a baseline, requiring ships of 400 gross tonnage and above to meet set standards. The CII calculates the annual reduction needed for continual carbon intensity improvement, linking emissions to cargo carried over distance travelled and verifying the actual performance against the required standards (IMO, 2024).

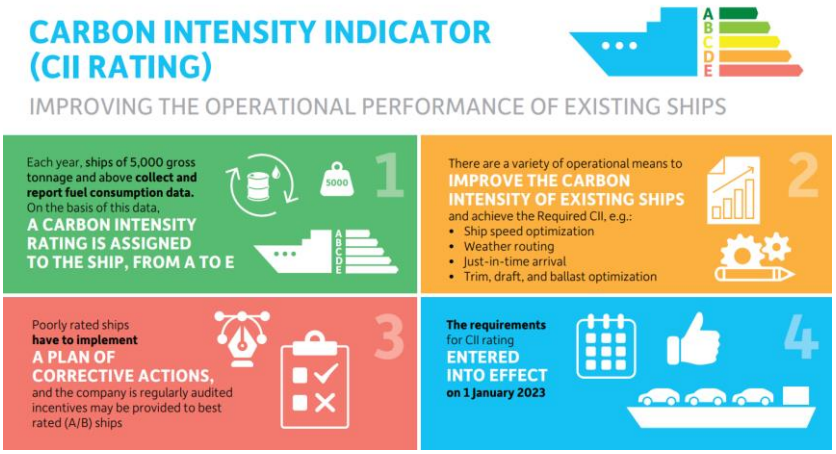


Figure 3 *- CII Rating Infographics*
Source: IMO

The latest "Maritime Forecast to 2050" report (DNV , 2023) provides an update on the progress of decarbonisation in shipping. There are increases in the orders for new ships able to run on lower carbon fuel options, but very few operating vessels are currently doing so. Maritime will have to compete with other sectors to secure the amounts of the available global supply of carbon-neutral fuels needed to achieve the IMO targets. However, reducing energy consumption can make a significant contribution, for example, 'Smart' and digital systems on individual vessels and fleets offer high rewards through operational efficiencies.

The DNV report highlights the role "green shipping corridors" can play in overcoming the technical, practical, organizational, legal, political, and financial barriers to the uptake of carbon-neutral fuels in the maritime industry.

At "COP26" in Paris 2021, governments united to address the pressing need for Green Shipping Corridors (GSC) by endorsing the Clydebank Declaration to which Spain, Ireland, and France were signatories. A GSC is a specific trade route where the feasibility of zero-emission shipping is catalyzed by public and private action.

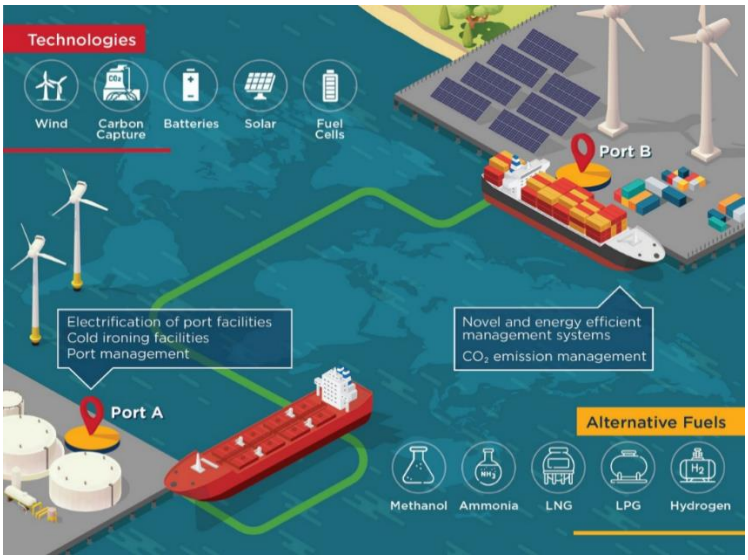


Figure 4 *- Infographic of a high-level vision of an operational green shipping corridor*
Source: ABS

The “Annual Progress Report on Green Shipping Corridors” (Global Maritime Forum, 2022) provides a summary of GSC initiatives underway. However, the involvement of ports in the Atlantic area is currently at a very low level.

GSCs are now seen as a major lever towards shipping decarbonization and the 2022 GSC progress report identifies 21 initiatives worldwide, 12 of them concerning short sea shipping. It is expected that by 2026, more than six GSCs will be in operation. Although there is still uncertainty about the energy sources to be used for these initiatives, the main alternative fuels envisaged so far are green methanol and green ammonia, while green hydrogen, synthetic diesel, and electric power are also considered. As green methanol and green ammonia are produced from green hydrogen, the cost of fuel remains one of the main challenges as well as the and safety concerns with ammonia.

Figure 5 *- Annual Progress Report on Green Shipping Corridors*
Source: Global Maritime Forum 2022

The number of ultra large transport ships is expected to represent around 40% of transport vessels by 2050, and a key challenge is to decarbonise them or build them in a way that they are energy efficient and that does not affect their efficiency/speed

The installation of onshore power supply (OPS) in ports will also, and is critical to, contribute to decarbonisation in the maritime sector and the FuelEU Maritime Regulation imposes a requirement to use On-shore Power Supply (OPS) while at berth for container and passenger ships from 2030 onwards. Several ports in the Atlantic area are developing plans for the deployment of OPS, however, none are currently in operation according to the latest insights data from DNV.

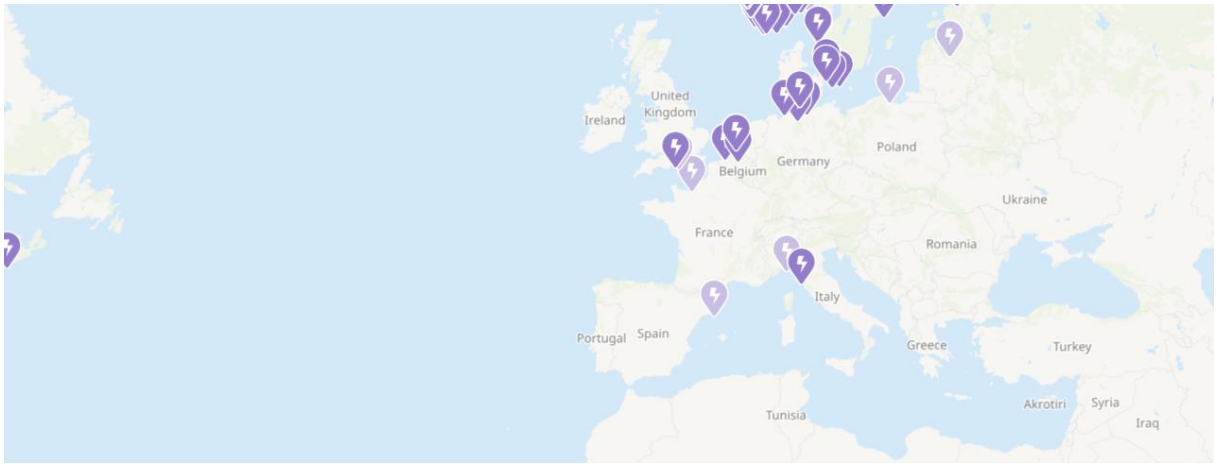


***Figure 6** - Alternative Fuels Insight platform*
Source: DNV

Review of Previous Research and Initiatives

Maritime transport plays a pivotal role in Europe's economic growth, fostering trade connections among nations while guaranteeing the steady supply of vital resources such as energy, food, and commodities. With almost 90% of the EU's external freight trade (container, tanker, bulk, ro-ro, cargo) reliant on seaborne transportation, it serves as the primary route for the continent's imports and exports across the globe. Short sea shipping within the EU itself accounts for a substantial portion of intra-EU trade, highlighting its importance in regional commerce. The reliability of maritime transport is pivotal for sustaining a high quality of life in Europe's islands and peripheral maritime regions, where it serves as a lifeline for essential goods and services.

European ports play a crucial role in facilitating maritime trade, handling over 400 million passengers annually. Beyond its role in trade facilitation, the maritime sector significantly contributes to the European economy by providing employment opportunities and generating income across various industries. Overall, maritime transport is not only a means of moving goods and people but also an indispensable driver of Europe's economic vitality and societal well-being, underlining its enduring significance in the continent's history and future prosperity. Furthermore, other major activities such as fishing and aquaculture, which provide a meaningful share of the diet of European coastal communities, and offshore service vessels, for construction, installation and maintenance of coastal and offshore infrastructures, rely on seagoing vessels.

The European Commission first approach to the maritime transport sector was in the 1985 memorandum called “Progress towards a common transport policy – maritime transport” and in the Commission communication of 1996 “Towards a new maritime strategy” (Debyser, 2023). This marked the initial move towards regulating the maritime transport industry and laid the groundwork for the current decarbonisation strategy within the sector.

Consequently, projects aimed at improving the maritime transport sector and its decarbonisation have been successfully undertaken with funding from the European Commission, fostering innovation and collaboration among EU members. These initiatives have provided practical solutions and strategies that are now in daily use, contributing to the reduction of greenhouse gas emissions in the waterborne transport sector.

One of the interesting areas to research is the Atlantic one. This area holds considerable potential to bolster the EU's blue economy, since it stands as the largest sea basin in terms of Gross Value Added (GVA), constituting 36% of the EU's blue economy GVA (European Commission, 2024). In the Press Release for the announcement of the adoption of an Action Plan for the Atlantic Ocean Area, it was stated that the Atlantic Ocean hosts a multitude of maritime endeavours, encompassing traditional pursuits like fisheries, aquaculture, tourism, and shipping, alongside other emerging sectors such as offshore renewables and marine biotechnology. Within this context, each EU member of the Atlantic Area (Ireland, France, Portugal, and Spain) is actively engaged in various maritime domains, with some having formulated their specific maritime strategies. The Action Plan currently advocates for collaborative efforts among these Member States, promoting the exchange of information, resources, outcomes, and best practices, while also fostering the exploration of additional avenues for cooperation (European Commission, 2013).

A. Interreg Atlantic projects

The Interreg Atlantic Area Programme aims to promote cross-border collaboration in the Atlantic regions of Portugal, Spain, France, and Ireland. Through the new 2021-2027 program, support for innovative initiatives fostering growth in this area will be provided. The program consists of 4 thematic priorities: blue innovation and competitiveness, blue and green environment, sustainable tourism a culture, and better governance for cooperation.

Waterborne transportation is crucial to the EU's Blue Economy, yet decarbonisation remains the primary challenge in addressing environmental degradation. It has been noted previously that the European Commission has introduced a range of regulations and initiatives for EU member states to adhere to, aimed at mitigating the environmental impact of human activities. To face this challenge, the European Commission has allocated funding to European Projects aimed at mitigating environmental impact through research and innovation in areas such as renewable energies, biofuels, electric vehicles, efficient consumption, waste reduction, and other related fields.

This is the case of different EU projects, including “Funding Atlantic Network for Blue Economy Technology Transfer” of the 2014 - 2020 INTERREG VB Atlantic Area Programme, co-funded by the European Union (FANBEST, 2019-2023), which seeks to improve the technology transfers strategies to SMEs in the field of sustainable exploitation of marine resources by increasing the offer of funds and financial support available, and by improving the ecosystem and tools for future beneficiaries.

SMARTDEC’s objective of establishing an Atlantic network to share knowledge, innovations, emerging technologies, and best practices of decarbonisation of the waterborne transportation is directly related to FANBEST. This is because FANBEST offers a stakeholder map detailing their funding support, which proved its benefits for the Atlantic network. Additionally, it highlights the significant innovative capacity of numerous blue economy companies, facilitating the sharing of emerging technologies. Moreover, SMARTDEC leverages the financial capabilities of stakeholders to invest in R+D+I within the maritime sector towards decarbonisation.

It appears that the Interreg Atlantic Area supports relatively few projects focused on maritime decarbonization compared to regions like the North Sea. The North Sea region is engaged in several initiatives such as "Developing Low Carbon Utilities, Abilities, and Potential of Regional Entrepreneurial Ports" (DUAL Ports, 2015-2021), aimed at decarbonizing ports, "Wind Assisted

Ship Propulsion" (WASP, 2019-2023), which researches and tests wind propulsion on five vessels to reduce fuel consumption and emissions, and "Zero Emission Ports North Sea" (ZEM Ports NS, 2019-2023), which promotes the use of zero-emission fuels, electric and hydrogen, in ports and the maritime sector. These projects align with SMARTDEC's goals, highlighting the need to transfer and adapt new technologies and knowledge to the Atlantic Area to advance the decarbonization of the shipping sector.

B. Other EU funded projects

Besides the projects led by the Interreg Atlantic Area Programme focusing on decarbonisation, European coastal countries outside the program also collaborate to address one of the European Commission's most pressing concerns: reducing greenhouse gas emissions.

The following table contains all the EU funded projects collected and researched in the different platforms:

PROJECT NAME	ACRONYM	PERIOD	PROGRAMME
Saving fuel and emissions from maritime transport in the Adriatic region	GUTTA	2019-2022	2014 - 2020 INTERREG V-A Italy – Croatia
Grow and accelerate your smart projects in new value chains of the European Blue Economy	GALATEA	2020-2023	Horizon 2020
Onshore Power Supply OPS Project for the Port of Bilbao	BilbOPS	2022-2026	2021-2027 Connecting Europe Facility Transport
Automation Towards Multimodal Transportation and Integration of Freight	AUTOMOTIF	2024-2027	Horizon Europe
Atlantic Smart Ports Blue Acceleration Network	AspBAN	2021-2022	EMFF
Cooperative information platform for low carbon and sustainable mobility	CISMOB	2016-2020	Interreg Europe

Often, observing the solutions implemented on the opposite side of Europe can bring valuable insights, technologies, innovations, and initiatives that can be adapted and implemented in alternative ways in the Atlantic Area.

This is the case of the "saving fuel and emissions from maritime transport in the Adriatic region" project, co-funded by the European Union (GUTTA, 2019-2022), is dedicated to developing

software aimed at minimising CO2 emissions in ferry routes, thereby contributing to decarbonisation efforts. In today's climate-conscious world, the maritime industry faces mounting pressure to reduce emissions and embrace sustainable practices. As one of the primary modes of transportation for both goods and people, ferries play a significant role in this narrative. By optimising ferry routes to minimise CO2 emissions, Gutta not only addresses environmental concerns but also sets a precedent for the broader transportation sector.

Gutta aligns with SMARTDEC objective in its efforts to mitigate the environmental footprint by developing the software to establish the best ferry routes to reduce GHG emissions. Passenger transportation, particularly cruises and ferries, holds significant importance in the waterborne transportation as it plays a vital role in the tourism of coastal areas. In this regard, stakeholders from the sub-sector can be reached through the database the project provides for the mapping of stakeholders and research facilities that will be involve in SMARTDEC. The GUTTA database comprises 43 academic facilities, 92 institutions, 104 businesses, and 103 sectoral agencies. (Gutta, 2020).

Other initiatives contributing to the net-zero emissions goal involve partners from the Atlantic Area. These initiatives will benefit the SMARTDEC Atlantic Network by enabling the sharing of knowledge, technologies, and best practices. However, there are limited examples from the Atlantic Area, as most research focuses on decarbonising other sectors. Although these initiatives are part of EU programs beyond the Interreg scope, further R&D on maritime transport decarbonization can still be pursued through the Interreg Atlantic Area program.

The “Grow and accelerate your smart projects in new value chains of the European Blue Economy” project, co-funded by the European Union (GALATEA, 2020-2023), targeted four main domains of Blue Growth having a high potential in terms of smart and sustainable growth: Smart Port, Smart Ship, Smart Shipyard, Maritime Surveillance. With the aim to accelerate the development of new value chains in the blue economy, GALATEA is implementing an innovation support scheme: 1) Challenges developed from the four main axes, 2) SMEs placed ate the heart of the ideation process, 3) GALATEA supervised the matchmaking of European SMEs in order to create cross-sectorial and cross-border partnerships, and 4) GALATEA supported SMEs through the TRLs increasing process to have access to a financial support and/or cluster services.

“Onshore Power Supply OPS Project for the Port of Bilbao” project, co-financed by the European Union (BilbOPS, 2022-2026), counts on the EU funding for the execution of a strategic investment project drawn up by the Bilbao Port Authority for the electrification of the container, cruise-liner and ferry wharves by deploying OPS (Onshore Power Supply) technology, also known as cold-ironing, with 11 connection points. This technology enables vessels with the right equipment to connect to the onshore power supply while they are berthed, and disconnect their diesel motors. This does away with emissions of greenhouse gases (CO2, nitrogen & sulphur dioxide), vibrations and noise and is thus beneficial to the environment and to human health.

