Innovation Norway

Green Maritime Transport

Sustainability in the Spanish Maritime Transport Sector

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CLUSTER MARÍTIMO DE CANARIAS

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Introduction

Maritime transport plays an essential role in the world economy. It enables more than 80% of world trade in volume and more than 70% in value. However, maritime transport is the responsible of more than one billion tons of CO_2 that are emitted to the atmosphere each year, which represents 2.9% of all emissions of human origin.

These emissions are projected to increase from 90% to as much as 130% of 2008 emissions by 2050 for a range of plausible long-term economic and energy scenarios. If the climate change impact of shipping activities grows as projected, it would undermine the objectives of the Paris Agreement a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C.

At EU level, maritime transport is a substantial CO_2 emitter, representing 3 to 4% of the EU's total CO_2 emissions, or over 144 million tonnes of CO_2 in 2019.

At national level, Spain is, after the Netherlands, the second European country with the highest greenhouse gas emissions from ships arriving or leaving its coasts, according to the European Federation of Transport and Environment (T&E).

It is estimated that, in 2018, CO_2 emissions from ships sailing to and from Spain were around 17 million tons. To understand the magnitude of the emissions and the environmental problem associated to these figures, it is important to consider that these emissions are higher than those made by all the vehicles in the 30 largest Spanish cities.

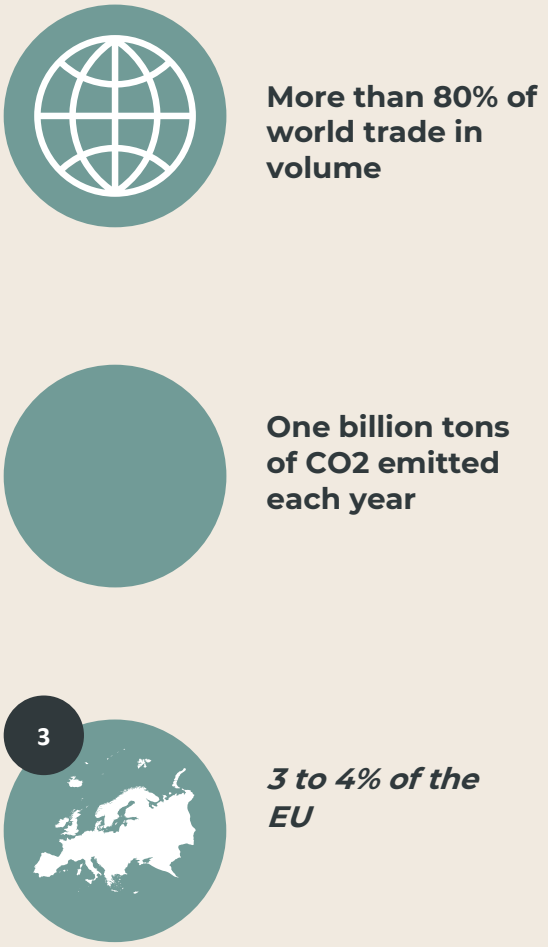


Figure 1. Maritime transport in a nutshell

In this sense, maritime transport is likely the only sectors that has not yet taken generalized and effective measures to reduce the release of gases, nor taxation for the pollution it produces. To date, no adequate measures are in place, either at the global level or in the EU, to achieve the necessary emissions reductions for the maritime transport sector to contribute to the EU's increased climate ambition.

At national level, the situation is quite similar o even worse. There is no potential and important projects in terms of infrastructure to speed the transition and there is absence of fiscal and economic measures to incentive the process.

With relation to the energy mix in terms of green production, the situation in 2021 has become 23.3% for wind production. In addition, other renewable energies have been increasing their percentages. And, now, hydropower accounts for 11.4% of the mix, solar photovoltaic 8.1% and solar thermal 1.8%. These figure indicate that in 2021, more than 44% of the energy production comes from renewable energies. The rest of energy mix is composed by the nuclear energy 20,8%; combined cycle 17.1% and co-generation 10%.

However, the pressure to improve the environmental performance has increased in recent years and International Maritime Organization (IMO) decided to cut greenhouse gas emissions from international shipping by at least 50% compared to 2008 levels. Considering the steady increase of maritime trade, population growth, and the arising economies of scale, it is evident that a combination of operational measures, policy instruments, and development of green technologies are necessary in order to achieve the aspired reductions.

International Maritime Organization (IMO) decided to cut greenhouse gas emissions from international shipping by at least 50% compared to 2008 levels.

In this sense, Europe has a strong commitment to fight against climate change and environmental degradation. This commitment was clearly determined in the European Green Deal whose main objective is to transform the EU into a modern, resource-efficient and compe-titive economy. To achieve this ambitious goal, the EU will invest 1.8 trillion euro investments from the NextGeneration, EU Recovery Plan, and the EU's seven-year budget.

This ambitious plan has a set of objectives with an important common factor, to increase the standard of living and to guarantee the future of the European citizens under a healthy life. Transport is a key factor because it articulates the mobility of people and goods and this the main reason why the European Green Deal is focused on boosting the use of public transport in Europe. Therefore, there are objectives concretes and clearly defined for the transport and concretely, maritime transport.

Moreover, the European Commission adopted a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

In addition to the Green Deal, there are other different alternatives or proposal to guarantee the sustainability of the maritime transport, such as extending the EU Emissions Trading System (ETS) to maritime transport creating a carbon price signal, boosting demand for marine renewable and low-carbon fuels, accelerating the supply of renewables in the EU or revising the existing Energy Taxation Directive, among others.

Moreover, there is a global strategy to reduce the pollutant emissions to hold with the internationally agreed temperature goals under the Paris Agreement. Another important document and strategy that is directly linked with the green maritime transport is the EU Fuel Maritime to increase

the development and implementation of alternative fuels.