The “Automation Towards Multimodal Transportation and Integration of Freight” project, co-funded by the European Union (AUTOMOTIF, 2024-2027), that focus on the development of strategies, business and governance models, regulatory recommendations and synergies enabling the integration and interoperability of automated transport systems and solutions towards the operational automation of multimodal cargo flows and logistics supply chains in the intra-European network. Real challenges and gaps in seamless automated logistics that will be simulated in real settings and different geographical locations to set up a master

scenario addressing the end-to-end delivery of goods using highest degree of automation possible, based on their social, environmental and economic impact, such as decreased emissions and congestion, improved working conditions and safety, as well as reduced logistics and freight transport costs, with the SSH aspects being a priority.

Through the Atlantic Maritime Strategy, it can also be observed and researched on projects aiming for the decarbonisation of the sector, how the European Commission listen to what stakeholders have to say. This Atlantic Strategy was adopted in 2011 in response of persistent calls from stakeholders for enhanced, inclusive, and efficient collaboration in the Atlantic Ocean Area (European Commission, 2024). Aligned with the EU 2020 agenda and its flagship initiatives, the strategy categorised the challenges and opportunities in the Atlantic region into five primary thematic areas: implementing the ecosystem approach, reducing Europe's carbon footprint, sustainable exploitation of the Atlantic seafloor's natural resources, responding to threats and emergencies, and socially inclusive growth (European Commission, 2011).

The “Atlantic Smart Ports Blue Acceleration Network” project, co-funded by the European Union (AspBAN, 2021-2022), empowers EU Atlantic ports to thrive as blue economy hubs. By fostering new blue companies, AspBAN diversifies revenue streams and promotes sustainability. With a wide network of 123 strategic partners and 391 ports globally, AspBAN aimed to address common challenges, attract start-ups, secure investments, and reduce CO2 emissions across 30 ports.

Ports play a crucial role in maritime transportation, serving as the primary hubs of the Blue Economy by offering essential infrastructure and services for any type of vessels. This is the reason why SMARTDEC targets the decarbonisation of ports and infrastructures within the waterborne transport sector. AspBAN's research on port innovation needs and accelerator activities (AspBAN, 2021), highlights a deficiency in port innovation within certain Atlantic regions. Despite access to funding and government support, there are persistent barriers blocking innovation efforts. These findings are crucial for SMARTDEC as it navigates engaging stakeholders, considering the complexities surrounding innovation within the ports sub-sector.

Through the “Cooperative information platform for low carbon and sustainable mobility” project, co-funded by the European Union (CISMOB, 2016-2020), was dedicated to advancing urban sustainability through the strategic utilisation of Information and Communication Technology (ICT) to streamline transport operations and mitigate carbon footprint. By harnessing the capabilities of sensor technology and data analytics, CISMOB focus on informing about policymaking, optimising traffic management, and promoting environmentally conscious mobility options. In addition to CISMOB, the “Prioritizing low carbon mobility services for improving accessibility of citizens” project of the Interreg Europe programme, co-funded by the European Union (PriMaas, 2019), had the goal to integrate traditional and innovative transport modes, ensuring equitable, low-carbon, and accessible mobility options.

Both projects share a common focus on promoting policy changes aimed at decarbonisation. While many initiatives in the Atlantic region address decarbonisation to some extent, SMARTDEC uniquely focusses on decarbonising waterborne transportation. This targeted objective offers several advantages, including access to insights, stakeholder databases across various sectors, the exchange of best practices, and extensive research on emerging technologies, all of which boost the project toward its goals.

C. Zero Emission Waterborne Transport (ZEWT) partnership

The Horizon 2020 programme, the predecessor to Horizon Europe running from 2014 to 2021, supported a wide range of projects in the Waterborne sector as it can be seen in the figure below.

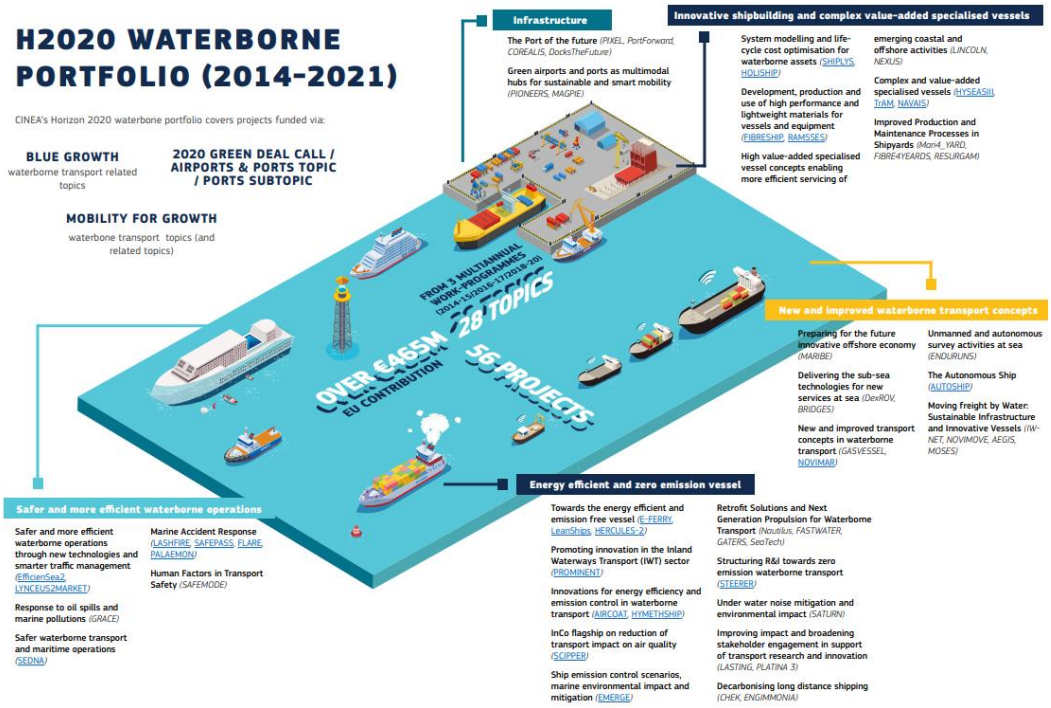


***Figure 7** - Waterborne Transport Projects - Horizon 2020 projects managed by CINEA and opportunities for synergies ; Source: European Commission*

In the Horizon Europe programme, the Co-Programmed Partnership on Zero-Emission Waterborne Transport (ZEWT) was established. The Strategic Research and Innovation Agenda produced by ZEWT (Waterborne, 2023) informs the call topics announced by the European Commission. The CORDIS database shows that 34 projects have been awarded funding for Horizon Europe calls under the ZEWT partnership.

Nearly fifty projects have been identified that contribute directly to the goals of the ZEWT partnership that involve over 500 partners from across Europe. However, less than 80 partners (16%) are from the Atlantic area. Further research can be undertaken on the database of projects through the stakeholder consultations to gain an understanding of any barriers or bottlenecks that may be contributing to the relative low level of participation of partners from the Atlantic area in these projects.

Some of the projects highlight the strengths and capabilities of the Atlantic Area that can make a significant contribution to achieving the overall aim to provide and demonstrate zero-emission solutions for all main ship types and services before 2030, which will enable zero-emission waterborne transport before 2050.

For example, the DT4GS project is aimed at delivering an “Open Digital Twin Framework” for both shipping companies and the broader waterborne industry actors to tap into new opportunities made available using Digital Twins (DTs). There are two partners from Ireland, IBM Ireland and Konnecta Systems, from the digital cluster that has been established.

Another example is the GAMMA project that aims to revolutionise energy conversion technologies by integrating biomethanol and ammonia fuels. The project's goal is retrofitting an Ultramax bulk carrier for international routes. The project partners include a Portuguese company, Amnis Purs, that specialises in hydrogen purification and two French companies with expertise in developing new technologies for the transport sector.

However, the trend of a relatively low level of participation from partners in the Atlantic Area is also evident and merits further investigation through the stakeholder consultations.

D. National programmes

In addition to the European programmes, there are national funding programmes in France, Spain, Portugal and Ireland that could be applied to support research and innovation on maritime decarbonisation. A summary of the relevant national programmes identified is provided in a table in Appendix A.

Some of the national funding programmes are dedicated to the maritime sector (shipping & ports), however, most of the programmes are open to other industrial sectors. Projects in maritime decarbonisation would therefore have to compete for funding from these programmes.

It is not clear if there is any degree of coordination between national funding programmes to support decarbonisation in the maritime sector. However, the recent announcement for a co-funded call on developing green shipping corridors between Ireland and the UK, funded by InnovateUK and the Marine Institute in Ireland, is an example of coordination activities that could be realised.

Furthermore, consultation with stakeholders involved in successful projects and the funding providers will be required to assess the relative success of projects related to maritime decarbonisation.

E. Conclusion

In terms of funding, it is evident that investment in decarbonising the maritime transport sector is in progress and the establishment of the co-funded partnership on "Zero Emission Waterborne Transport (ZEWT)" means that over €1bn, from the Horizon Europe programme and industry contributions, will be invested in research and developments in this area during the 2021 – 2027 period.

These investments will support the start of actual implementation of the new solutions that are being developed through innovative initiatives and research such as software to monitor CO2 emissions, wind powered ships, green hydrogen as alternative fuel, Atlantic networks to promote sustainable solutions, routing of ferries to reduce the carbon footprint, reducing fuel consumption, smart on-shore power supply technology to turn off the motors while ships are on-shore, and many more.

It appears that the Interreg Atlantic Area supports relatively few projects focused on maritime decarbonization compared to regions like the North Sea. This might influence the Atlantic exclusive countries capacity to leverage their own maritime sector technologies development and roll-out.

Even when we count many European funding programs (European Commission, 2021-2027) such as the ones from Interreg, Horizon, EMFAF, and Connecting Europe Facility; and with national funding programs [see the table in Appendix 1], these are focused on research and testing, meaning that it is still in a very early stage and most solutions cannot be implemented or commonly used among the key actors of the waterborne transportation.

Through the desk-based research done among the waterborne projects that aim to decarbonize the sector (Waterborne Technology Platform, 2024), the participation levels from companies and research centres in the Atlantic Area appears to be relatively lower than other areas. Further research through the stakeholder consultations should examine this issue in more detail. The stakeholder consultations could analyse factors such as politics, quality of the workforce, the economic relevance of the sector in the countries, behaviour and talent of younger generations, and public/private investment.

2. Status Picture of the Waterborne Transportation Sector

The number of vessels calling at main EU ports was estimated at 2.2 million (Eurostat, 2024), with Spain (200,000 vessels) having one the highest totals. The total gross weight of goods handled in EU ports was estimated at 3.5 billion tonnes and some of the main cargo ports are located in France, Spain, and Portugal.

Vessels in main ports, in selected years, 2012-2022
(number)

	2012	2018	2019	2020	2021	2022	Change 2022/2021 (%)	Change 2022/2012 (%)
EU	**2 096 398**	**2 189 422**	**2 278 469**	**1 944 030**	**1 993 617**	**2 232 354**	**12.0**	**6.5**
Belgium	26 795	25 758	25 726	23 679	24 707	23 079	-6.6	-13.9
Bulgaria	3 648	3 121	3 451	3 161	3 101	3 257	5.0	-10.7
Denmark	348 391	325 283	322 427	323 819	328 192	324 241	-1.2	-6.9
Germany	111 989	112 825	110 374	104 925	106 307	117 120	10.2	4.6
Estonia	28 474	30 276	30 774	28 730	31 335	32 091	2.4	12.7
Ireland	11 378	12 587	12 384	11 428	12 346	12 147	-1.6	6.8
Greece	511 951	478 567	515 899	362 036	424 557	448 495	5.6	-12.4
Spain	148 794	198 948	204 514	136 661	159 416	199 957	25.4	34.4
France	44 800	64 092	63 003	41 967	51 099	58 939	15.3	31.6
Croatia	205 040	279 916	285 456	198 116	246 266	274 255	11.4	33.8
Italy	437 058	427 551	472 540	505 968	381 820	504 411	32.1	15.4
Cyprus	2 324	2 250	2 263	1 833	1 818	2 201	21.1	-5.3
Latvia	7 404	6 680	6 428	5 824	5 629	5 740	2.0	-22.5
Lithuania	4 857	4 932	5 075	5 033	5 123	4 484	-12.5	-7.7
Malta	22 600	27 308	30 202	31 676	39 611	43 569	10.0	92.8
Netherlands (¹)	36 637	37 276	36 308	32 864	41 575	42 264	1.7	15.4
Poland	15 300	18 678	17 725	15 599	17 211	16 732	-2.8	9.4
Portugal	11 137	14 116	14 189	12 002	12 153	12 710	4.6	14.1
Romania	4 678	4 044	4 123	4 100	5 232	5 356	2.4	14.5
Slovenia	1 980	1 878	1 649	1 397	1 527	1 812	18.7	-8.5
Finland	33 818	31 145	31 968	25 297	26 213	26 641	1.6	-21.2
Sweden	77 345	82 191	81 991	67 915	68 379	72 853	6.5	-5.8
Iceland	:	:	:	:	:	:	:	:
Norway	66 268	58 379	59 442	60 953	64 389	71 189	10.6	7.4
Montenegro	:	580	614	510	595	977	64.2	:
Türkiye	65 008	59 446	55 081	48 685	51 031	57 792	13.2	-11.1

(:) not available
Note: main ports are ports handling more than one million tonnes of goods or 200 000 passengers annually. Data are based on inward declarations.
(¹) Break in time series from 2021 due to methodological improvement in the data reported by the Netherlands.

***Table 1** - Vessels in main ports 2021-2022*
Source: Eurostat

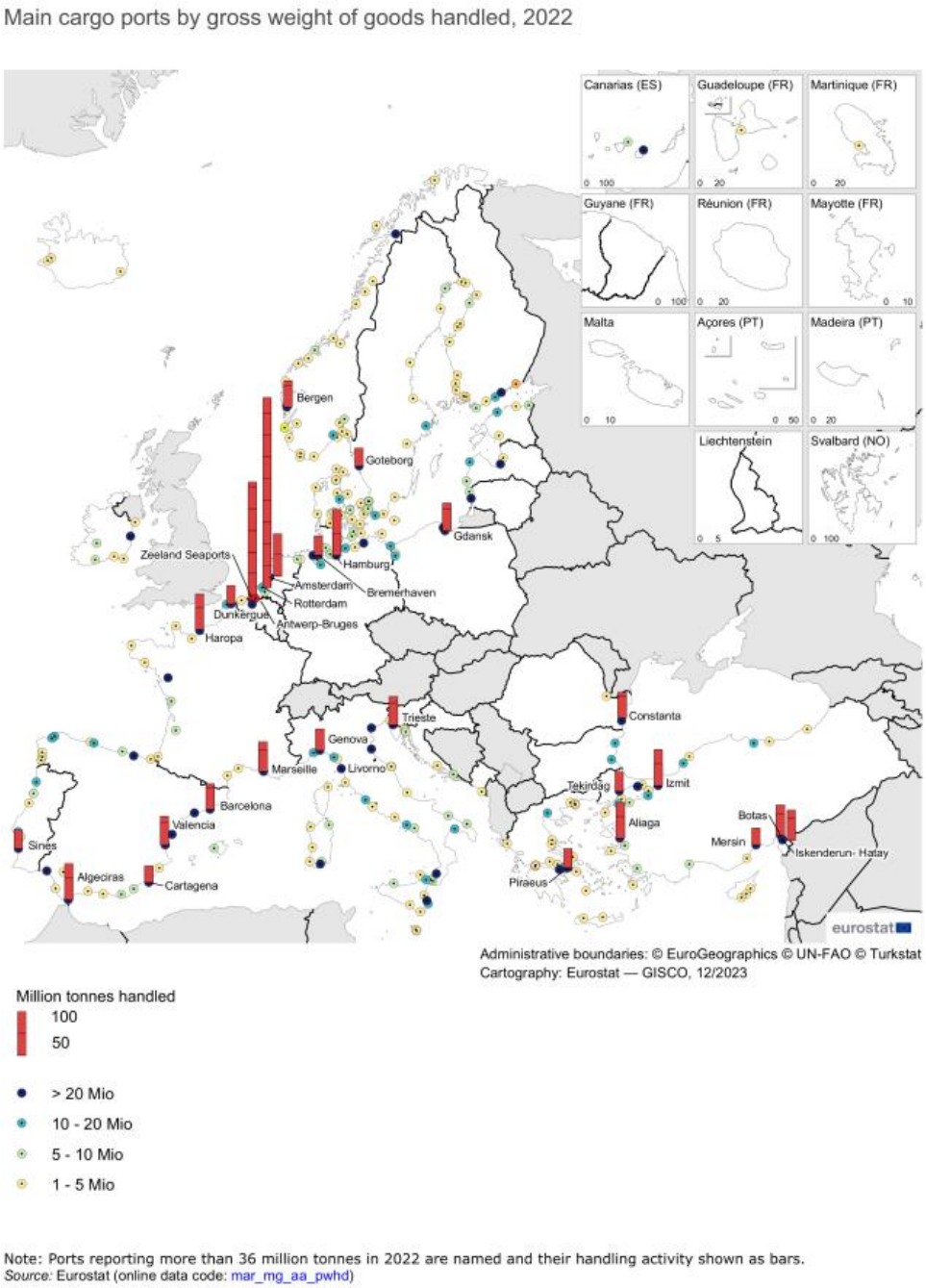


***Figure 8** - Main cargo ports by gross weight of goods handled 2022*
Source: Eurostat

The first European Maritime Transport Environmental Report (EMTER) (European Environment Agency & European Maritime Safety Agency, 2021), published in 2021, provides a comprehensive analysis of the environmental impact of the maritime transport sector and progress in addressing the decarbonisation challenge and other pollution issues related to shipping.

In 2018, ships calling at EU and European Economic Area ports emitted around 140 million tonnes of CO2.

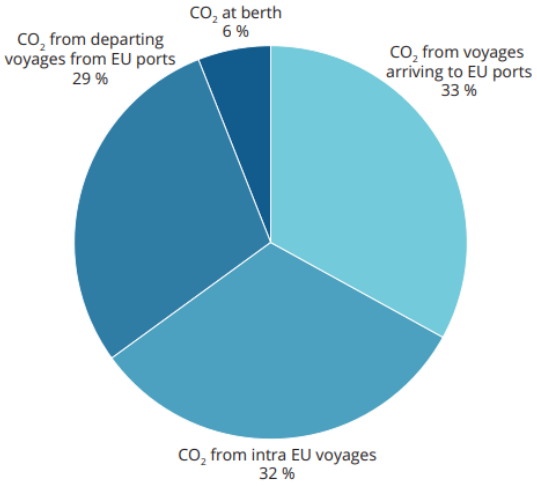


Figure 9 *- Emissions from ships calling at EU and European Economic Area ports in 2018*
Source: EMTER (European Environment Agency & European Maritime Safety Agency)

The most ship calls in the EU were made by Ro-pax ships, which highlights the importance of short-sea shipping to the EU's economy, representing 58.2 % of the total sea transport of goods to and from the main EU ports in 2022. However, Atlantic countries such as Spain and France are less relevant if we take into account the total sea transport, but in terms of freight, Spain, France and Portugal are top 3, 7 and 12. Nevertheless, in terms of CO2, the highest volume of GHG emissions came from container ships, followed by bulk carriers and oil tankers. These ship types are associated with higher levels of extra-EU cargoes.

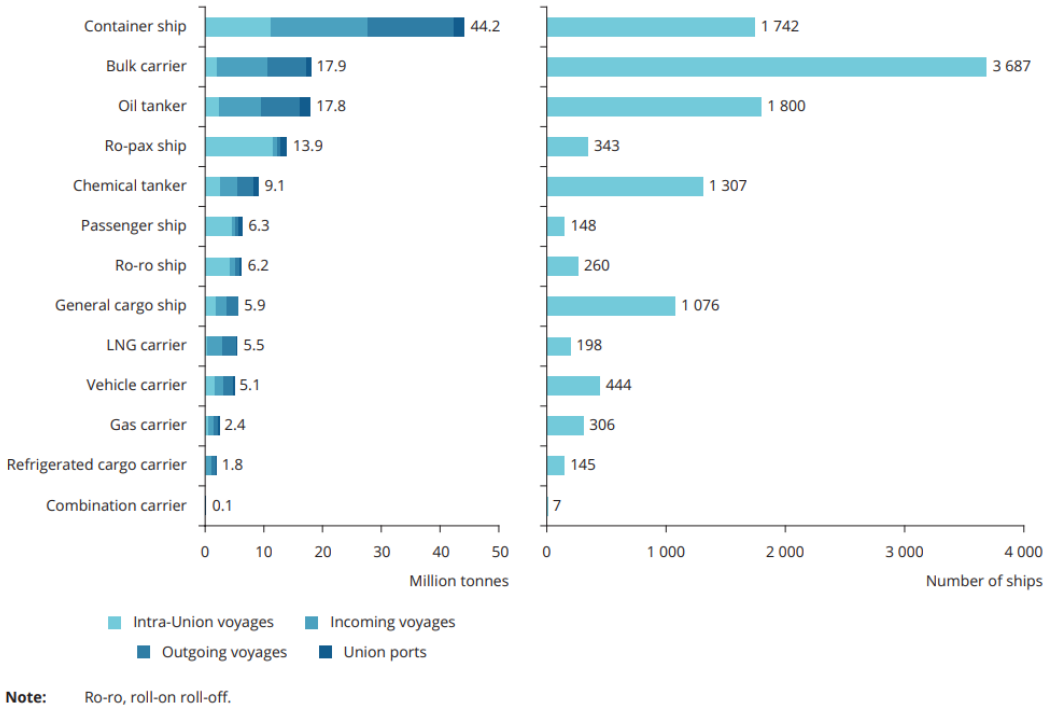


Figure 10 *-Total amount of CO2 emissions by ship type, 2018*
Source: EMTER (European Environment Agency & European Maritime Safety Agency)

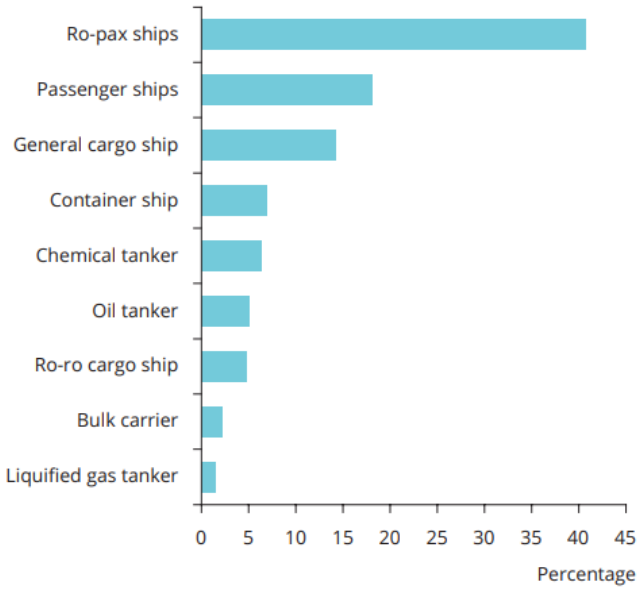


Figure 11 *- Port call distribution in EU ports by ship type*
Source: EMTER (European Environment Agency & European Maritime Safety Agency)

Shipbuilding and ship recycling are also a major part of Europe's maritime industry. France and Spain are among the leading countries for shipbuilding in the EU.

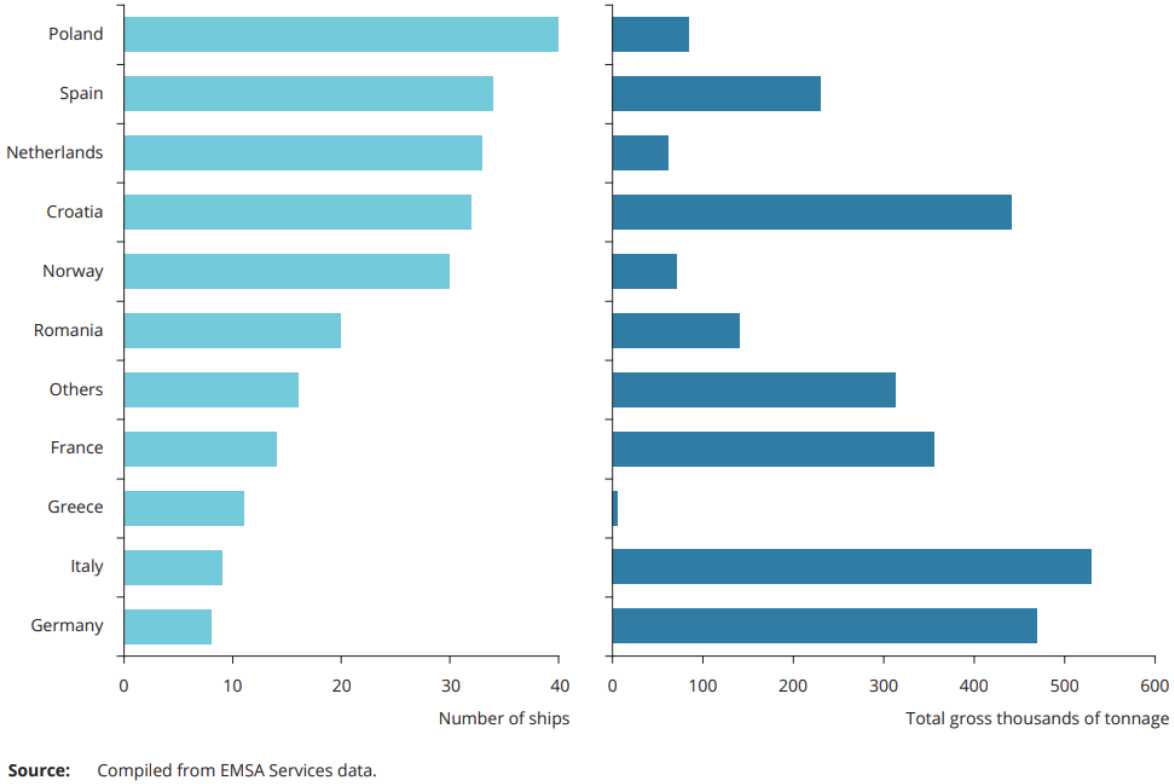


Figure 12 *- GT and number of new ships built in EU Member States and Norway in 2019*
Source: EMTER (European Environment Agency & European Maritime Safety Agency)

The OECD provides estimates for the CO2 emissions from all vessel types and the total for France, Spain, Ireland and Portugal in 2022 was 34,803,172 tonnes.

Vessel type	All vessels			
Measure	Tonnes of CO2-equivalent OECD estimation			
Frequency	Annual			
Time	2019	2020	2021	2022
Country				
France	24,529,952.5	22,931,460.6	24,876,311.1	27,474,728.0
Ireland	2,376,214.5	2,389,695.4	2,368,976.8	2,427,529.8
Portugal	369,119.5	508,114.1	444,178.6	480,716.2
Spain	4,117,102.5	4,302,097.4	4,202,446.4	4,420,199.3

***Table 2** - Maritime Transport CO2 Emissions*
Source: OECD stat

These measure stats differ in high values from the STEAM model, a shipping emission model, developed by Finnish Meteorological Institute (FMI), in the scope of the EMERGE project. These data are not public yet, but it will be part of the CAMS emissions which are based in different existing data sets (e.g. nationally reported emissions, EDGAR, ECLIPSE and CEDS), which ensures good consistency between the emissions of greenhouse gases, reactive gases and aerosol particles and their precursors (European Comission - Copernicus, 2024).

A. Spain

Spanish port system consists of 46 general interest ports and its 28 Port Authorities closed in 2022 with a total traffic of 564.6 million tonnes. In terms of cargo type, dry and liquid bulk presented a growth of 10.8% and 6.9% in 2022 respectively, yet, general cargo, the largest group, faced a decrease of 1.8%, even though, according to Transporte XXI (INDUSTRIA Y COMUNICACIÓN SA, 2023), "the six leading ports in Spain in terms of freight traffic (Algeciras, Valencia, Barcelona, Cartagena, Bilbao and Huelva), concentrate 64% of the cargo handled by the port system as a whole, with a movement of more than 350 million tonnes, not including inland cargo, provisioning and fishing".

Algeciras Port finds itself at its peak among the Iberian ports, and it is in the fourth position in the European Union's top list of total traffic. This port reached 108.3 million tonnes at the end of 2022 with a growth of 3% in comparison with the previous year (INDUSTRIA Y COMUNICACIÓN SA, 2023).

RK	PORT	COUNTRY	2022	%22/21	%22/19	2021	2020	2019
1	Roterdam	Netherlands	467.4	-0%	-0%	468.7	436.8	469.4
2	Amberes + Zeebrugge	Belgium	286.9	-1%	+1%	288.9	277.8	284.0
3	Hamburg	Germany	119.9	-7%	-12%	128.7	126.3	136.6
4	Algeciras	Spain	108.3	+3%	-1%	105.1	107.3	109.4
5	Haropa	France	85.1	+2%	-5%	83.6	75.0	90.0

***Table 3** - Top 5 ports of the EU by total traffic in million tonnes*
Source: Port Authorities. Elaboration: Transporte XXI

According to Transporte XXI and Port Authorities, Port of Las Palmas has reached of 28.8 million tonnes in 2022 and with a growth of 8% than in 2019, meaning that is one of the European ports of the Atlantic area with highest growth since the pandemic.

In terms of container traffic, Algeciras stays top five in the EU with a throughput of 4.8 million TEUs, ending 2022 with a decrease in international shipping and a growth in national shipping and import-export traffic according to Gerardo Landaluce, president of the port.

In 2022, Puertos del Estado estimated a market share gap of 34.4% between the Mediterranean and Atlantic sea basins. Historically, Mediterranean ports have dominated shipping traffic, largely due to the extended Mediterranean coastline and the international importance of Algeciras Port. Nevertheless, the Atlantic Ports have been lately gaining value in the European Union and it is closing its gap between both Spanish borders.

***Figure 13** - Share of total cargo in the Spanish port system*
Source: Puertos del Estado

Recently, the rest of the Andalusian Ports were introduced as eligible in the Interreg Atlantic Area Programme 21-27 (Interreg Atlantic Area, 2022). Even when Andalusian Ports focus its shipping activity in the MED area, it cannot be ignored the fact that it plays a pivotal role in the Atlantic due to their nearness to the opposite border and their internationalisation.

Taking a closer look at how Spain's waterborne transport sector is bouncing back and showing its strengths, let's focus on the Spanish Atlantic seaboard.

				2022		
	2022	%22/21	%22/19	GENERAL C.	LIQUID BULK	DRY BULK
Bahía de Algeciras	100,739	+1%	-4%	70%	28%	1%
Valencia	79,189	-7%	-2%	90%	7%	3%
Barcelona	69,067	+6%	+5%	71%	22%	7%
Cartagena	36,448	+17%	+7%	3%	77%	20%
Bilbao	32,766	+5%	-8%	26%	62%	11%
Huelva	31,852	+5%	-5%	4%	78%	18%
Tarragona	29,386	-6%	-10%	8%	60%	32%
Las Palmas	26,310	+1%	+9%	69%	30%	1%
Castellón	20,907	-1%	+1%	7%	49%	44%
Gijón	19,043	+15%	+10%	7%	4%	89%
Baleares	15,399	+12%	-7%	88%	10%	2%
A Coruña	14,800	+26%	+10%	6%	58%	36%
Ferrol - San Cibrao	11,772	+18%	+5%	8%	33%	58%
S.C. Tenerife	11,666	+9%	-6%	65%	32%	4%
Santander	6,415	-5%	-2%	43%	4%	53%
Bahía de Cádiz	5,555	+15%	+28%	39%	27%	34%
Almería	5,501	-5%	-1%	27%	2%	71%
Vigo	4,552	-2%	+9%	93%	1%	7%
Avilés	4,444	-4%	-13%	22%	15%	63%
Málaga	4,341	-2%	+25%	66%	3%	32%
Sevilla	3,780	-10%	-13%	42%	11%	47%
Pasaia	3,268	-6%	+2%	72%	0%	28%
Alicante	3,213	+22%	+11%	47%	1%	52%
Motril	2152	-14%	-21%	7%	62%	32%
Marín - Pontevedra	2,077	-3%	-15%	50%	0%	50%
Vilagarcía	1,490	-1%	+13%	53%	20%	27%
Ceuta	1,258	+15%	-27%	45%	54%	0%
Melilla	565	-5%	-34%	84%	11%	5%
TOTAL	**547,954**	**+3%**	**+8%**	**49%**	**33%**	**17%**

***Table 4** - Total container traffic by cargo type in million tonnes. 2022, preliminary. Ship supply, fresh fish and local traffic not included ; Source: Puertos del Estado*

The chart above showcases the breakdown of total container traffic by cargo type in million tonnes. Among the national top 10 ports in container traffic are Bilbao, Huelva, Las Palmas, and Gijón Ports, together, they constitute almost 20% of Spain's total cargo traffic. Las Palmas Port stands out for its handling of general cargo, managing 18.159 million tonnes. Meanwhile, Huelva Port takes the lead in dry and liquid bulk, with traffic figures of 24,803 and 5.73 million tonnes, respectively. (Please note that only the Atlantic ports were considered for the last ranking).