At national level, in Spain, the legal framework is fundamentally based on RD 2/2011 the State Ports and Merchant Marine Law and the formal organization of the Spanish Maritime Transport System. Another point is from the national perspective, most of the legislation is basically transposed of the European one and the Agreements of the International Maritime Organization.

With respect to the policies, it is possible to summarize them into two main points to achieve the proposed objectives.

- Market Based Measure
- The Adoption of Technological Changes

This report has two basic objectives. First, to describe the existence of potential measures to achieve the fixed objective and what is the progress in terms of implementation of the alternatives. Second, to analyse carefully the state of the art at national level.

Market Analysis. The Port System in Spain

Spain has more than 8.000 km and it has a strategic situation in the Southern Europe connected with Africa and with strong cultural connections with South America.

Considering the Spanish Port System, it is necessary to differentiate, in the first place, between the two types of ports that exist in the national port system based on their ownership: the state domain and the regional domain which are the ones with the least activity, dependent on regional public bodies and which are usually sports, fishing and refuge ports.

State-owned ports are public bodies dependent on the Ministry of Public Works, although they have management autonomy. They are considered of general interest, and it is where commercial activity is high.

For a port to be considered of general interest, it must host international commercial activities, serve industries of strategic importance to the national economy, have a significant volume of activity for the state economy, or have technical or geographical conditions that compromise national maritime security. The Spanish state-owned port system is made up of 46 ports of general interest.

The coordination, management and execution of the government's port policies in these 46 ports is carried out through the Puertos del Estado. This entity depends on the Ministerio de Transportes, Movilidad y Agenda Urbana, whose Ministry is Mrs. Raquel Sánchez Jiménez, and includes, in turn, 28 Port Authorities.

The Port Authorities, or Port Police, are in charge of managing each of the Spanish ports, or several of them, and their powers are included in the State Ports and Merchant Marine Law (Royal Legislative Decree 2/2011, of 5 of September). More than 6,000 agents are in charge of the protection, surveillance and management of the different national docks, where the Port Authorities that register the greatest commercial activity

Table 1. Port system in Spain

PORT AUTHORITIES	REGION
Port Authority of A Coruña	Galicia
Port Authority of Alicante	The Community of Valencia
Port Authority of Almería	Andalusia
Port Authority of Avilés	Asturias
Port Authority of Bahía de Algeciras	Andalusia
Port Authority of Bahía de Cádiz	Andalusia
Port Authority of Baleares	The Balearic Islands
Port Authority of Barcelona	Catalonia
Port Authority of Bilbao	Basque Country
Port Authority of Cartagena	The Community of Valencia
Port Authority of Castellón	The Community of Valencia
Port Authority of Ceuta	Ceuta
Port Authority of Ferrol-San Cibrao	Galicia
Port Authority of Gijón	Asturias
Port Authority of Huelva	Andalusia
Port Authority of Las Palmas	The Canary Islands
Port Authority of Málaga	Andalusia
Port Authority of Marín y Ría de Pontevedra	Galicia
Port Authority of Melilla	Andalusia
Port Authority of Motril	Andalusia

Port Authority of Pasajes	Basque Country
Port Authority of Santa Cruz de Tenerife	The Canary Islands
Port Authority of Santander	Cantabria
Port Authority of Sevilla	Andalusia
Port Authority of Tarragona	Catalonia
Port Authority of Valencia	The Community of Valencia
Port Authority of Vigo	Galicia
Port Authority of Vilagarcía	Galicia
Port Authority of Almería y Motril	Andalusia

happen to be those of Valencia and the Bay of Algeciras.

The State-owned Spanish Port System includes 46 ports of general interest, managed by 28 Port Authorities, whose coordination and efficiency control corresponds to the government agency Puertos del Estado that belongs to the Ministry of Public Works that is responsible for implementing the government's port policy.

The importance of ports as links in the logistical and transport chains is supported by the following figures: they handle nearly 60% of exports and 85% of imports, which account for 53% of Spanish foreign trade with the European Union and 96% with third countries.

In addition, the State port system's activity contributes nearly 20% of the transport sector's GDP, which accounts for 1.1% of the Spanish GDP. Moreover, it generates direct employment of more than 35,000 jobs and around 110,000 indirectly.

Legal framework

The legal framework of the maritime transport, it is very important the transposition to the national legislation of the International Agreement of IMO. The main agreements are the following ones:

- Article III of the International Convention for the Safety of Life at Sea. SOLAS, 1974)
- Article 11 of the International Convention for the Prevention of Pollution from Ships (MARPOL, 1973, modified by the Protocol of 1978, and the Protocol of 1997).
- Article IV of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW, 1978)
- Article 26 of the International Load Line Convention (LL, 1966, and the Protocol of 1988).
- Article 15 of the International Convention on Tonnage Measurement of Ships (Tonnage Measurement, 1966).
- Convention on International Regulations for Preventing Collisions at Sea (COLREG, 1972)

The following table indicates the relation between most important national laws (an important amount of them represents a transposition of European legislation) and the previous international agreements represented in the columns by each acronym.