For the rest of the Andalusian Ports that are considered in Spain as part of the Mediterranean sea basin, it can be highlighted the role that Algeciras Port plays nationally is crucial for the container traffic. In the contrary, Malaga isn't yet as developed to be considered as essential as Algeciras Port, handling only 4,341 million tonnes in 2022.

According to the Transport and Logistics Observatory in Spain (OTLE), there has been an increase in the number of passenger, container, and Ro-Ro vessels following the pandemic. In 2022, the number of vessels has nearly returned to the same level as in 2019. Specifically, there were 40,849 passenger vessels, 2,596 other vessels, 14,124 container vessels, 67,111 Ro-Ro vessels, 11,154 general cargo vessels, 7,251 bulk vessels, and 14,014 tanker vessels.

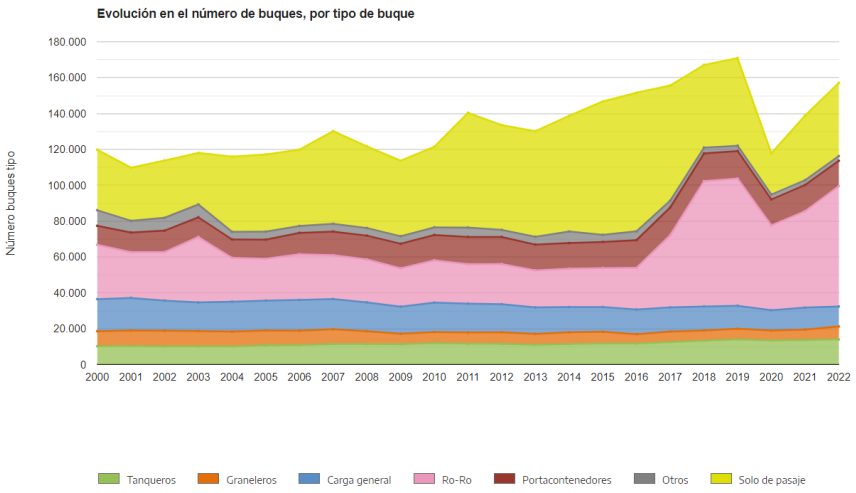


***Figure 14** - Evolution in the container traffic by type of cargo*
Source: OTLE

Short Sea Shipping plays a pivotal role in Spain due to its connectivity within the European waters and to its strategic geographic position that links Europe to Africa and America. In the first half of 2022, Spain closed with a total of 140 million tonnes moved, showing an increase of 6.6% compared to the previous year (INDUSTRIA Y COMUNICACIÓN SA, 2023). In the Atlantic coastline of Spain, the short sea shipping was focused on goods vehicles and moved 550 thousand vehicles, representing a decrease compared to 2021.

In terms of emissions from vessels navigating in Spain, as per the findings of the Organisation for Economic Cooperation and Development (OECD, 2023), the total annual CO2-equivalent emissions in 2022 amounted to 4.420 million tonnes. This marks a 7.36% increase compared to the figures recorded in 2019, even with Spain's efforts to reduce its carbon footprint.

As for achieving the net-zero emissions goal by 2050, Spain has been engaging maritime stakeholders into innovative projects to research about renewables energies, biofuels, smart ports, vessels engineering, infrastructures and more.

Additionally, Spain is also involved in projects such as the Bilbao Wind Hub, aimed at constructing a new facility capable of converting up to 160 thousand tonnes of steel annually into offshore towers and XXL monopiles. Additionally, the DemoSath project is underway, involving the testing of a 2MW floating turbine connected to the grid in the Bay of Biscay (INDUSTRIA Y COMUNICACIÓN SA, 2023).

Bilbao Port has implemented several decarbonization initiatives, establishing itself as an as a key player in the reduction of emissions and the improvement of environmental sustainability (Bilbao Port, 2022). Here are some of the key measures and projects undertaken by the Port of Bilbao:

- **OPS OnShore Power Supply (Cold Ironing)**
  The Port of Bilbao is investing in shore power facilities that allow berthed ships to plug into the local electrical grid, reducing the need to run auxiliary engines on diesel. This significantly cuts down on emissions of CO2, NOx, and particulate matter.
- **Renewable Energy Integration**

The port is incorporating renewable energy sources into its operations. This includes the installation of solar panels and wind turbines to generate clean energy, which helps reduce the port's reliance on fossil fuels and is actively supporting the R&D of wave power and innovative options of power generation.

- **Electrification of Port Equipment**
  The Port of Bilbao is transitioning its cargo handling equipment to electric and hybrid models. This includes cranes, forklifts, and other vehicles used within the port, aiming to lower emissions and improve air quality.
- **Energy Efficiency Projects**
  Various energy efficiency initiatives are being implemented to reduce the overall energy consumption of port operations. This includes the use of LED lighting, energy management systems, and optimizing logistics to minimize fuel use.
- **Environmental Monitoring and Management**
  The Port of Bilbao employs advanced monitoring systems to track air quality and emissions. This data helps in making informed decisions and implementing measures to further reduce environmental impact.
- **Alternative Fuels and Green Shipping**
  The Port of Bilbao is supporting the use of alternative fuels in maritime transport, including biofuels and hydrogen. The port is also part of initiatives to promote green shipping corridors that encourage the use of low-emission technologies.

As a regional Macro strategy, The Basque Hydrogen Corridor, was created in 2021 to promote decarbonisation in strategic sectors such as energy, mobility, industry and services. The project will be funded with over 1,500 million euros up to 2026 and will create more than 1,340 direct and 6,700 indirect jobs.

Among the projects in the Basque Hydrogen Corridor is that of synthetic fuel plants that Repsol/Petronor plans to build in the Port of Bilbao, using captured CO^2 and green hydrogen obtained from water electrolysis using renewable energy as raw materials. In 2023, Bilbao Port Authority authorized the creation of this Decarbonization Hub in the Port. The area covered by the new terminal will include a synthetic fuels production plant and an electrolytic hydrogen production plant. This initiative will require an investment of more than 200 million euros, with the first facilities scheduled to be operational in 2026 (Repsol, 2023).

Moreover, Gijon is conducting trials with the "Hydrotug," a tugboat equipped with two hydrogen and diesel propulsion engines. Petronor is establishing a decarbonisation hub to produce synthetic fuels for trucks, ships, and airplanes. Furthermore, a MoU has been signed between Cepsa and Rotterdam Port to establish the first green hydrogen corridor connecting the Dutch port with Algeciras. The Triskelion project focuses on producing green methanol from carbon dioxide captured at facilities in Mugardos. Lastly, the "H2Pole" initiative aims to produce 14.4 thousand tonnes of green hydrogen in As Pontes (A Coruña).

These initiatives represent merely the initial steps towards the larger decarbonisation process unfolding in Spain and Europe. As these projects gain traction and evolve, they lay the groundwork for a sustainable future, driving innovation, collaboration, and progress in the transition towards net-zero carbon emissions.

B. Portugal

Nestled along the scenic Atlantic coastline, Portugal's maritime transport sector stands as a cornerstone of its economy and cultural identity. With a coastline stretching over 1,794 km, Portugal's shores have long served as a gateway to the world, facilitating trade, commerce, and cultural exchange. Moreover, the country's network of rivers, including the iconic Douro and Tagus rivers, further enhances its maritime connectivity and economic vitality.

As illustrated in the chart below, Portugal ranks 14th in the traffic of goods among European countries, handling 85,025 million tonnes in 2022. However, when compared to other EU Atlantic regions, Portugal has low volume of traffic despite its Atlantic coastline.

TIME	2022
REP_MAR	
European Union - 27 countries (from 2020)	3 480 872
Netherlands	590 048
Turkey	535 825
Spain	489 714
Italy	478 036
Belgium	288 229
France	282 609
Germany	279 177
Norway	214 922
Sweden	172 055
Greece	170 695
Poland	118 958
Finland	105 092
Denmark	98 220
Portugal	85 025

***Table 5** - Top ranking gross weight of goods handled in 2022 (in million tonnes)*
Source: Eurostat

According to Transport and Mobility Authority (Autoridade da Mobilidade e dos Transportes, 2022), Portugal ports closed 2022 with a total of 10,111 ship calls on the mainland of Portugal, representing a growth of +6.2% compared to the previous year. Port of Leixões is the one with the highest number of ship calls (2,430 calls) followed by Lisbon (2,045 calls) and Sines Ports (1,927 calls).

	TEN-T Core Ports				TEN-T Comprehensive Ports					
	Leixões	Lisboa	Setúbal	Sines	Viana do Castelo	Aveiro	Figueira da Foz	Faro	Portimão	**Total**
Ship calls	2430	2045	1512	1927	252	1316	546	19	64	**10111**

***Table 6** - Total number of shipcalls in the different Portugal ports*
Source: AMT: Acompanhamento do Mercado Portuário

At the end of 2022, a total of 10,111 vessels travelled in and out of Portugal. The chart above provides relevant information on the different ports in Portugal. As it can be observed, Leixões Port, together with Lisbon Port, have 45% of the shipcalls in Portugal

General cargo vessels are the primary type of vessels arriving and departing from Portugal, indicating that Portugal does not specialise in a specific type of cargo but has sufficient storage capacity within its ports. In total, 40,456 general cargo vessels are handled in their ports, being

Sines the port that handles 48.6% of the total. Additionally, Portugal handles 30,372 liquid bulk vessels, a significantly higher number compared to dry bulk vessels.

Porto / Categoria	Carga Geral		Granéis Sólidos		Granéis Líquidos		Totais Porto	
	mil ton	Quota (%)	mil ton	Quota (%)	mil ton	Quota (%)	mil ton	Quota (%)
Viana do Castelo	214	0,5%	160	1,1%	35	0,1%	410	0,5%
Leixões	9 703	24,0%	2 836	19,4%	2 353	7,7%	14 891	17,4%
Aveiro	2 202	5,4%	2 265	15,5%	1 524	5,0%	5 992	7,0%
Figueira da Foz	1 206	3,0%	1 141	7,8%	15	0,1%	2 363	2,8%
Lisboa	4 099	10,1%	5 292	36,2%	1 330	4,4%	10 721	12,5%
Setúbal	3 371	8,3%	2 542	17,4%	289	1,0%	6 202	7,3%
Sines	19 659	48,6%	327	2,2%	24 826	81,7%	44 812	52,4%
Faro		0,0%	73	0,5%		0,0%	73	0,1%
Totais Categoria	40 456	47,3% 100,0%	14 637	17,1% 100,0%	30 372	35,5% 100,0%	85 464	100,0%

***Table 7** - Number of total vessels by type of cargo*
Source: Autoridade da Mobilidade e dos Transportes

General cargo represents 47.3% of the total port movement in Portugal. Notably, Containerized Cargo, the most significant type (38%), experienced a -6.7% reduction, mainly in Sines, Leixões, and Setúbal, but grew in Lisbon. Fractional Cargo comprises 7.1% of the port movement, with Aveiro being the primary hub (2.2 million tons). While there were overall increases, Setúbal and Leixões experienced decreases, balancing the total movement similar to the previous year. Lastly, Ro-Ro Traffic holds a 2% market share, significant in Leixões but experienced a global decrease of -4.7%, with Setúbal and Sines showing increases.

For the other type of dry bulk such as coal, only represents 0.3% of port markets, witnessed growth in Setúbal and Sines, with a global increase of +34.4%. Agricultural Products is 5.6% of total traffic, with a positive growth in all ports except Aveiro, resulting in a global increase of +1.4%. Other Solid Bulk represents 9.9% of port traffic, with a global growth of +24.8%, except for decreases in Setúbal and Viana do Castelo. Lastly, crude oil has 11.7% of the total movement in Portugal and it has experienced a +7.2% growth primarily in Sines, partially offset by decreases in Leixões.

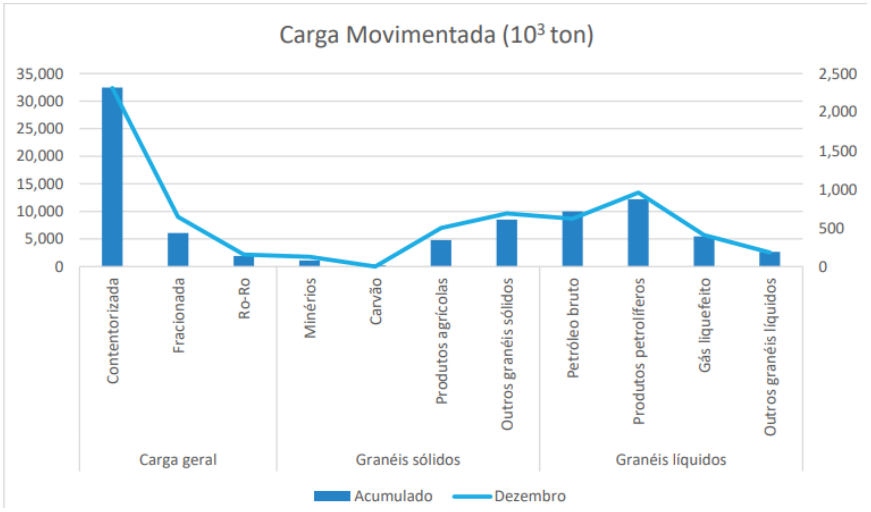


***Figure 15** - Total cargo movement in TEUs*
Source: Autoridade da Mobilidade e dos Transportes

Transhipment operations represent 42.1% of the container traffic in the port system, with Sines standing out with the 67.8% of the total transhipment movement. Sines leads in transhipment traffic, followed by Setúbal, Leixões, and Lisbon.

On the other side, in all ports except Sines, containers with origin or destination in the hinterland represent more than 60% of container traffic, reaching 100% in Figueira da Foz. Furthermore, container movement with the hinterland represents 57.9% of the total, and is led by Leixões, followed by Sines, Lisbon, Setúbal, and Figueira da Foz.

Porto \ Contentores	*Hinterland*				*Transhipment*				Totais
	mil TEU	Proporção (%)	Quota (%)	Var. (%)	mil TEU	Proporção (%)	Quota (%)	Var. (%)	mil TEU
Leixões	654	91,7%	38,0%	-0,6%	59	8,3%	4,7%	-0,4%	713
Figueira da Foz	21	100,0%	1,2%	-3,1%	0	0,0%	0,0%		21
Lisboa	405	98,7%	23,5%	12,5%	5	1,3%	0,4%	-22,9%	411
Setúbal	106	63,1%	6,2%	-38,2%	62	36,9%	5,0%		169
Sines	536	32,2%	31,1%	-1,0%	1 127	67,8%	89,9%	-12,2%	1 663
Total Geral	**1 723**	**57,9%**	100,0%	**-1,8%**	**1 253**	**42,1%**	100,0%	**-7,1%**	**2 976**

***Table 8** - Total Hinterland and Transhipment traffic in 2022*
Source: Autoridade da Mobilidade e dos Transportes

It is essential to draw attention to the concerning trend regarding CO2 emissions. According to Table 2 (OECD, 2023), between 2019 and 2022, there has been a significant increase of 30.23% in CO2-equivalent emissions. In 2022, the data collected indicates a total of 480,716.2 tonnes of CO2-equivalent emissions. This notable rise underscores the urgent need for action to address and mitigate the environmental impact of Portugal's maritime sector. It's particularly concerning that, despite Portugal's relatively modest stature in terms of vessel traffic and cargo handling compared to other European countries, the nation is experiencing a notable increase in emissions.

For this reason, in Portugal, there are initiatives focused on energy efficiency, including the utilisation of biofuels within their ports. With its strategic positioning along the Atlantic coast and the expansive River Tagus flowing into the Atlantic Ocean in Lisbon, Portugal possesses ample space to conduct pilot projects and test new vessels tailored for reduced consumption and the utilisation of alternative fuels. These initiatives not only contribute to the reduction of greenhouse gas emissions but also align with global efforts to transition towards cleaner and more sustainable maritime practices.

Furthermore, the International Council on Clean Transportation (ICCT) is conducting a free technical and feasibility study to create an emission control area (ECA) in the Northeast Atlantic Ocean for SOx, particulate matter, and NOx, considering criteria from MARPOL's Annex VI. The University of Porto's Faculty of Engineering will study the impacts of pollutant reduction and associated costs, funded by Portugal. In late 2022, discussions began among Northeast Atlantic coastal States, gaining support from multiple European countries and the European Commission. This ECA would link existing ECAs, tackling air pollution from shipping and ensuring uniform regulation. Portugal plans to present an INF document at the MEPC 80th session, aiming to establish the ECA to protect human health and the ocean (DGRM, 2023).

In 2024, Portugal in collaboration with Mexico, created an international maritime corridor between the ports of Coatzacoalcos in the Gulf of Mexico and Sines in Portugal for various forms of transport including containerised cargo, solid and dry bulk, and liquefied natural gas (Bovenizer, 2024).

C. Ireland

In 2022 there were 12,447 ship arrivals in Irish ports.

Vessel types	TEN-T Core ports			TEN-T Comprehensive ports				
	Dublin	Cork	Shannon Foynes	Rossalre	Waterford	Galway	Others	Total
All vessels	7,402	1,390	431	2,023	438	59	704	12,447
RoRo	5,851	582	160	2,023	275	-	400	9,291
Container	855	398	-	-	95	-	-	1,348
Dry Bulk	35	35	150	-	25	11	237	493
Liquid Bulk	530	279	118	-	-	48	34	1,009
Passenger	23	82	2	-	24	-	24	155
Specialised & other	108	14	1	-	19	-	9	151

***Table 9** - Total number of shipcalls in the different Irish ports*

No supply of alternative fuels is currently available in Irish ports.

Dublin ports has nearly 60% of the ship calls.

Most of the vessel calls are operating on shortsea routes with 75% of ships operating on RoRo routes with UK and European ports.

RoRo and Container vessels calling to Ireland's Core and Comprehensive ports represent 82% of the shipping activity in Ireland.

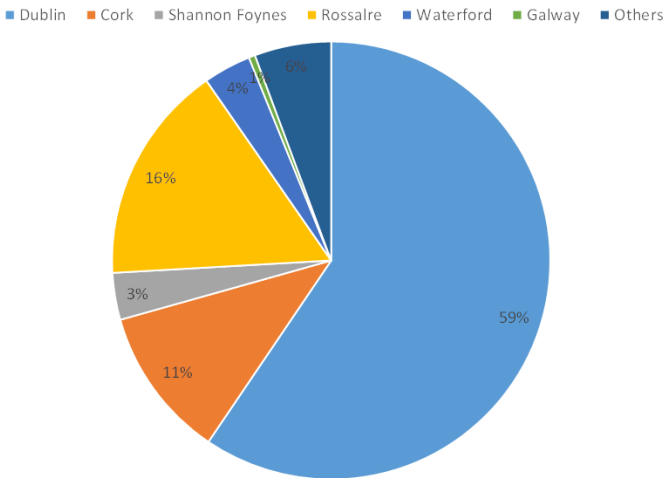


***Figure 16** - Vessels calls to Irish Ports in 2022*

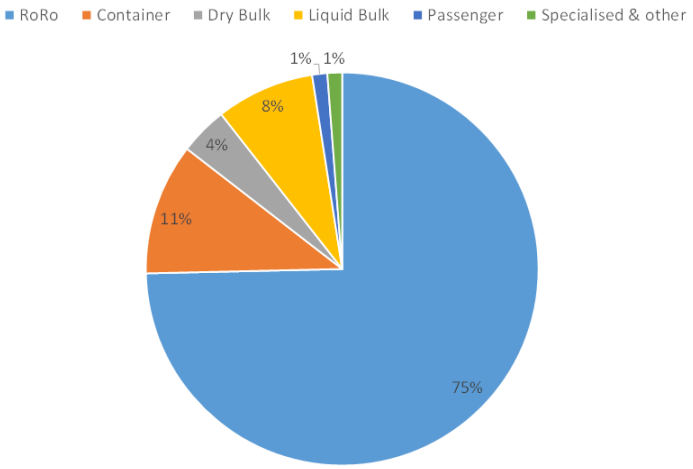


***Figure 17** - Vessel types using Irish Ports in 2022*

The report “The Development of Alternative Fuel Infrastructure in Irish Ports” (Irish Maritime Development Office, 2018) concluded that the demand for alternative fuels at Irish ports was at a very low level and that the drivers of AFI deployment are not prevalent in the Irish shipping industry. It recommended continued monitoring of market trends to assess the level of convergence in solutions to achieve the ambitions for the maritime transport sector set out in the Alternative Fuels Directive and identified the potential of Ireland’s offshore renewable energy resources to contribute to the fuel supply challenges.

Research at University of Maynooth (Gore, Rigot-Müller, & Coughlan, 2022) is assessing the costs and barriers to the use of alternative fuels in Irelands maritime sector and the Sustainable Energy Authority of Ireland is funding R&D in this area (ShipFuel-IE, 2023-2026).

The Irish Maritime Development Office, as part of the Marie Institute, has launched a co-funded initiative with InnovateUK for “Feasibility Studies on Green Shipping Corridors”, that will support the development of routes that stimulate early adoption of promising long-term solutions to reach zero emissions in shipping.

D. France

France's geographical position, which gives it access to several seas and oceans, has enabled it to take full advantage of the maritime sector, which is a major contributor to its economy and generates many direct jobs: more than 68,000 in fishing and aquaculture, 40,500 in the nautical industry, 40,000 in ports and so on. In fact, two of Europe's ten major ports are located in France: Marseille and Le Havre. On the Atlantic area, the largest port is Nantes-Saint-Nazaire.

The French maritime sector concentrates a number of activities, including the import and export of goods via France's major seaports: Marseille, Le Havre, Dunkirk, Nantes, Rouen, Bordeaux, La Rochelle and Calais. Nearly two million tonnes of containerized goods pass through the port of Le Havre every month.

The maritime sector also includes everything to do with fishing (such as the fishing fleet and fishermen) and auctions, which are flourishing sectors. For example, the wholesale and retail market in the port of Lorient is worth almost 76,000 euros (Statista, 2023).

In France, one shipping company in particular stands out: Compagnie Maritime d'Affrètement - Compagnie Générale Maritime (CMA CGM). This is the world's third-largest container

shipping company, and the leading French one, whose prevalence is recognized both in Europe and worldwide. Its services include maritime transport, port handling and logistics. It has sales of around $23.5 billion and a fleet of some 500 vessels. Other French-based shipowner company with worldwide recognition include, for example:

- Bourbon (primarily operating in the Oil&Gas sector)
- Louis Dreyfus Armateur (mostly dry bulk and submarine cable laying)
- Ponant (luxury cruising)

The maritime sector is not only of economic interest. It also has a governmental and security dimension: several missions are carried out in French waters, such as the fight against drug trafficking and illegal immigration.

Finally, scientific research is not left out: France has six oceanographic research vessels, and scientific institutes invested nearly 500 million euros in their research activities in 2017.

Looking at the port side, France usually considers three types of ports:

- Grand Port Maritime – GPM (literraly Large Maritime Port)
- Metropolitan ports
- Overseas ports

In terms of gross weight transported, the table below gives the evolution for the above three categories of ports in France over the past few years (in milions of tons):

Year	2015	2019	2020	2021
GPM & Calais	304,6	312,2	279,5	294,5
Other metropolitan ports	33,4	34,6	31,6	33,2
Overseas ports	12,2	13,2	16,5	13,4
Total	350,2	360	327,6	341,1

The Atlantic area accounts for one of the GPM, namely Nantes-Saint-Nazaire. Other ports of importance in this region include Brest, Lorient, La Rochelle, Bayonne and Bordeaux.

Among the different vessel traffic activities, 20.9 million passengers registered in 2022 in France's main seaports, passenger traffic is growing again (+87.2% compared with 2021) but remains heavily impacted by the COVID crisis (--24.3% compared with 2019). Traffic in Calais, France's leading passenger port, rebounds by 112.6% compared to 2021. In 2022, maritime passenger transport will increase in the English Channel and North Sea (+141.1%), the French overseas territories (+72.8%) and the Mediterranean (+57.7%) but will not return to pre-crisis levels on any of the seaboards. As for the cruise business, which came to a virtual standstill in 2020 and 2021, it will pick up very gradually (3.2 million passengers in 2022, after 4.6 million in 2019). Main passenger fleet statistics can be found below (Territoire, 2024):

	2003	2011	2019	2020	2021
Mainland France	**27 416**	**26 786**	**25 453**	**9 805**	**10 523**
North Sea and Channel (8 ports)	19 647	16 455	14 318	4 997	3 801

of which Calais	*13 729*	*10 065*	*8 478*	*3 269*	*2 360*
Mediterranean (9 ports)	7 769	10 330	11 135	4 808	6 722
of which Bastia	*2 123*	*2 287*	*2 112*	*1 139*	*1 427*
of which Toulon	*549*	*1 429*	*1 906*	*1 137*	*1 537*
of which Marseille	*1 953*	*2 342*	*3 120*	*744*	*1 256*
Overseas	**1 643**	**1 014**	**1 925**	**1 068**	**596**
France (ALL)	**29 059**	**27 800**	**27 378**	**10 874**	**11 119**
In thousands of passengers embarked and disembarked, including cruise passengers					

***Table 10** - Main passenger fleet*

In 2022, sea freight traffic through French ports increased again (+5%, after +4.3% in 2021), driven by rising energy traffic. However, with 341.2 million tons traded in 2022, compared with 360.0 million in 2019, it remains 5.2% below its pre-sanitary crisis level.

Two factors played a key role in the growth of French seaborne traffic in 2022: on the one hand, the rise in liquefied natural gas (LNG) traffic (+65.4%) due to the maritimization of natural gas imports following the economic sanctions imposed by the European Union against Russia; on the other, the increase in crude oil traffic (+21.9%), partly attributable to the restart of the Donges (near Saint-Nazaire) refinery in 2022. Overall, the pie chart below gives the share of maritime freight in 2022 (Territoire, 2024) :

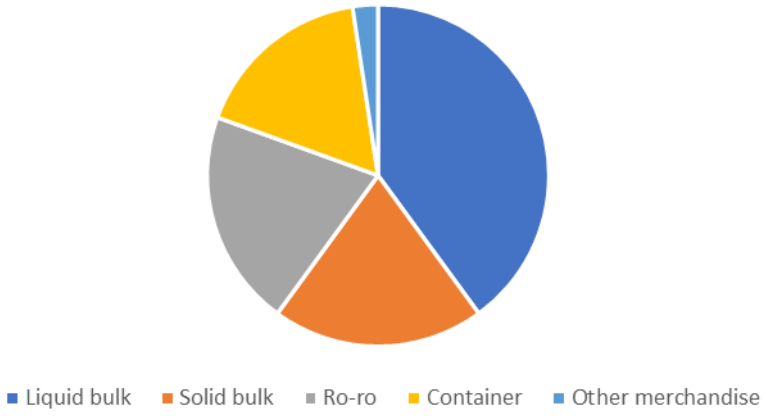


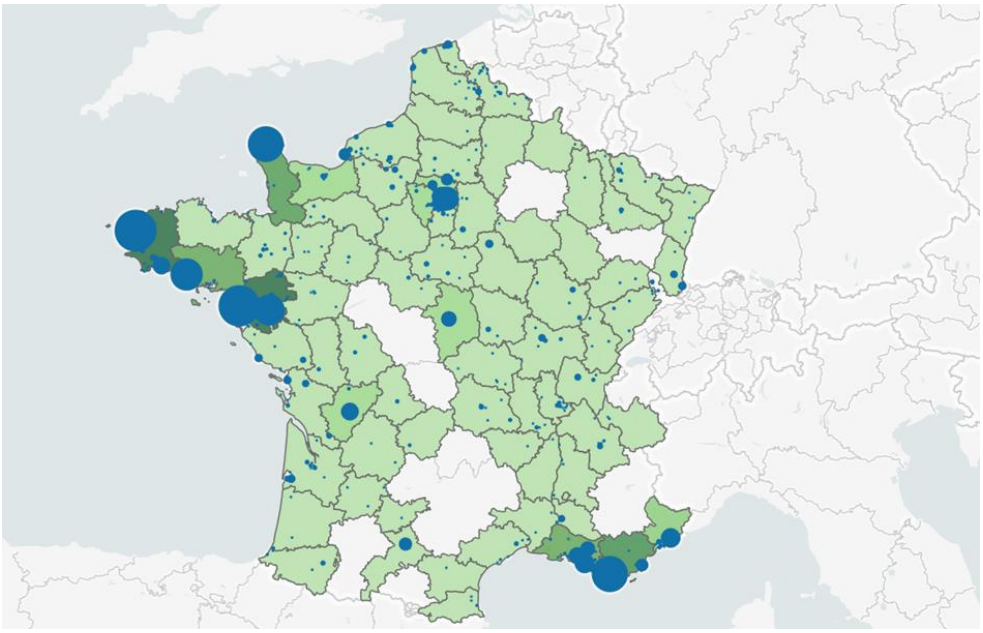
***Figure 18** - Share of freight maritime transport called at French ports in 2022*

While maritime freight transportation weighs 342 Million tons in 2022, only 2.1 Million tons were transported by aerial means. Regarding the 'interior' freight traffic, the national centre for statistics uses the metric expressed in Billions of tons transported per km. In 2022, below is the distribution of interior freight transportation in France (Territoire, 2024):

- Road-based 296.2, i.e 87.6%
- Rail-based 35.3, i.e 10.4%
- River-based 6.6, i.e less than 2% of the overall traffic

Looking at the shipbuilding industry, the figure below draws the picture of where are located the jobs. It can be noticed that Brittany and Pays de la Loire regions dominate this map hosting a number of well-known industrial companies (Chantiers de l'Atlantique, Naval Group,

Beneteau etc...) as well as a strong supply chain and many small to medium size naval construction sites (e.g Piriou, Ocea, Multiplast, Merre etc...)



Finally, the policy and strategic agenda in France can be depicted in two levels.

- National: currently there are mainly two roadmaps of interest for the maritime transport
  - National port strategy
  - Greenship roadmap
- Regional: most coastal regions have ambitious plans for their maritime sector. For what concerns the two regions directly represented in SMARTDEC, below are the strategic documents related to their maritime roadmap
  - Pays de la loire – Ambition maritime
  - Bretagne - Une transition maritime pour la Bretagne

3. Needs, gaps, challenges, impact

The policy direction and ambitions for decarbonising the maritime transport sector have been established through the European Green Deal and the IMO Strategy on Reduction of GHG Emissions from Ships.

Significant funding from governments, the European Commission, and industry has been targeted at these ambitious goals. There is a wide range of technology options being considered, for example, green hydrogen, wind propulsion vessels, port infrastructures for refuelling and electric charging stations for e-ships. The commercial readiness of these technologies remains at a low level and significant investment will be needed to develop the vessels, sources of alternative fuels and associated infrastructure in our ports. The concept of Green Shipping Corridors has been established as a mechanism to bring together the various stakeholders and decision makers required to accelerate the progress toward zero-emission shipping. The GSC approach can also facilitate coordination of funding among countries toward maritime decarbonisation.

Needs: The Atlantic Area has a particular reliance on maritime transport to overcome issues related to peripherality and links required with established trade and transport routes with Europe and the rest of the world. To meet its obligations and targets for GHG reductions, the maritime industry in the Atlantic Area must select, deploy, and scale up the technologies, fuels, and infrastructure that will be required to achieve these ambitions.

The adoption of low-carbon and zero-carbon fuels, such as hydrogen, ammonia, and biofuels, is essential for reducing emissions. Additionally, electrification through the implementation of Onshore Power Supply (OPS or cold ironing) and the retrofitting of port equipment to reduce fossil fuel dependence is crucial. Energy efficiency technologies also play a vital role, encompassing advanced systems for ships, cranes, and port operations, including hybrid systems, energy-saving devices, and optimized vessel designs.

Additionally, ports must establish refuelling infrastructure to support the use of alternative fuels, ensuring that vessels have the necessary facilities for bunkering. Integrating renewable energy sources like solar and wind power within port facilities can significantly reduce emissions by providing clean energy for port operations.

Decarbonization of the maritime transport sector must be a transversal and multisector priority, implemented through various phases and methods. This includes tracking and measuring impacts through empirical data, IoT, sensor systems, and digital twins. Establishing key performance indicators (KPIs) such as emissions, biodiversity, and stakeholder engagement will be crucial. A paradigm shift is needed, incorporating new policies, technologies, innovation ecosystems, collaboration, data sharing, and reskilling/upskilling of the workforce.

Gaps: Evidence from the desk-based study indicates that the participation level from industry and research centres in European projects dedicated to zero-emission shipping may be at a relatively lower level than other areas. The Atlantic Area may not be able to rely on solutions developed in other regions to satisfy their specific requirements, which may be linked to the vessels operating in the region, the location and type of port infrastructure available, and the capacity or natural resources available to produce alternative fuels at scale.

Further research into the reasons for low participation levels is required.

Challenges: Increased levels of collaboration between industry, academia, and research entities will be crucial to enhance R&D in the Atlantic Area, particularly for new studies on alternative fuels, ship engineering, and accurate monitoring of GHG emissions. Strengthened collaboration among stakeholders in the ports & shipping sector is also essential to effectively implement these initiatives, specifically local universities in each region that can serve as the basis for research on decarbonisation in ports, meaning that national and regional authorities must increase the use of their territorial researchers.