National Legislation	SOLAS	MARPOL	STCW	LL	ARQUEO	COLREG
Law 25/1964 about nuclear energy.	X					
Decree 3384/1971, on Regulation of Recognition of Merchant Ships and Vessels.	X	X	X	X	X	
Royal Decree 1661/1982 declaring application to all national merchant ships and vessels precepts of the International Convention for the Safety of Human Life at Sea, 1974, and its protocol of 1978 (new text).	X					
Royal Decree 1835/1983 which adopts for the buoyage of the coasts the maritime buoyage system of the International Association of Maritime Signaling (AISM).	X					
Order of the Ministry of Transport and Communications, 1983, on complementary rules of application to the Convention International for the Safety of Life at Sea, 1974, and its Protocol of 1978, to national merchant ships and vessels.	X					
Royal Decree 145/1989, approving the National Regulation of Admission, Handling and Storage of Dangerous Goods in Ports.	X					
Royal Decree 1561/1995, on special working days.			X			
Royal Decree 258/1999 on establishing minimum conditions on health protection and medical care of sea workers.			X			
Royal Decree 665/1999 which regulates the registry of people traveling on board passenger ships.	X					
Royal Decree 1247/1999 on safety rules and regulations applicable to passenger ships.	X			X		
Royal Decree 1837/2000, of November 10, approving the regulation of inspection and certification of civil ships.	X	X	X	X	X	X
Royal Decree 525/2002 on the control on the organization of working time.			X			
Royal Decree-Law 9/2002, on tankers which carrying dangerous goods or contaminants		X				
Royal Decree 995/2003, which establishes the harmonized requirements and procedures for loading and unloading operations unloading of bulk carriers. Royal Decree 210/2004 establishing a monitoring and information system on maritime traffic.	X					
Regulation (EC) No. 725/2004 of the European Parliament and of the Council, regarding the improvement of the protection of ships and port infrastructures.	X					
Royal Decree 61/2006, which establishes the specifications of gasoline, diesel, fuel oil and liquefied gases of the oil and regulates the use of biofuels and the content of sulfur from marine fuels.		X				
Regulation (EC) No. 336/2006, on the application in the Community of the Code international security management system and repealing the Council Regulation (EC) No. 3051/95.	X					
Royal Decree 394/2007, on measures applicable to vessels in transit that discharge pollutants.		X				
Royal Decree 543/2007 which determines the standards safety and pollution for fishing boats.		X				
Law 41/2010, on the protection of the marine environment.		X				
Royal Decree 1737/2010, approving the Regulations Governing Inspections of Foreign Ships.	X	X	X	X	X	X
Royal Decree 799/2011, which establishes the obligations incumbent on the Ministry of Public Works in matters of safety and prevention of marine pollution.	X	X	X	X	X	X
Royal Decree 804/2014, establishing the legal regime and safety standards and prevention of pollution from ships which carry up to twelve passengers.	X	X	X	X	X	X
Royal Decree 128/2022, on port infrastructure to receive waste.		X				

Figure 2. Ports of Algeciras

Spanish ports: A brief description of the main ones.

The Spanish port system is composed by more than 40 ports of national interest. However, there are some which have more importance than others so it is important to describe them briefly in order to show a clear image about the situation of the ports.

Concretely, we are going to analyse the 10 most important ports of the whole system considering the traffic and the geographical situation.

Port of Algeciras

In terms of importance and traffic, the most important port of the Spanish network is Puerto de Algeciras that is one of the largest ports in Europe for containers.

Regarding transshipment traffic measured in tons, it closed 2020 in positive with a growth of 0.84%, led by Bahía de Algeciras (73.7 million tons) and followed by Valencia, Barcelona, Las Palmas and Huelva.

Very close to Algeciras is the port of Bahía de Cádiz. This port maintains its leadership in growth of general merchandise at the state

level in the first half of 2021. With an increase of 76.24% compared to June 2020 and 1.18 million tons of general merchandise moved, it is positioned in the position number 12 of the 28 Port Authorities.

The main operators of the Port of Algeciras may be classified as follows:

Table 2 Port system of Algeciras

Operator's Name	Activity
APM Terminals	Container
Total Terminal International Algeciras	Container
Cepsa	Liquid Bulk (refinery)
Exolum	Liquid Bulk
Vopak Terminal Algeciras	Liquid Bulk
Acerinox	Solid Bulk
Endesa	Solid Bulk

Agro Merchants Algeciras, SL	Reefer
Almacenamiento de Frío y Logístico del Sur, SL	Reefer
Depósito Aduanero y Logístico Sur de Europa S.L. – DALSE	Reefer

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Algeciras.

- APM Terminal Algeciras. APM Terminals Algeciras occupies a 67 hectare plot on Juan Carlos I Quay, which has drafts of 17 metres. At the moment, the terminal has 19 STS (Ship-to-Shore) cranes – 8 of which are over-super-post-panamax class, 59 RTG (Rubber Tyred Gantry) Cranes and 102 tractor heads. The adaptation of the Port of Algeciras Bay's facilities to meet the new demands of the container sector under the Algeciras 2014 Project has allowed APM Terminals Algeciras to be able to accommodate the newest generation of 18,000 TEU-plus megaships.

- Total Terminal International Algeciras. TTI Algeciras, the common-user terminal funded by Korean giant, Hanjin Shipping, occupies a 30-hectare concession on Isla Verde Exterior Quay. It has a 57,271-square-metre public manoeuvring zone, and two quay lines: a 650-metre-long quay to the East and a 550-metre-long quay to the North, with 18.5 and 17.5 metre drafts respectively. The terminal is fitted out with 8 STS (Ship-to-Shore) cranes, 32 ASC (Automatic Stacking Cranes) on rails and 22 Shuttle Carriers that allows to terminal to service the newest generation of 18,000 TEU-plus megaships.

- Heavy Traffic Terminal. It provides an enclosed, controlled space that is dedicated to the concentration of heavy goods traffic (semi-trailers and complete loads) that operate within the port premises to encourage optimization of the import-export logistics chain, thus offering added value for both operators and haulage companies. It is operated by many transport companies.

Figure 3 Port of Valencia

- Cepsa. CEPSA's "Gibraltar-San Roque" refinery is fitted out with piers and a sea-island anchored at 60 metres depth, where oil-tankers of up to 350,000 tons DW can moor and unload up to 12,000m3/hour.The refinery has a capacity to distil 12 million tonnes of crude per year. The port that is located within the facility has seven loading and unloading berths on a 1,467-metre-long pier, plus another terminal dedicated exclusively to barge activities. Ships of up to 175,000 tons DW can berth at the facility, whose drafts vary from between 6 and 20 metres depth.

- Exolum. EXOLUM runs a facility on the Port of Algeciras 'North Breakwater to receive products from tankers. The North Breakwater is used to load barges at a maximum rate of 500m3/hour. Having expanded the capacity of their facility on Isla Verde Quay, CLH now occupies a total 203,144m2 surface area at the Port of Algeciras. In 2014, EXOLUM passed a €7-million investment scheme that is set to upgrade their hydrocarbon blending service at this facility.

- Vopak Terminal Algeciras. Isla Verde Exterior Quay houses Vopak Terminal Algeciras ' hydrocarbon and liquid bulk storage and distribution terminal. It has a 403,000m3 storage capacity with 22 tanks and a pier for ships of up to 225,000 tons DW. Vopak's new expansion project is set to see their nominal storage capacity grow by an extra 880,803m3 with 36 more tanks planned to be built, making a grand total of 1,286,649m3 storage volume. At the same time, three new berthing points have been planned in the project, including all the required auxiliary equipment and pipework to load and unload tankers from the pier.

With respect to the main services provided at the port, the following table summarizes the most important ones:

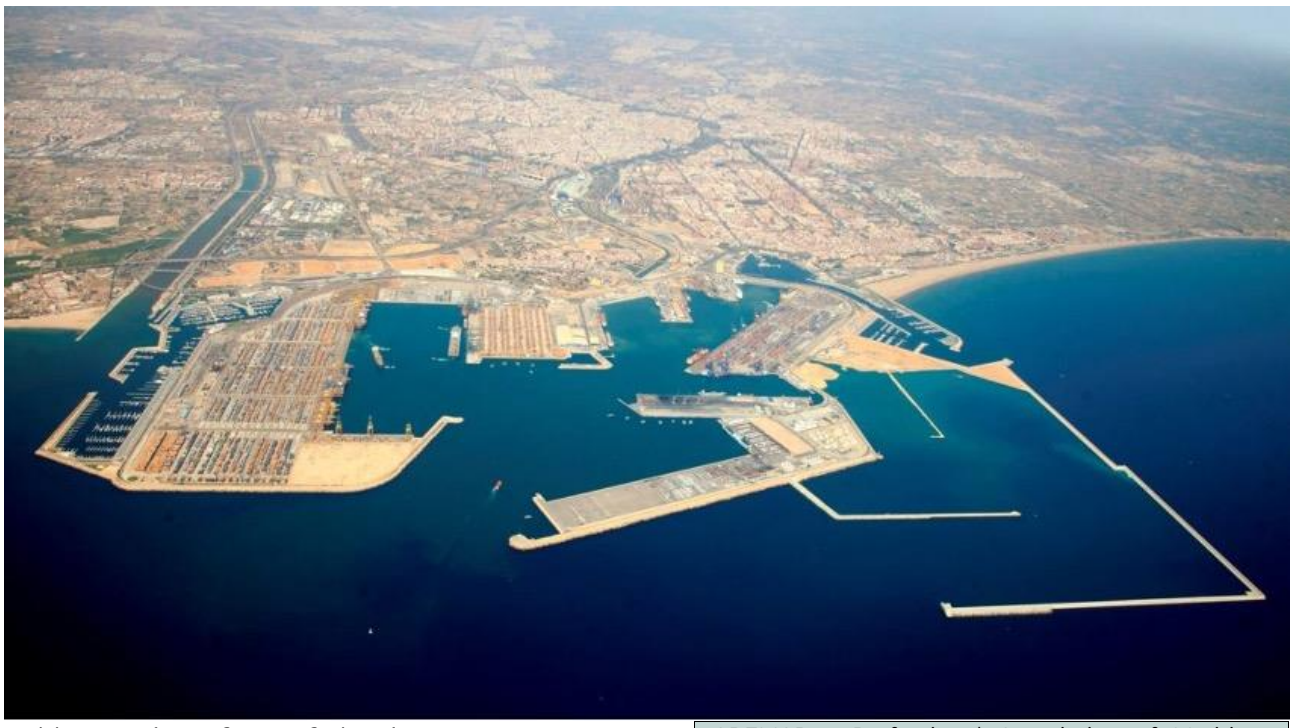


Table 3 Services of Port of Algeciras

Operator's Name	Activity
Port of Algeciras Pilot's Corporation	Piloting
>50 different ship agents	Consigning
Cepsa	Bunkering
Peninsula Energy Flowing	Bunkering
Repsol Trading	Bunkering
Astilleros Cernaval	Shipyards
Yacht Center Green Island	Shipyards

Another important partners of a port are the set of associations which assist to the different activities, such as:

Table 4 Associations of Port of Algeciras

Association's Name
ACETM - Regional Association of Road Transport and Industrial Machinery for Public Works of Campo de Gibraltar
AESBA - Association of Service Companies of the Bay of Algeciras
AGI - Association of Large Industries of the Bay of Gibraltar
APEMAR – Professional Association of Maritime Activities Companies
ATEIA OLTRA – Association of Freight Forwarders, International Shippers and Assimilated of the Bay of Gibraltar
COMPORT – Port Community of the Bay of Algeciras Port
CMMA – Andalusian Marine-Maritime Cluster

Port of Valencia

The Port of Valencia is the second largest port in Spain. It has traffics of practically any type of goods from all sectors of the economy. Its main clients include the following sectors: furniture and wood, textiles, footwear, agricultural and livestock farming and food (cereals and fodder, wines and beverages, preserves, fruits, etc.), energy (diesel, gasoline, coal, etc.), chemical, automobile (Ford, Fiat, Land Rover, Jaguar, etc.), construction (cement and clinker, tiles, marble, etc.), machinery, etc.

The Port of Valencia also hosts regular passenger traffic with the Balearic Islands and Italy and has been the protagonist, in recent years, of one of the most continuous and solid growths in Mediterranean cruise traffic. This port transported 80,683,260 tons in 2020.