The high initial costs associated with green technologies and fuels present a barrier to widespread adoption, making cost-effectiveness a significant challenge. This makes maintaining competitiveness while transitioning to low-carbon operations challenging for port operators and shipping companies. Also, existing port infrastructure often requires substantial upgrades to accommodate new technologies and energy sources, adding another layer of complexity, safety, security and cost.

There is a lack of harmonization in regulations across different regions and countries, complicating the implementation of decarbonization measures. Even where regulations exist, ensuring compliance requires robust monitoring and enforcement mechanisms, which can be resource-intensive to establish and maintain. Additionally, adequate funding mechanisms and financial models are essential to support large-scale decarbonization efforts, but securing such funding can be challenging.

The quantity of goods to be transported each year is also expected to highly increase in the next years, which makes even more important to ensure the decarbonisation of the vessels. What is needed both at international and regional level are qualitative and quantitative analysis of decarbonisation levers for each sector and area, the definition of transition scenarios, simulation and analysis, and the development of a global transition model for the merchant fleet.

Coordinating efforts among diverse stakeholders, including port authorities, shipping companies, regulatory bodies, and technology providers; and raising awareness and building consensus on the importance of decarbonization within the maritime industry, is challenging when there is a lack of Atlantic stakeholder involvement and proper fundings.

Impact: SMARTDEC aims to foster the cooperation needed to address the gaps and challenges through its future network. Through this Network, it is expected to share knowledge, new technologies and best practices to start making progress in the decarbonisation of the Atlantic Area.

Expected results for SMARTDEC in different aspects such as significant reduction in GHG emissions contributing to the EU regulation, market leadership in those pioneer ports and maritime companies that adopt green technologies, decreasing initial costs of these technology, strengthening the port-city relationship, partnerships and agreements between Atlantic stakeholder, will lead the Atlantic area to progressively achieve the net-zero emissions goal.

Appendix A

Country	Programme	Budget	Period	About
Spain	PERTE de energías renovables, hidrógeno renovable y almacenamiento	16.300M Eur	2021-2035	Funding for renewable energies, hydrogen and storage capacity
	PERTE de descarbonización industrial	11.800M Eur	2021-2035	Funding for industrial decarbonisation
	PERTE para la industria naval	1.460M Eur	2021-2035	Funding for the navy sector
	PORTS 4.0	1%cashflow Spanish Port Authorities (15-20M€)	2020-on	Funding to attract, support and facilitate the application of talent and entrepreneurship to the Spanish public and private ports sector, within the context of 4th industrial revolution
Portugal	PORTUGAL MAR2030	539M Eur	2022-2027	Funding for a sustainable fisheries, acuaculture, blue economy coastal and surveillance
	PRR - Navegação Ecológica	50M Eur	2024	Energy efficiency measures and digitisation on board, as well as the use of alternative fuels, low and zero carbon, are intended to accelerate the energy transition of the maritime transport of goods and passengers.
France	ADEME - Navire du futur	51 projects funded 176,7 M€ of public fund for 814,4 M€ total budget	2011-2020	energy and operational efficiency of vessels - clean and sustainable ship (eco-design, reduced atmospheric emissions, liquid and solid and solid waste management); - safe ship (improving the safety and security of the ship and its activities, safety and comfort of people on board) on board); - intelligent ships (dissemination of new information technologies in ships); - competitiveness of industries

				and new uses resulting from the application of innovations (offshore wind turbine maintenance)
	AMI CORIMER 2022	8 projects funded; 46M€ of public support	2022	Funding to support research and development projects carried out by companies in the marine industrial sector, small, medium or large, alone or associated within a consortium, which accelerate the marketing of technologies. , services and/or ambitious innovative and sustainable solutions, from the industrial R&D phases to the more downstream scale 1 demonstration of the benefit of a system in its operational environment.
	AMI CORIMER 2023	13 projects funded; approx 50M€ of public support	2023	
	BPI AAP "soutien à la décarbonation de la filière maritime française"	at least 750k€ of public fund per project	2024-2025	Area 1: The integration of new equipment or technological solutions (hardware or software) and, more generally, all measures enabling short-term improvements in the energy and environmental performance of new and existing ships. Area 2: Development of carbon-free ship concepts for different fleet segments. Area 3: The development of technological building blocks, from research and development to the testing of demonstrator solutions on ships in operation. Area 4: Expansion of industrial sites or improvement of production processes, to promote the decarbonization of shipyards and subcontractors
	BPI fonds CMA CGM pour la décarbonation de la pêche	20M€	2024-2026	Fishing fleet decarbonisation
Ireland				
	EPA Research 2030	€7.6M for 2024 call	2021 - 2030	EPA Research 2030 is a ten-year high-level framework for research programme that delivers essential scientific support for environmental

				policy development, implementation and broader decision making. Recent projects on maritime decarbonisation: Sustainable and Holistic management of Irish Ports (SHIP)
	Marine Institute - National Marine Research Programme	€6.2M for 2023	Annual	The Marine Institute provides funding for marine related projects under the Marine Research Programme. Funding is provided under a number of programmes. Recent projects on maritime decarbonisation: Cullen Scholarship: Irish maritime industry's transition to alternative fuels (PhD Award)
	Enterprise Ireland - Disruptive Technologies Innovation Fund (DTIF)	A €500 million challenge-based fund.	2018 - 2027	DTIF is seeking investment in the development and deployment of disruptive innovative technologies, on a commercial basis, targeted at tackling national and global challenges. No maritime projects have been funded from the €371M awarded to date.
	SEAI National Energy Research Development and Demonstration (RD&D) Funding Programme	~€13M for 2023		The SEAI National Energy RD&D Funding Programme is open to public and private sector organisations based in the Republic of Ireland. Recent projects on maritime decarbonisation: Developing Pathways for a Sustainable Shipping and Maritime Fuel Value Chain in Ireland (ShipFuel-IE)

***Table 11** - National funding programmes active in Sapain, Portugal, France and Ireland*

References

AspBAN. (2021, 08 09). *AspBAN D2.3 Workshop Report*. Retrieved from https://aspban.eu/wp-content/uploads/2022/03/Attachment_0-4.pdf

AspBAN. (2021-2022). *Atlantic Smart Ports Blue Acceleration Network*. Retrieved from https://aspban.eu/en/home/

Autoridade da Mobilidade e dos Transportes. (2022, December). *Acompanhamento do Mercado Portuário.* Retrieved from https://www.amt-autoridade.pt/media/3655/relat-_estat_port_dez2022.pdf

Bilbao Port. (2022). *THE PORT OF BILBAO LAUNCHES AN AMBITIOUS PROJECT TO REDUCE THE CARBON FOOTPRINT OF PORT ACTIVITY*. Retrieved from https://www.bilbaoport.eus/en/news/the-port-of-bilbao-launches-an-ambitious-project-to-reduce-the-carbon-footprint-of-port-activity/

BilbOPS. (2022-2026). *Onshore Power Supply OPS Project for the Port of Bilbao*. Retrieved from https://bilbops.bilbaoport.eus/bilbops-ingles

BLUEGIFT. (2018-2021). *Blue Growth and Innovation Tracked*. Retrieved from https://bluegift.eu/

Bovenizer, N. (2024, January 5). *Mexico and Portugal create new shipping corridor*. Retrieved from https://www.ship-technology.com/news/mexico-and-portugal-new-shipping-corridor/

CISMOB. (2016-2020). *CISMOB*. Retrieved from https://projects2014-2020.interregeurope.eu/cismob/

CONSORTEX. (2017-2019). *About Consortex*. Retrieved from https://www.consortex-project.eu/p188-about--en

Debyser, A. (2023, 10). *Maritime Transport: strategic approach*. Retrieved from https://www.europarl.europa.eu/factsheets/en/sheet/124/maritime-transport-strategic-approach

DGRM. (2023). *STUDIES FOR THE IMPLEMENTATION OF AN EMISSIONS CONTROL AREA (ECA) IN THE NORTH-EAST ATLANTIC OCEAN ARE ALREADY BEING DEVELOPED BY PORTUGAL WITH THE SCIENTIFIC SUPPORT OF ICCT*. Retrieved from https://www.dgrm.pt/en/destaques?articleId=706050

DNV . (2023). *Maritime Forecast to 2050.* Norway: DNV AS.

DUAL Ports. (2015-2021). *Interreg North Sea Region - Developing Low carbon Utilities, Abilities and potential of regional entrepreneurial Ports*. Retrieved from https://northsearegion.eu/dual-ports/

Enagas. (2022). *El sistema gasista español.* Retrieved from https://www.enagas.es/content/dam/enagas/es/ficheros/sala-de-comunicacion/publicaciones/informe-sistema-gasista/Informe-Sistema-Gasista-Espa%C3%B1ol-2022.pdf

European Comission - Copernicus. (2024). *Anthropogenic and natural emissions*. Retrieved from https://atmosphere.copernicus.eu/anthropogenic-and-natural-emissions

European Commission. (2011). *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Developing a Maritime Strategy for the Atlantic Ocean Area*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52011DC0782

European Commission. (2013, May 13). *European Commission unveils maritime strategy for the Atlantic*. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/IP_13_420

European Commission. (2021). *Fit 55 Policy*. Retrieved from https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55/

European Commission. (2021-2027). *EU funding programmes*. Retrieved from https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes_en

European Commission. (2021-2030). *What is the EU ETS?* Retrieved from https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en?prefLang=es

European Commission. (2022, April). *Supporting study for the implementation of Regulation (EU) 2015/757 on the monitoring, reporting and verification of CO2 emissions from maritime transport.* Retrieved from https://climate.ec.europa.eu/document/download/55b302ef-c819-4a2f-9b83-c57c2bcfbe7e_en?filename=policy_transport_maritime_study_eu_mrv_en.pdf

European Commission. (2023). *FuelEU Maritime*. Retrieved from https://www.consilium.europa.eu/en/press/press-releases/2023/07/25/fueleu-maritime-initiative-council-adopts-new-law-to-decarbonise-the-maritime-sector/

European Commission. (2024). *Atlantic Ocean*. Retrieved from https://oceans-and-fisheries.ec.europa.eu/ocean/sea-basins/atlantic-ocean_en

European Commission. (2024). *The Atlantic Strategy*. Retrieved from https://atlantic-maritime-strategy.ec.europa.eu/en/atlantic-strategy-glance/atlantic-strategy

European Commission. (n.d.). *Maritime*. Retrieved from https://transport.ec.europa.eu/transport-modes/maritime_en#:~:text=Maritime%20Transport%20enables%20trade%20and,the%20rest%20of%20the%20world.

European Environment Agency, & European Maritime Safety Agency. (2021). *European Maritime Transport Environmental Report 2021.* Retrieved from https://www.eea.europa.eu/publications/maritime-transport

Eurostat. (2024). *Country level - gross weight of goods handled in all ports*. Retrieved from https://ec.europa.eu/eurostat/databrowser/view/mar_mg_aa_cwh/default/table?lang=en

Eurostat. (2024). *Maritime freight and vessels statistics*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Maritime_freight_and_vessels_statistics#:~:text=In%202022%2C%20the%20number%20of,12.0%20%25%20from%20the%20previous%20year.

FANBEST. (2019-2023). *Funding Atlantic Network for Blue Economy Technology Transfer - A common challenge*. Retrieved from https://fanbest.eu/fan-best/description/

Fundação Francisco Manuel dos Santos. (2023). *PORDATA*. Retrieved from https://www.pordata.pt/en/subtheme/portugal/maritime-409

GALATEA. (2020-2023). *GALATEA.* Retrieved from https://galateaproject.eu/about/at-a-glance/

GALATEA. (2020-2023). *GALATEA Blue Growth Accelerator*. Retrieved from https://galateaproject.eu/

Gore, K., Rigot-Müller, P., & Coughlan, J. (2022). Cost assessment of alternative fuels for maritime transportation. *Transportation Research Part D: Transport and Environment, 110*. doi:https://doi.org/10.1016/j.trd.2022.103416.

GREEN RAY. (2022-2027). *About Green Ray*. Retrieved from https://greenray-project.eu/about/

GUTTA. (2019-2022). *savinG fUel and emissions from mariTime Transport in the Adriatic region*. Retrieved from https://programming14-20.italy-croatia.eu/web/gutta/about-the-project

Gutta. (2020). *Gutta*. Retrieved from https://programming14-20.italy-croatia.eu/documents/298851/0/GUTTA__D.2.1.2.pdf/d69b6c25-2a6f-cc30-10bf-d908231418d6?t=1666361053336

IMO. (2024). *EEXI and CII - ship carbon intensity and rating system*. Retrieved from https://www.imo.org/en/MediaCentre/HotTopics/Pages/EEXI-CII-FAQ.aspx

INDUSTRIA Y COMUNICACIÓN SA. (2023, April). *Transporte xxl.* Retrieved from https://www.transportexxi.com/wp-content/uploads/2023/04/TransporteXXI-SP-Spanish-Ports-2023-web.pdf

Interreg Atlantic Area. (2022). *A brand new programme, renewed commitment with the Atlantic regions.* Retrieved from https://www.atlanticarea.eu/about-us/interreg-atlantic-area-2021-2027

Irish Maritime Development Office. (2018). *The Development of Alternative Fuel Infrastructure in Irish Ports.* Retrieved from https://www.imdo.ie/Home/sites/default/files/IMDOFiles/13774%20IMDO%20Development%20of%20Alternative%20Fuel%20V6%20HR.PDF

Ministerio de Transportes y Movilidad Sostenible. (2023). *Tráfico de mercancía y pasaje en puertos de interés general (número de buques y GT) por Autoridad Portuaria, tipo de buque y nacionalidad*. Retrieved from https://apps.fomento.gob.es/BDOTLE/visorBDpop.aspx?i=328

OECD. (2023). *Maritime Transport CO2 Emissions*. Retrieved from https://stats.oecd.org/Index.aspx?DataSetCode=MTE

PriMaas. (2019). *PriMaas*. Retrieved from https://projects2014-2020.interregeurope.eu/primaas/

Repsol. (2023). *Synthetic fuels*. Retrieved from https://www.repsol.com/en/sustainability/sustainability-pillars/environment/circular-economy/our-projects/synthetic-fuels/index.cshtml

Republica Portuguesa, Fundo Ambiental, apa. (2019). *LONG-TERM STRATEGY FOR CARBON NEUTRALITY OF THE PORTUGUESE ECONOMY BY 2050*. Retrieved from https://www.portugal.gov.pt/download-ficheiros/ficheiro.aspx?v=%3D%3DBAAAAB%2BLCAAAAAAABACzMDexBAC4h9DRBAAAAA%3D%3D

ShipFuel-IE. (2023-2026). *ShipFuel-IE*. Retrieved from https://www.marei.ie/project/shipfuel-ie/

Statista. (2023). *https://fr.statista.com/themes/2956/le-secteur-maritime-en-france/*.

Territoire, M. d. (2024). *Chiffres clés des transports - Edition 2024.* Service des Données et Etudes Statistiques.