The Port of Valencia distributes goods within a radius of 2,000 km to North Africa and the

European Union. The port that grew the most in tons in transit in 2020 was Valencia with 2.64 million tons more, followed by the Port Authority of Gijón with 1.64 million tons more, Las Palmas with 1.13 million tons more, Cartagena with a total of 318,894

more tons and Santa Cruz de Tenerife with 299,171 more tons.

The main operators of the Port of Valencia may be classified as follows:

Table 5 Port system of Valencia

Operator's Name	Activity
APM Terminals Valencia	Multipurpose Terminal
MSC Terminal	Container
CSP Iberian Valencia Terminal	Container
Eurolíneas Marítimas (Balearia)	Passengers
Trasmediterranea	Passengers
Valencia Terminal Europa	Multipurpose Terminal
Galp Energía España	Bunkering
TEVA-Tank	Bunkering
TEPSA	Bunkering

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Valencia.

- CSP Iberian Valencia Terminal. It has a surface of 145 hectares and direct connection with railways and an annual capacity of 3,500,000 TEUs. It has a 2,310 m berth length and 15.5 metre drafts. The terminal has 20 twin lift cranes – 15 SSPX and 1 Malaccamax, among others - 55 RTG and 105 tractor heads

- APM Terminal Valencia. APM Terminals Valencia occupies 45 hectares and a berth length 1,660 with an annual capacity of 1,340,000 TEUs located at the Levante Pier. At the moment, the terminal has 12 STS (Ship-to-Shore) cranes – 4 of which are over-super-post-panamax class, 30 RTG (Rubber Tyred Gantry) Cranes and 63 tractor heads. Moreover, the APM Terminal has direct access via railway and 700 conection point to refeer containers

- MSC Terminal Valencia. This terminal occupies 337,000 square meters including deposit and administrative buildings. It has a 770-metre-long quay with 17 metre drafts. The terminal is fitted out with 8 STS (Ship-to-Shore) cranes, 25 transtainers, 53 terminal tractors, 7 reach stackers and 4 empty container handlers.

- Balearia. It operates in the passengers terminal with a surface of 15,126 square meters

- Trasmediterranea. It belongs to Naviera Armas group and it operates on a surface of 40,724 square meters with a passenger terminal which has 2 fingers. It has also direct access to the ro-ro traffic.

- Valencia Terminal Europa. It has a 85,000 square metres and it is more adapted to the ro-ro traffic with a center to the pre-delivery of vehicles with a 800 m^2 area. It has a capacity of 14,500 vehicles (including 5,000 vehicles area for Ford manufacturer).

With respect to the main services provided at the port, the following table summarizes the most important ones:

Figure 4 Port of Barcelona

Table 6 Services of Port of Valencia

Operator's Name	Activity
Port of Valencia Pilot's Corporation	Piloting
Boluda Towage and Salvage	Tugboats
Moor ships of the Valencia's Port	Moor ships
Docks Logistics Spain	Deposit
FCC Logística	Deposit
>50 different ship agents	Consigning

Another important partners of a port are the set of associations which assist to the different activities, such as:

Table 7 Associations of Port of Valencia

Association's Name
FEPORTS - Fundación Instituto Portuario de Estudios y Cooperación de la Comunidad Valenciana
Fundación Valenciaport – Fundación de la Comunidad Valenciana para la Investigación, Promoción y Estudios Comerciales de Valenciaport
ELTC – Asociación de Empresas de Logística y Transporte de Contenedores
Asociación Naviera Valenciana
APORTEM – Puerto Solidario Valencia
ATEIA - Association of Freight Forwarders, International Shippers and Assimilated
IVACE – Institute of Business Competitiveness in Valencia

Port of Barcelona

The port of Barcelona is located in the northeast of the Iberian Peninsula next to the Mediterranean Sea and it is managed by the Port Authority of Barcelona. This port has existed for more than 2000 years and is still

strong in terms of trade and port services. In addition, it is an excellent ally for other important ports along the Mediterranean coast.

The port of Barcelona processed almost 3 million TEUs in 2017 and about 4 million passengers at the same time. After a two-million-euro expansion project, traffic to the cruise section of the port increased greatly during 2019.

This port is closer to tourist areas compared to the rest and this is used to increase the cruise portfolio. In terms of commercial activities, its proximity to France makes the port of Barcelona a good gateway to international trade.

The port of Barcelona is divided into the commercial port, the old port and the logistics port. It also has a free trade zone.

The port of Barcelona is divided into five areas: the city port (Port Vell), the commercial port (mainly containerized cargo), the cruise port (tourist), the energy port and the logistics port. Each of these activities has its own space, segregated from the others, with facilities and specialized personnel.

In terms of passenger transport, it is the largest port in the Mediterranean in terms of cruise traffic and fourth in the world, only behind the Caribbean ports. A large number of cruise ships operating in the Mediterranean are based in the Port of Barcelona.

The container terminal operators are Hutchison Ports BEST, APM Terminals Barcelona and Port Nou (multipurpose). The car terminals are Autoterminal and Setram. The terminals that handle liquid bulk are: Enagas, Meroil, Relisa, Tepsa, Vopak Terquimsa, Decal España, Koalagas, CLH, Quimidroga, Parc Delta 1, Tradebe. The solid bulk stevedoring companies are: Portcemen, Cemex Spain, Ergransa, Cargill Spain, Bunge Ibérica, Tráfico de Mercancías and Sammer.