WASP. (2019-2023). *Interreg North Sea Region - Wind Assisted Ship Propulsion*. Retrieved from https://northsearegion.eu/wasp/

Waterborne. (2023, November). *Strategic Research and Innovation Agenda Zero Emission Waterborne Transport.* Retrieved from https://www.waterborne.eu/images/231109_SRIA_Zero_Emission_Waterborne_Transport_2.0_clean_public_consultation_2_final.pdf

Waterborne Technology Platform. (2024). *PROJECTS CONTRIBUTING TO ACHIEVING THE VISIONS OF THE WATERBORNE TP*. Retrieved from https://waterborne.eu/projects

ZEM Ports NS. (2019-2023). *Interreg North Sea Region - Zero Emission Ports North Sea*. Retrieved from https://northsearegion.eu/zem-ports-ns/

DECARBONISING MARITIME TRANSPORT SECTOR - PREVIOUS PROJECTS DATABASE

Study No.#	PARTNER who Introduced it	Acronym	Project title	Period	Programme	Objectives	Results/Outputs	Website	Lead Applicant
1	CMMA	CONSORTEX	European Maritime Export Consortia	2017-2019	Interreg Atlantic Area	Form export consortia consisting of SMEs specialised in the manufacture of certain built-in packages for marine vessels and structures including offshore vessels, marine power plants, cruise ships, scientific vessels and naval.	◉ Economic sector & territories diagnosis ◉ Supply & agents analysis ◉ World market opportunities ◉ Export consortia	https://www.consortex-project.eu/p1-homepage-en	Foro Marítimo Vasco
2	CMMA	FANBEST	Funding Atlantic Network for Blue Economy Technology Transfer	2019-2023	Interreg Atlantic Area	Foster the technology transfer to SMEs in blue biotechnology and exploitation of marine resources by creating a network of public and private entities focused on the fund raising that make possible the start and scale-up phase.	◉ Stakeholders map ◉ R&D in the BE companies ◉ Portfolio of financial instruments ◉ Analysis of private capital funds for the BE	https://fanbest.eu/	UNIVERSITY OF SANTIAGO DE COMPOSTELA
3	CMMA	BLUEGIFT	Blue growth and innovation fast tracked	2018-2021	Interreg Atlantic Area	A minimum of 8 MRE floating wind, wave or tidal pre-commercial demonstrations, over 24,000hrs of operation, work with over 20 SME's, sustaining 30+ jobs and helping to secure €15M investment into MRE companies.	◉ Review of EU strategies & legal framework for MRE development ◉ Database of test centres ◉ Review of public policies supporting MRE in each region ◉ Open sea test sites	https://bluegift.eu/	European Marine Energy Centre
4	CMMA	GUTTA	Saving fuels and emissions from maritime transport in the Adriatic Region	2019-2022	Interreg Italy-Croatia	Improve the quality, safety and environmental sustainability of marine and coastal transport services and nodes by promoting multimodality in the Programme area.	◉ Gutta-VISIR tool ◉ Database of stakeholders ◉ Reports about traffic data, eco-routes tool UX satisfaction, forecast, fuel & CO2 emissions of vessels	https://programming14-20.italy-croatia.eu/web/gutta/about-the-project	Euro-Mediterranean Center on Climate Change (CMCC)
5	CMMA	GREEN RAY	New generation marine engines and retrofit to achieve methane abatement flexibility	2022-2027	Horizon Europe	Reduce "methane slip"by developing new add-on technologies for existing and new engines. New on-engine technologies will be developed both for four-stroke engines like those used in cruise ships and ferries, as well as for two-stroke engines used in tankers and container ships.	◉ Methane Emissions from a State-of-the-Art LNG-Powered Vessel (ongoing project)	https://greenray-project.eu/	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY
6	CMMA	AIRSHIP	Autonomous flying ships for inter-island and inland waters transport	2023-2026	Horizon Europe	AIRSHIP envisions an innovative use of a known transportation mean: flying ships. Such vehicles (also known as ekranoplans or wing-in-ground -WIG- vehicles) are designed and built to take advantage of the ground effect, that allows these crafts to fly with enhanced lift and reduced drag	◉ Review of Technologies applicable to the propulsion DC Microgrid ◉ AIRSHIP scenarios & lab demonstrations ◉ Control System design for the dynamic model (ongoing project)	https://airshipproject.eu/	UNIVERSIDAD POLITECNICA DE MADRID
7	CMMA	ASPBAN	Atlantic Smart Ports Blue Acceleration Network	2021-2022	EMFAF	Create an open innovation ecosystem based on a network composed of ports of the Atlantic Strategy Group (ASG), of the EU Atlantic, of the Atlantic EEA and of the Transatlantic area that will operate as gateways and blue economy hubs.	◉ CPMR Blue Accelerator Platform ◉ Report of challenges & needs in the industry ◉ Handbook on Investment in the Blue Economy ◉ Guidelines with practical input to enhance the innovation readiness of Atlantic Ports and improve their innovation ecosystems efficiency	https://aspban.eu/en/home/	Beta-i collaborative innovation

8	CMMA	CISMOB	Cooperative information platform for low carbon and sustainable mobility	2016-2020	Interreg Europe	Promote innovative ways to reduce carbon footprint and increase the sustainability of urban areas by improving the efficiency in the use of urban transport infrastructure through ICT.	◉ 4 action plans for mobility ◉ 10 good practices identification ◉ 5 regional development policies	https://projects2014-2020.interregeurope.eu/cismob/	University of Aveiro
9	CMMA	PriMaas	Prioritizing low carbon mobility services for improving accessibility of citizens	2019-2023	Interreg Europe	Promote the integration of traditional collective transport modes with personal and innovative ones by creating equitable mobility services truly focused on citizens' needs.	◉ Policy briefs for the development and implementation of Low Carbon MaaS ◉ Article about relevant factors behind a MaaS scheme ◉ Report on multidimensional Indicator of MaaS systems Performance ◉ eMaas platform: shared, electric and micromobility vehicles	https://projects2014-2020.interregeurope.eu/primaas/	University of Aveiro
10	CMMA	EMERGE	Evaluation, control and mitigation of the environmental impacts of shipping emissions	2020-2024	Horizon Europe	Study the effects of different emission reduction solutions for shipping in Europe and to develop effective strategies to decrease the environmental and climatic impacts of shipping.	◉ Database and analysis on waste stream pollutant concentrations, and emission factors ◉ Report and datasets on shipping contribution to air quality in Europe and case study areas ◉ Baltic, north and mediterranean sea reports ◉ Different articles for the research of pollutants in air and water	https://cordis.europa.eu/project/id/874990	ILMATIETEEN LAITOS
11	CMMA	Restore4Cs	Modelling restoration of wetlands for carbon pathways, climate change mitigation and adaptation, ecosystem services, and biodiversity, co-benefits	2023-2025	Horizon Europe	Modelling restoration of wetlands for carbon pathways, climate change mitigation and adaptation, ecosystem services, and biodiversity co-benefits		https://www.restore4cs.eu/about/	University of Aveiro
12	CMMA	SEABAT	Solutions for large batteries for waterborne transport	2021-2024	Horizon Europe	Provide an alternative to previous energy storage solutions for waterborne transport by developing a full-electric maritime hybrid battery concept. This concept combines two different battery types in a standardised and modular package that may allow it to be produced in larger quantities and profit from economies of scale.		https://cordis.europa.eu/project/id/963560	FLANDERS MAKE
13	BPL	HYPOBATT	HYper POwered vessel BATTery charging system	2021-2025	Horizon Europe	The European project HYPOBATT (HYper POwered vessel BATTery charging system) has brought together 18 key players from the maritime sector. The aim is to develop a modular, fast and simple multi-megawatt charging system. This fast charging station will improve energy efficiency by 20%, charger availability by 95% and battery life by 10%.		https://www.hypobatt.eu/	Ikerlan
14	BPL	H2Ports	First application of hydrogen technologies in port handling equipment in Europe		Horizon Europe	The H2Ports project will demonstrate and validate a Reach Stacker to be tested in MSC Terminal Valencia and a Yard Tractor to be tested in Valencia Terminal Europa (part of Grimaldi's group) have been selected as those specially fitted to the use of Fuel Cells in port facilities. For an effective low-carbon/zero-emission and safe operative model, piloting, evaluating and demonstrating new Fuel Cell technologies oriented to increase energy efficiency, decarbonisation and safety of port terminals.		https://h2ports.eu/	Fundación Valenciaport

15	BPL	GALATEA	Grow and accelerate your smartprojects in new value chains of the European Blue Economy	2020-2023	Horizon 2020	Targeting four main domains of Blue Growth having a high potential in terms of smart and sustainable growth: Smart Port, Smart Ship, Smart Shipyard, Maritime Surveillance.		https://h2ports.eu/value-c	Mobility and Logistics Cluster Association ITS Euskadi
16	BPL	BilbOPS	ONSHORE POWER SUPPLY OPS PROJECT FOR THE PORT OF BILBAO	2022-2026	CEF Transport	BilbOPS is a strategic investment project drawn up by the Bilbao Port Authority for the electrification of the container, cruise-liner and ferry wharves by deploying OPS (Onshore Power Supply) technology, also known as cold-ironing, with 11 connection points. This technology enables vessels with the right equipment to connect to the onshore power supply while they are berthed, and disconnect their diesel motors. This does away with emissions of greenhouse gases (CO2, nitrogen & sulphur dioxide), vibrations and noise and is thus beneficial to the environment and to human health.		https://bilbops.bilbaoport.	Bilbao Port Authority
17	BPL	AUTOMOTIF	AUTOMATION TOWARDS MULTIMODAL TRANSPORTATION AND INTEGRATION OF FREIGHT	2024-2027	Horizon Europe	AutoMoTIF will focus on the development of strategies, business and governance models, regulatory recommendations and synergies that will enable the integration and interoperability of automated transport systems and solutions towards the operational automation of multimodal cargo flows and logistics supply chains in the intra-European network. real challenges and gaps in seamless automated logistics that will be simulated in real settings and different geographical locations to set up a master scenario addressing the end-to-end delivery of goods using highest degree of automation possible, based on their social, environmental and economic impact, such as decreased emissions and congestion, improved working conditions and safety, as well as reduced logistics and freight transport costs, with the SSH aspects being a priority.		under construction	Vicomtech
18	CMMA								
19	CMMA								
20	CMMA								
21	PMBA	CirclesOfLife	Enhancing material CIRCularity and Lower Emissions of Shipbuilding processes in all phases OF the LIFE cycle	2024 - 2026	Horizon Europe	CirclesOfLife develops the Shipyard Environmental Performance Index (SEPI) and the Cradle to Cradle (C2C) Ship Passport, empowering stakeholders across the full supply chain to monitor, assess, and enhance their environmental footprint.		https://circles-of-life.eu/	Damen

22	PMBA	Enigmonia	ENGIMMONIA Sustainable technologies for future long distance shipping towards complete decarbonisation ID: 955413	2021-2025	Horizon 2020	The EU-funded ENGIMMONIA project will promote the global introduction of alternative fuels like ammonia and transfer clean energy technologies successfully demonstrated in terrestrial applications like waste heat recovery and renewables to the maritime sector. It will explore the benefits of carbon-free fuel for vessel engine application and develop an exhaust aftertreatment system.	D2.1 – "Validated mechanism for ammonia at high pressure and high temperature" D2.3 – "Tabulated chemistry coupled with CFD for combustion modelling" D2.4 – "Validated mechanisms for ammonia n-heptane at high pressure and high temperature" D4.2 – "Simulation of NOx and N2O catalytic processes in the flue gas of the ammonia dual-fuel engine" D5.7 – "On-Board real time decision support System – Fincantieri NexTech" D5.8 – "Platform Analytics for Energy Performance Monitoring and Evaluation" D8.2 – "Regulatory, policy, infrastructure and safety aspects" D8.2 – "Guidelines for the update of existing International (IMO, EU) and National regulation and standards related to the use of ENGIMMONIA Clean energy technologies in maritime sector" https://www.engimmonia.eu/demonstration/	https://www.engimmonia.eu/	RINA CONSULTING SPA
23	PMBA	SaferSea	Smarter and Eco-friendlier Atlantic Area	2023-2026	Interreg Atlantic Area	SaferSEA aims to raise awareness of the challenges faced by the shipping industry. The objective of this project is to contribute to the development of a safer, eco-friendly maritime sector and to provide maritime stakeholders with off-the-shelf solutions to support their green transition. SaferSEA will foster the identification and development of innovative technologies for ships and ports while creating a stronger connection between stakeholders – shipowners, port authorities, researchers and innovative startups.		https://www.safersea.eu/	Technopôle Brest-I
24	PMBA	CHEK	deCarbonising sHipping by Enabling Key technology symbiosis on real vessel concept designs	2021-2024	Horizon 2020	The EU-funded CHEK project will pioneer the development of zero-emissions shipping with a future-proof vessel design platform. This will be used to develop and demonstrate two bespoke vessel designs in practice: a wind energy optimised bulk carrier and a hydrogen-powered cruise ship. Both use an interdisciplinary combination of technologies that work together to reduce greenhouse gas emissions by 99 %, while saving at least 50 % energy. Focus will be on maximising symbiosis between these technologies, as they operate in unison for the first time. Finally, CHEK will study the potential impact of this approach on the world fleet's greenhouse gas emissions.		https://www.projectchek.eu/	VAASAN YLIOPIST

25	PMBA	MAGPIE	sMArt Green Ports as Integrated Efficient multimodal hubs	2021-2026	Horizon 2020	The EU-funded MAGPIE project will embark on 12 pilot activities in three key areas: alternative energy sources; smart technologies applied to power operations; and river and rail connections with the hinterland. The ports of Rotterdam (Netherlands) and Sines (Portugal), as well as Haropa Port (France) and the DeltaPort association (Germany) are supporting the project. MAGPIE will combine the accelerated introduction of green energy carriers with logistics optimisation in ports through automation and autonomous operations. The project will demonstrate technical, operational and procedural energy supply solutions to stimulate green, smart and integrated multimodal transport, and guarantee their implementation through the European Green Ports of the Future Master Plan.		https://www.magpie-ports.eu/	HAVENBEDRIJF R
26	PMBA	bound4blue	Advanced sails to reduce environmental impact and OPEX of maritime transport	2022-2024	Horizon Europe	The EU-funded bound4blue project proposes a highly innovative aeronautics-based wingsail. It uses the wind as a renewable energy source for propulsion to reduce more than 30 % of the fuel used in maritime transport (merchant vessels, fishing vessels, passenger vessels, etc.). It also complies with the new International Maritime Organisation (IMO) regulations and the European Green Deal goals. The project proposes two patented types: a foldable wingsail that is more suitable for vessels with space and manoeuvrability restrictions and a suction-based wingsail (eSAIL), more affordable for smaller vessels.		https://bound4blue.com/	BOUND 4 BLUE Sl

DECARBONISING MARITIME TRANSPORT SECTOR - WATERBORNE TP DATA

506 16% 79

Study No.#	Acronym	Project title	Period	Programme	Activity	Benefits/ outputs	Website	Lead Applicant	Nr. Partners	Partners from Atlantic area		% of atlantic partners involved
1	AIRCOAT	Air induced friction reducing ship coating	2018-2022	Horizon 2020	Manufacturing engineering: hull coating	◉ Reducing frictional resistance ◉ Reducing emission of pollutants ◉ Reducing biofouling	https://aircoat.eu/project/	Fraunhofer gesellschaft zur forderung der angewandten forschung ev (Germany)	10	1. Avery dennison materials (Belgium) 2. PPG coatings europe bv (Netherlands) 3. Revolve planet (Belgium)	2	20%
2	Ammonia2-4	Demonstrating a 2-stroke and 4-stroke large scale ammonia marine engine	2022-2026	Horizon Europe	Energy and fuels (ammonia)	◉ At least 80% less GHG emissions ◉ Commercial exploitation of dual fuel marine engines running on ammonia as main fuel ◉ Ammonia ICEs could constitute as much as 30-80% of the total energy use by shipping in 2050	https://www.ammonia2-4.eu/	WARTSILA ITALIA SPA (Italy)	5	1. C-JOB & PARTNERS BV (Netherlands)	1	20%
3	BioSFerA	BIOfuels production from Syngas FERmentation for Aviation and maritime use	2020-2024	Horizon Europe	Energy and fuels (biofuel from syngas fermentation)	◉ 70% total carbon conversion ◉ minimum selling price <0.7-0.8 €/l ◉ 40% GHG emissions reduction ◉ up to 60% reduction in production costs ◉ 22% land use reduction	https://biosfera-project.eu/project/	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS (Greece)	11	1. FUNDACION CARTIF (Spain) 2. BIO BASE EUROPE PILOT PLANT VZW (Belgium) 3. CSIC (Spain) 4. KUWAIT PETROLEUM RESEARCH & TECHNOLOGY BV (Netherlands) 5. SEANRG BV (Netherlands) 6. GOODFUELS BV(Netherlands)	6	55%
4	Aquasonic Diesel	Fuel efficency and emissions reduction system for the maritime and road transport	2018-2020	Horizon 2020	Electronic engeneering (A pulsed electromagnetic field performs a molecular cracking on the fuel components)	◉ Reduction on the polluting emissions of CO2 up to 60% ◉ Reduction of the fuel consumption until a 20% ◉ Molecular cracking to increase on the developed power up to 15%	https://aquasonicdiesel.com/	OMPI SRL (Italy)	2	AQUASONIC SL (Spain)	1	50%
5	Current Direct	Swappable Container Waterborne Transport Battery	2021-2023	Horizon 2020	Manufacturing engineering: lithium-ion cell	◉ Reduce the total cost of waterborne transport batteries ◉ cut GHG emissions of the marine transport sector through electrification of vessel fleets ◉ increase the energy density of waterborne battery cells ◉ trigger investments for innovation, job and knowledge creation in the European marine transport and battery sector	https://cordis.europa.eu/project/id/963603	VRIJE UNIVERSITEIT BRUSSEL(Belgium)	13	1. VRIJE UNIVERSITEIT BRUSSEL(Belgium) 2. CNET CENTRE FOR NEW ENERGY TECHNOLOGIES SA (Portugal) 3. VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK N.V. (Belgium) 4. KOTUG INTERNATIONAL BV(Netherlands) 5. UNIVERSITEIT HASSELT (Belgium) 6. SPEAR POWER SYSTEMS BV (Belgium) 7. UMICORE SA (Belgium)	7	54%
6	E-ferry	Prototype and full-scale demonstration of next generation 100% electrically powered ferry for passengers and vehicles	2015-2020	Horizon 2020	Engeneering: Electric ferry	◉ energy savings of up to 50% ◉ annual emission reductions of approx. 2,000 tonnes CO2, 41,500 kg NOx, 1,350 kg SO2 and 2,500 kg particulates ◉ 100% powered by electricity ◉ reduced weight by up to 60%	https://cordis.europa.eu/project/id/636027	AERO KOMMUNE (Denmark)	10	-	0	0%
7	e-SHyIPS	Ecosystemic knowledge in Standards for Hydrogen Implementation on Passenger Ship	2021-2024	Horizon 2020	Safety engeneering: guidelines for an effective introduction of hydrogen in maritime passenger transport sector	◉ Provide experimental data on hydrogen systems for vessels ◉ Propose a pre-standarisation plan for IGF code ◉ Provide a roadmap for the adoption of hydrogen passenger ships ◉ Develop CFD models and tools for ship design and safety assesment ◉ Generate knowledge on hydrogen systems in the marine sector	https://e-shyips.com/	POLITECNICO DI MILANO (Italy)	14	1. GHENOVA INGENIERIA SL(Spain) 2. SCHEEPSWERF DAMEN GORINCHEM BV (Netherlands)	2	14%
8	EcoSail	Eco-friendly and customer-driven Sail plan optimisation service	2018-2021	Horizon 2020	Engeneering: weather routing and voyage optimisation system	◉ reducing fuel consumption by at least 7 % ◉ roadmap for technical improvements ◉ a strategic business plan on entering the global maritime transport market ◉ between €1.4bn to 2.7bn in reduced costs	https://cordis.europa.eu/project/id/820593	O.M. OFFSHORE MONITORING LIMITED (Cyprus)	6	-	0	0%