The main operators of the Port of Barcelona may be classified as follows:

Table 8 Port system of Barcelona

Operator's Name	Activity
BEST Barcelona Europe South Terminal	Container
APM Terminals Barcelona	Container
Terminal Port Nou	Multipurpose
Autoterminal	Vehicles
Setram	Vehicles
Enagas	Liquid Bulks
Meroil	Liquid Bulks
Relisa	Liquid Bulks
TEPSA	Liquid Bulks
Vopak Terquimsa	Liquid Bulks
Decal España	Liquid Bulks
Koalagas	Liquid Bulks
CLH	Liquid Bulks
Quimidroga	Liquid Bulks
Tradebe	Liquid Bulks
Portcemen	Solid Bulks
Cemex Spain	Solid Bulks
Ergransa	Solid Bulks
Cargill España	Solid Bulks
Bunge Ibérica	Solid Bulks
Tráfico de Mercancías, SA	Solid Bulks
SAMMER, Manipuladora de Mercancías, SL	Solid Bulks

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Barcelona.

- **BEST Terminal.** It occupies an area of 80 hectares and it has 13 Super Post-Panamax

dock cranes, 54 automated cranes (ASC) and 34 Shuttle Carriers, operating along 1,500 meters of dock with a draft of 16.5 meters in depth. It has also the capacity to store and monitor 2,750 refrigerated containers and more than 2,500,000 TEUS per year.

- APM Terminal Barcelona. APM Terminals Barcelona occupies 81 hectares and a berth length 1,515 with an annual capacity of 1,560,000 TEUs. At the moment, the terminal has 13 STS (Ship-to-Shore) cranes – 5 of which are over-super-post-panamax class, connected with 6 rail tracks. It handles over 2,000 truck operations per day and it is foreseen to receive an investment of 170 millions of Euros over the coming years.

- Terminal Port Nou. The terminal is in hands of Begé group and it is the only multipurpose terminal in Barcelona with the capacity to handle any type of goods as containers, vehicles, semi-trailers and conventional goods. It has an area of 8 hectares, almost 450 metres of berthing line with a draft of 14 metres. Main terminal assets include STS cranes, mobile cranes, reach-stackers, RTG units, tug masters and platforms for special equipment.

- Autoterminal. It has a surface of 955,630 square meters and a capacity of storage of more than 50,000 vehicles. It has also a connection with the railways and routes or connections to Europe and the rest of the mainland.

- Enagas. The facilities of Enagas at the Port of Barcelona allows the activities of bunkering and transhipment with a total capacity of storing of LNG of 760,000 m^3 and 6 tanks.

- Decal España. It has a terminal of 120,708 m^2 and a total capacity of 29 tanks that include the provision of Biodiesel or Bioetanol.

With respect to the main services provided at the port, the following table summarizes the most important ones:

Table 9 Services of Port of Barcelona

Operator's Name	Activity
>50 different ship agents	Consigning
Port of Barcelona Pilot's Corporation	Piloting
Mooring & Port Services	Moor Ships
Rebarsa Group (Ex Remolcadores de Barcelona, SA)	Tugboats

Figure 5 Port of Cartagena

Another important partners of a port are the set of associations which assist to the different activities, such as:

Table 10 Associations of Port of Barcelona

Association's Name
ASCIPORT – Associació Catalana d'Empreses Concessionàries amb Instal laciones Portuàries.
Associació d'Empreses Estibadores Portuàries de Barcelona
Associació d'Agents Consignataris de Vaixells de Barcelona
ATEIA-OLTRA - Associació de Transitaris Internacionals de Barcelona. Organització per a la Logística, el Transport i la Representació Duanera
ATEC - Associació de Transportistes Empresaris de Contenidors
AMETRACI - Associació Mediterrània de Transportistes de Contenidors i Intermodal
BCL - Barcelona Centre Logístic Catalunya
Corporació de Pràctics del Port
Cluster Logistic de Catalunya
Barcelona Cluster Nautic

Port of Cartagena

The port of Cartagena is located in the city of Cartagena (Region of Murcia and is managed by the Cartagena Port Authority. It is the fourth port at the national level in freight traffic after Algeciras, Valencia and Barcelona and ahead of Bilbao, Tarragona and Las Palmas. 60% of the exports and 80% of the imports of the Region of Murcia are made through the Port of Cartagena, and more than 40% of the tourism that Cartagena receives does so through its port.

Currently, Cartagena ranks as the eighth port in Spain by volume of cruise passengers. The arrival of cruise passengers to Cartagena, which has grown by 150% in ten years, broke its record for stopovers and passengers in 2019 with the arrival of 167 ships and 250,000 visitors, respectively.

The main operators of the Port of Cartagena may be classified as follows:

Table 11 Port system of Cartagena

Operator's Name	Activity
Terminal Marítima de Cartagena	Multipurpose
Erhardt Mediterráneo	Multipurpose
Alkion Terminal Cartagena	Liquid Bulks
Enagas	Liquid Bulk
CEMESA	Solid Bulks

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Cartagena.

- Terminal Marítima de Cartagena. It has a surface of 60,279 m^2 and a berth length of 800 meters. The terminal has 3 Ship-to-Shore cranes and 9 reachstackers.
- Erhardt Mediterráneo. It has 40,000 m^2 of surface for storage in Port of Cartagena and 300 reefer containers and about 350 ships consigned every year. It has also 3 STS electrical cranes for containers and 2 ones for general goods.
- Alkion Terminals. It has a capacity of 25,000 m^3 and 11 tanks used for chemicals and heated products

Figure 6 Port of Bilbao

With respect to the main services provided at the port, the following table summarizes the most important ones:

Table 12 Services of Port of Cartagena

Operator's Name	Activity
Navantia	Ship Repair
Astilleros de Cartagena, SL (ASCAR)	Ship Repair
>15 different ship agents	Consigning
Agencia Marítima Blázquez	Stevedoring
Port of Cartagena Pilot's Corporation	Piloting
RECASA (Remolcadores de Cartagena, SA)	Tugboats

Another important partners of a port are the set of associations which assist to the different activities, such as:

Table 13 Associations of Port of Cartagena

Association's Name
ASEAM – Asociación de empresarios de actividades marítimas de Cartagena.
Agrupación de Boteros Amarradores Puerto de Cartagena
Cluster of business and companies in Cartagena
Cluster of Murcia Agroindustrial and Logistics
AML – Murcia Asociation of Logistics

Port of Bilbao

The Port of Bilbao is, for many reasons, one of the most important transport and logistics centres in the European Atlantic Arc. Bilbao has evolved to become the gateway to the trade routes of the European Atlantic Ocean. Today, it is the main port for trade with the United Kingdom. As one of the major logistics players in the Atlantic corridor trade, the port has built its infrastructure in dry ports and other logistics zones.

The port of Bilbao has less cruise traffic as it is still developing its presence in this regard. Despite this, it has already seen 80,000 passengers from 58 cruise ships.

The Port of Bilbao has been associated with the growing economy of the Vizcaya region. The population of the area depends heavily on the port for jobs in transportation, tourism, engineering, and shipping repairs, among other lucrative activities.

The Port of Bilbao moved, in 2020, a total of 29.6 million tons. 61% are liquid bulk; 18% containers; 12% solids; and 9%, conventional general merchandise and road traffic. The number of TEUs amounted to 485,776.

The ten main merchandise per ton are: crude oil (representing 27% of total traffic), natural gas (13%), diesel (8%), iron and steel products (7%), chemical products (6%), gasoline (4%), soybeans (3%) other non-metallic minerals (3%) and other petroleum products (2%). Imports account for 66% of traffic. However, if we isolate the liquids, Bilbao is an export port, since they account for 54% of the traffic.

The United Kingdom continues to be the main market for the Port of Bilbao and Bilbao is the main gateway for trade between Spain and this country. If before Brexit 66% of the traffic was with third countries, now with the United Kingdom outside the EU it becomes 76%.

The main operators of the Port of Bilbao may be classified as follows:

Table 14 Port system of Bilbao

Operator's Name	Activity
CSP Iberian Bilbao Terminal	Container
Servicios Logísticos Portuarios	Multipurpose
Consignaciones Toro y Betolaza, SA	Multipurpose
TEPSA	Liquid Bulks
Bergé Marítima Bilbao	Logistic Operator
Bunge Ibérica	Solid bulks
Petronor	Liquid Bulks
Repsol	Liquid Bulks

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Bilbao.

- CSP Iberian Bilbao Terminal. It has a43.8 hectare yard and two berthing lines, as well as a port railway terminal. It has an annual capacity of 950,000 TEUS, 7 Ship-to-Shore cranes – 2 of which are super post panamax and 1 feeder, and 6 reachstackers and 3 tug master.

- Servicios Logísticos Portuarios. It occupies a Surface of 140,000 m^2 (43,000 m^2 of warehouse)and a berthing line of 1.7 km with a draft of 20 meters. It has 4 mobile crane, 1 retro crane, 2 reach stackers, forklits and several bulldozers.

- TEPSA. It is a terminal for chemical products (including oil, chemical, biopetrol) mainly with a capacity of 321,900 m^3 and 79 tanks whose capacity varies between 50 and 24,500 m^3

- Petronor. The refinery has an area of 220 hectares, its storage capacity is 894,000 m^3 of crude oil, 1,279,000 tons of raw materials, 922,000 m^3 of finished products and 254,600 m^3 of intermediate products with 12 million

Figure 7 Port of Tarragona

tons per year (MTm/year). The Refinery is connected to the Maritime Terminal by pipelines, for Propylene, GLP, special products, gasoline, diesel and fuel oil.

With respect to the main services provided at the port, the following table summarizes the most important ones:

Table 15 Services of Port of Bilbao

Operator's Name	Activity
>40 different ship agents	Consigning
Amarradores Puerto de Bilbao, SA	Mooring
Compañía de Remolcadores Ibaizabal, SA	Tugboats
Corporación de Prácticos del Puerto y Ría de Bilbao, SL	Piloting

Another important partners of a port are the set of associations which assist to the different activities, such as:

Table 16 Associations of Port of Bilbao

Association's Name
ASETRAVI – Association of transport business in Vizcaya
ANAVAS – Association of basque shipping
ATEIA Bizkaia – OLT – Association of Freight Forwarders, Logístics Organization for Transport
Association of Ship Agents and Stevedores of the Port of Bilbao
ADIMDE – Association of Maritime Industries of Euskadi
Society of Loading and Unloading of Port of Bilbao
UNIPORTBILBAO

Port of Tarragona

The port of Tarragona is a fishing, commercial, passenger and sports port in the city of Tarragona (Spain) with a turnover of €57.2 million. It is one of the most important seaports on the Mediterranean coast. Much of

its activity is related to industrial or freight transport, but it is also a fishing, nautical and passenger port. The port is the destination of a railway line that runs through the Mediterranean corridor, and constitutes one of the main centres of this economic axis.

It is a key point for the chemical industry in the Campo de Tarragona, since the port has a specific platform for ships loaded with crude oil and its derivatives. The port is therefore a key point in the distribution of the products that the chemical industry in the province of Tarragona needs or generates through the Tarragona petrochemical complex.

With the presence of the Tarragona petrochemical complex, the Port is positioned as one of the main Mediterranean ports for the storage and distribution of petrochemical products. The companies of the chemical and petrochemical industry of Tarragona generate an annual production of 20 million tons, which represents 50% of the production of Catalonia and 25% of the Spanish and the Port of Tarragona is the logistics platform through which the raw materials necessary for the production processes of the chemical sector are imported, and the derived products are exported.

The facilities can store a wide variety of liquid products with all the security guarantees in three independent terminals. The storage capacity is around 800,000 m^3. Throughout the entire year 2020, it transported more than 26.5 million tons.

The main operators of the Port of Tarragona may be classified as follows:

Table 17 Port system of Tarragona

Operator's Name	Activity
DP World Tarragona	Container
EUROENERGO	Líquid Bulks
TEPSA (Terminales Portuarias, SA)	Líquid Bulks
TERQUIMSA (Terminales Químicos, SA)	Líquid Bulks
Bergé Marítima	Vehicles and Multipurpose
Ership	Minerals
Euroports Ibérica TPS, SL	Multipurpose
Noatum Terminal Tarragona	Multipurpose
Ecológica Ibérica y Mediterránea	Waste Management

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Tarragona.