9	Cool4Sea	Energy and Environmentally Efficient Cooling System for Maritime use	2016-2018	Horizon 2020	heat engeneering: cooling system getting the energy from the heat of the cargos		https://www.cool4sea.com/	COOL4SEA APS (Denmark)	1	-	0	0%
10	LOCOPS	LOW COST ONSHORE POWER SUPPLY	2017 -2018	Horizon	engineering and technology		https://cordis.europa.eu/project/id/756696	POWERCON AS	1	-	0	0%
11	MARANDA	MARINE APPLICATION OF A NEW FUEL CELL POWERTRAIN VALIDATED IN DEMANDING ARCTIC CONDITIONS	2017-2022	Horizon	Fuel		https://www.cordis.europa.eu/project/id/735717	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY	6	PERSEE France	1	17%
12	NAUTILUS	SUSTAINABLE LONG-HAUL PASSENGER SHIPS	2020-2024	Horizon	engineering and technology		https://cordis.europa.eu/project/id/861647	DEUTSCHES ZENTRUM FUR LUFT - UND RAUMFAHRT EV	14	chantiers de l'atantique france,	1	7%
13	NEMOSHIP	Innovative energy storage solutions for ships	2023-2026	Horizon	natural science		https://cordis.europa.eu/project/id/101096324	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	10	fundacion cidetec spain, cmpagnie du ponant france, stirling design international france, in extenso innovation croissance france,	3	30%
14	ROTORDEMO	NORSEPOWER ROTOR SAIL SOLUTION DEMONSTRATION PROJECT	2017-2018	Horizon	engineering and technology		https://cordis.europa.eu/project/id/738282	SOCIETAL CHALLENGES - Smart, Green And Integrated Transport	1	-	0	0%
15	SATURN	SOLUTIONS @ UNDERWATER RADIATED NOISE	2021-2025	Horizon	natural science		https://cordis.europa.eu/project/id/101006443	UNIVERSITY COLLEGE CORK - NATIONAL UNIVERSITY OF IRELAND, CORK	19	BUREAU VERITAS MARINE & OFFSHORE REGISTRE INTERNATIONAL DE CLASSIFICATION DE NAVIRES ET DE PLATEFORMES OFFSHORE france, NAVAL GROup france, SOCIETE D'INGENIERIE DE RECHERCHESET D'ETUDES EN HYDRODYNAMIQUE NAVALE france, CONSORCIO PARA EL DISENO, CONSTRUCCION, EQUIPAMIENTO Y EXPLOTACION DE LA PLATAFORMA OCEANICA DE CANARIAS Spain, QUIET OCEANS france , TECNICAS Y SERVICIOS DE INGENIERÍA, S.L Spain, UNIVERSITAT POLITECNICA DE CATALUNYA Spain, universidad de la laguna Spain,	8	42%
16	SEABAT	SOLUTIONS FOR LARGE BATTERIES FOR WATERBORNE TRANSPORT	2021-2024	Horizon	engineering and technology		https://cordis.europa.eu/project/id/963560	FLANDERS MAKE	16	FUNDACION CENTRO TECNOLOGICO SOERMAR Spain, COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES France, IKERLAN S. COOP Spain, MONDRAGON GOI ESKOLA POLITEKNIKOA JOSE MARIA ARIZMENDIARRIETA S COOP Spain,	4	25%
17	SEAHUB	REAL-TIME FLEET PERFORMANCE CENTER (FPC) TO OPTIMIZE ENERGY EFFICIENCY IN MARITIME TRANSPORT TO REDUCE FUEL CONSUMPTION AND HARMFUL EMISSIONS	2016-2017	Horizon	engineering and technology		https://cordis.europa.eu/project/id/744716	Marorka ehf	1	-	0	0%

18	SEATECH	NEXT GENERATION SHORT-SEA SHIP DUAL-FUEL ENGINE AND PROPULSION RETROFIT TECHNOLOGIES	2020-2023	Horizon	engineering and technology		https://cordis.europa.eu/project/id/857840	WARTSILA NETHERLANDS BV	7	-	0	0%
19	SHIPFC	PILOTING MULTI MW AMMONIA SHIP FUEL CELLS	2020-2025	Horizon	engineering and technology		https://cordis.europa.eu/project/id/875156	MARITIME CLEANTECH	16	PERSEE France,	1	6%
20	SLEEKSHIP	SPECTRAL IMAGING POWERED SHIP HULL BIOFOULING DETECTION AND CLEANING	2020-2022	Horizon	engineering and technology		https://cordis.europa.eu/project/id/950854	SUBSEA TECH SAS	4	-	0	0%
21	STREAMLINE	STRATEGIC RESEARCH FOR INNOVATIVE MARINE PROPULSION CONCEPTS	2015-2018	Horizon	natural science		https://cordis.europa.eu/project/id/688191	RISE RESEARCH INSTITUTES OF SWEDEN AB	8	MEO-SERVICOS DE COMUNICACOES E MULTIMEDIA SA Portugal, NMUSIC SA Portugal, INTERNET MEMORY RESEARCH SAS France, ALTICE LABS SA Portugal	3	38%
22	SULPURE	INNOVATIVE EXHAUST GAS PURIFICATION SOLUTION FOR THE SHIPPING INDUSTRY	2020-2022	Horizon	natural science		https://cordis.europa.eu/project/id/946288	DAPHNE TECHNOLOGY SA	2	-	0	0%
23	SUPREME	SHIP PERFORMANCE MONITORING AND SIMULATION TO REDUCE FUEL CONSUMPTION AND EMISSIONS	2023-2026	Horizon	natural science		https://cordis.europa.eu/project/id/101058422	KATHOLIEKE UNIVERSITEIT LEUVEN	14	PNO INNOVATION UNIPESSOAL LDA Portugal, FUNDACION TECNALIA RESEARCH & INNOVATION Spain,	2	14%
24	UTOFIA	A NEW, COMPACT AND COST-EFFICIENT CONCEPT FOR UNDERWATER RANGE-GATED IMAGING SYSTEM	2015-2018	Horizon	agricultural scoences		https://cordis.europa.eu/project/id/633098	SINTEF AS	7	SUBSEA TECH SAS France, FUNDACION AZTI - AZTI FUNDAZIOA Spain,	2	29%
25	VIRTUAL-FCS	VIRTUAL & PHYSICAL PLATFORM FOR FUEL CELL SYSTEM DEVELOPMENT	2020-2023	Horizon	engineering and technology		https://cordis.europa.eu/project/id/875087	SINTEF AS	9	COMMUNAUTE D' UNIVERSITES ET ETABLISSEMENTS UNIVERSITE BOURGOGNE - FRANCHE - COMTE, UNIVERSITE DE TECHNOLOGIE DE BELFORT - MONTBELIARD France, UNIVERSITE DE FRANCHE-COMTE France, ECOLE NATIONALE SUPERIEURE DE MECANIQUE ET DES MICROTECHNIQUES France,	4	44%
26	EMERGE	EVALUATION, CONTROL AND MITIGATION OF THE ENVIRONMENTAL IMPACTS OF SHIPPING EMISSIONS	2020-2024	Horizon	natural science		http://www.fmi.fi/	ILMATIETEEN LAITOS	17	UNIVERSIDADE DE AVEIRO Portugal, FUNDACIO INSTITUT CATALA DE RECERCA DE L'AIGUA Spain,	2	12%
27	ENGIMMONIA	SUSTAINABLE TECHNOLOGIES FOR FUTURE LONG DISTANCE SHIPPING TOWARDS COMPLETE DECARBONISATION	2021-2025	Horizon	engineering and technology		http://www.dappolonia.it/	RINA CONSULTING SPA	24	FUNDACION TECNALIA RESEARCH & INNOVATION Spain, UNIVERSIDAD DEL PAIS VASCO/ EUSKAL HERRIKO UNIBERTSITATEA Spain	2	8%
28	EONAV	EARTH OBSERVATION FOR MARITIME NAVIGATION	2016-2019	Horizon	engineering and technology		https://www.offshoremonitoring.com/	O.M. OFFSHORE MONITORING LIMITED	8	/	0	0%
29	ESHARK	ECO-FRIENDLY SHIP HULL FILM SYSTEM WITH FOULING RELEASE AND FUEL SAVING PROPERTIES	2015-2019	Horizon	engineering and technology		https://www.ppg.com/	PPG COATINGS EUROPE BV	5	/	0	0%

30	FASTWATER	THE GREEN REVOLUTION OF WATERBORNE TRANSPORT	2020-2024	Horizon	engineering and technology		http://www.lu.se/	LUNDS UNIVERSITET	13	/	0	0%
31	FLAGSHIPS	CLEAN WATERBORNE TRANSPORT IN EUROPE	2019-2025	Horizon	social sciences		https://www.vtt.fi/	TEKNOLOGIAN TUTKIMUSKESKUS VTT OY	13	PERSEE France,Compagnie Fluviale de Transport France, LMG MARIN FRANCE France, SOGESTION France, SOGESTRAN France,	5	38%
32	FLEXI-GREEN FUELS	FLEXIBLE AND RESILIENT INTEGRATED BIOFUEL PROCESSES FOR COMPETITIVE PRODUCTION OF GREEN RENEWABLE JET AND SHIPPING FUELS	2021-2023	Horizon	natural science		https://www.hs-bremerhaven.de/	HOCHSCHULE BREMERHAVEN - UNIVERSITY OF APPLIED SCIENCES	13	/	0	0%
33	FLEXSHIP	FULL STEAM AHEAD OF CLIMATE NEUTRALITY IN MARITIME INDUSTRY	2023-2026	Horizon EUROPE	engineering and technology		https://cordis.europa.eu/project/id/101095863	BRUSSELS RESEARCH AND INNOVATION CENTER FOR GREEN TECHNOLOGIES	14	FUNDACION CENTRO TECNOLOGICO SOERMAR Spain,FUNDACION CENTRO TECNOLOGICO SOERMAR Spain,FAIVELEY TRANSPORT TOURS SAS France,	2	14%
34	FUELSAVE	FS MARINE+: HYDROGEN SYNGAS INJECTION UNIT FOR SHIPS TO SAVE FUEL AND CUT EMISSIONS	2018-2020	Horizon	engineering and technology		https://cordis.europa.eu/project/id/806083	FUELSAVE GMBH	1	/	0	0%
35	GASVESSEL	COMPRESSED NATURAL GAS TRANSPORT SYSTEM	2017-2022	Horizon	natural science		https://cordis.europa.eu/project/id/723030	NAVALPROGETTI SRL	16	/	0	0%
36	GLAMOUR	GLYCEROL TO AVIATION AND MARINE PRODUCTS WITH SUSTAINABLE RECYCLING	2020-2024	Horizon	engineering and technology		http://www.manchester.ac.uk/	THE UNIVERSITY OF MANCHESTER	9	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS Spain,	1	11%
37	GREENDRIVE	A MOLECULAR FUEL MODIFIER FOR SHIPS ABLE TO REDUCE THE COSTS RELATED TO FUEL AND MAINTENANCE FOR FLEET OPERATORS	2016-2016	Horizon	natural science		https://cordis.europa.eu/project/id/734473	ECOMFM LIMITED	2	EQUIMER SARL france	1	50%
38	GREEN MARINE	RETROFITTING TOWARDS CLIMATE NEUTRALITY	2017-2017	Horizon	engineering and technology		https://cordis.europa.eu/project/id/762384	GREEN STAR MARINE SWEDEN AB	1	/	0	0%
39	H2ENGINE	SUSTAINABLE. CLEAN. UNCOMPROMISING. THE INTERNAL COMBUSTION ENGINE BECOMES GREEN	2020-2022	Horizon	engineering and technology		https://cordis.europa.eu/project/id/953629	KEYOU GMBH	1	/	0	0%
40	HCR	MARKET MATURATION OF THE FIRST ON-BOARD AUTONOMOUS BIOFOULING CLEANING SYSTEM TO KEEP SHIP'S HULL CLEAN AT ALL TIMES	2018-2022	Horizon	engineering and technology		https://cordis.europa.eu/project/id/806303	CLIIN APS	1	/	0	0%
41	HERCULES	FUEL FLEXIBLE, NEAR-ZERO EMISSIONS, ADAPTIVE PERFORMANCE MARINE ENGINE	2018-2023	Horizon	natural science		http://www.warwick.ac.uk/	THE UNIVERSITY OF WARWICK	11	ECOLE NATIONALE DES PONTS ET CHAUSSEES France,DARES TECHNOLOGY SL Spain	2	18%
42	HERCULES-2	FUEL FLEXIBLE, NEAR-ZERO EMISSIONS, ADAPTIVE PERFORMANCE MARINE ENGINE	2015-2018	Horizon	engineering and technology		http://www.ntua.gr/	ETHNICON METSOVION POLYTECHNION	32	WARTSILA IBERICA SA Spain,	1	3%
43	HYMETHSHIP	ON THE WAY TO ZERO EMISSION SHIPPING	2018-2021	Horizon	natural science		https://cordis.europa.eu/project/id/768945	LEC GMBH	13	/	0	0%

44	HYPOBATT	HYPER POWERED VESSEL BATTERY CHARGING SYSTEM	2022-2025	Horizon EUROPE	engineering and technology		http://www.ikerlan.es/	IKERLAN S. COOP	15	FUNDACION DE LA COMUNIDAD VALENCIANA PARA LA INVESTIGACION, PROMOCION Y ESTUDIOS COMERCIALES DE VALENCIAPORT España,FUNDACION CENTRO TECNOLOGICO SOERMAR España, COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES Francia,	2	13%
45	HYSEAS III	THE FINAL STEP TO ZERO EMISSIONS MARINE TRANSPORT POWERED ENTIRELY FROM RENEWABLES	2018-2022	Horizon	social sciences		http://www.st-andrews.ac.uk/	THE UNIVERSITY COURT OF THE UNIVERSITY OF ST ANDREWS	10	MCPHY ENERGY France	1	10%
46	HYSHIP	DEMONSTRATING LIQUID HYDROGEN FOR THE MARITIME SECTOR	2021-2025	Horizon	social sciences		https://cordis.europa.eu/project/id/101007205	WILH WILHELMSEN HOLDING ASA	18	LMG MARIN FRANCE France,PERSEE France,	2	11%
47	IDEALFUEL	LIGNIN AS A FEEDSTOCK FOR RENEWABLE MARINE FUELS	2020-2024	Horizon	natural science		http://www.tue.nl/en	TECHNISCHE UNIVERSITEIT EINDHOVEN	11	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS España,	1	9%
48	LEANSHIPS	LOW ENERGY AND NEAR-TO-ZERO EMISSION SHIPS	2015-2019	Horizon	engineering and technology		https://www.damen.nl/	SCHEEPSWERF DAMEN GORINCHEM BV	51	CHANTIERS DE L'ATLANTIQUE France,SOCIETE D'INGENIERIE DE RECHERCHESET D'ETUDES EN HYDRODYNAMIQUE NAVALE France,ENERTIME SA France, LEROUX ET LOTZ TECHNOLOGIES France,PAULSTRA France,NAVANTIA S.A. Spain, VICUS DESARROLLOS TECNOLOGICOS SL Spain, WARTSILA IBERICA SA Spain,	9	18%
49												14%