- **DP World Tarragona.** The terminal operates mainly with the movement of containers but also offers other services and general cargo services. It has about 2,00 m^2 of surface and a docking line of 1,056 meters, operated by 4 cranes (3 super-post-panamax and 1 liebherr LHM 500). It annual capacity is 450,00 TEUS/year and it has more than 200 reefer connections.

- **EUROENERGO.** The total surface of the concession is 52,000m^2 at the Hidrocarburos dock plus 81,000m^2 at the Chemical Warf. The total storage volume is 331,000 m^3 thanks to 18 tanks whose capacity is between 8,750 m^3 to 50,000 m^3.

- **TEPSA.** The actual capacity is 86,277 m^3 with 50 tanks (a range from 650 m^3 to 3,850 m^3) and 5 berths. The main products they work with are chemicals, biofuels and foodstuffs.

- **Noatum Terminal Tarragona.** The area is about 47,000 m^2 and it allows to work with different goods, including ro-ro thanks to the 1,200 meters of docking line and the equipment composed by 3 cranes, 2 shuttle vehicles and 1 hopper among others.

- **Euroports Ibérica TPS, SL.** The company has three terminals.

- It is prepared for fossil fuels and it has 119,000 m^2 with a capacity of 500,000 t and the berth line is about 1 kilometer with a maximum draft of 20.5 meters.
- Dry Bulk Terminal. It has 2 mobile crane, 4 fix hoppers for bulk, 2 ecologic hoppers and 600 meters of covered conveyor belts for manipulating mainly agribulk (food and feed products).
- Forest Product Terminal. It has 3 warehouses with a maximum of 90,000 tns total with a surface of 24,300 m^2. The products handled are mainly forest Products (paper reels, pulp, wood chips/pellets)

With respect to the main services provided at the port, the following table summarizes the most important ones:

Table 18 Services of Port of Tarragona

Operator's Name	Activity
>25 different ship agents	Consigning
Boteros Amarradores Puerto de Tarragona, SL	Mooring
Remolcadores Portuarios de Tarragona, SL	Tugboats
Corporación de Prácticos del Puerto de Tarragona, SL	Piloting

Another important partners of a port are the set of associations which assist to the different activities, such as:

Table 19 Associations of Port of Tarragona

Association's Name
CHEMMED – Tarragon's logistics, industrial, academic and scientific cluster
AEQT – Associació d'Empreses Químiques de Tarragona
Cambra de Comercio, Indústria y Navegación de Tarragona
Maritime Cluster of Catalunya
APPORT – Association for the Promotion of the Port of Tarragona
AEST – Association of Service Business of Tarragona

Port of La Luz (Gran Canaria)

In the Canary Islands, Puerto de La Luz in Gran Canaria is the most important port area in the Middle Atlantic due to its size, its infrastructure and the variety and quality of the services it offers thanks to its privileged geographical location, a bridge between Europe, Africa and America,

This strategic location has consolidated this port as a first-rate logistics hub with more than thirty maritime lines that connect with more than 180 ports on the planet. The Port of La Luz in Gran Canaria is the largest in the Canary Archipelago and one of the most important merchandise distribution links in Spain. It currently has almost 16 kilometres of berthing line, distributed among all its docks, with drafts that range between 3 and 45 meters deep.

Over time, it has become a commercial port providing quality services in cruises, bunkering, fishing, containers, ship repairs, cargo and passengers, and it also has a free zone and border facilities for the control of goods. Total freight traffic in 2020 exceeded 15.2 million tons.

Figure 8 Port of Gran Canaria

Among the advantages offered by this port are its historical relationship with shipping companies from all over the world, links accumulated over the years; its availability of state-of-the-art facilities; and the flexibility and versatility of its services. All this has contributed to the fact that the Port of La Luz in Gran Canaria stands out today as a logistics centre for containers and other commercial cargo at an international level and as a service station for the Atlantic routes, mainly in supplying ships, fishing, ship repairs (specializing in the offshore sector) and fuel supply.

In terms of containers, one of the most relevant indicators of activity, the Port of La Luz in Gran Canaria registered in 2020 a movement of 1,033,486 TEUs, once again exceeding the figure of one million units.

Another aspect in which this port has a wide margin for future development is in the cruise sector. Nearly 1.6 million cruise passengers passed through its docks, which represented a decrease of 47% compared to 2019 due to the Covid pandemic. To facilitate the expansion of this sector, projects have been launched to increase the berthing line at the Passenger Dock and to build a new cruise station.

Moreover, the Puerto de La Luz in Gran Canaria stands out internationally for being a port of solidarity. The Red Cross and Red Crescent and the UN World Food Program have warehouses, from where humanitarian aid is distributed to African countries in need. The location of these bases was chosen for its strategic position, availability of excellent services, dense network of maritime and air connections, and favourable customs regulations.

In 2020, it took place an unprecedented disaster for the Spanish cruise because of Covid-19 pandemic what generates the suspension of practically all cruise ship stopovers in Spanish ports. Only the Canarian ports managed to restart certain scales at the end of the year; which showed an unusual panorama in terms of the volume of passengers served and in terms of the leading ports in traffic. In 2020 a total of 1.37 million cruise passengers called at Spanish ports, that

is, 87% of traffic was lost. This meant losing the scale of 9.29 million passengers. As a result, the cruise traffic ranking in 2020 was led by Las Palmas with 517,241 passengers; followed by Santa Cruz de Tenerife (345,093), Barcelona (203,855), the Balearic Islands (156,757) and Cádiz (40,690). The ports that lost the most traffic was Barcelona (-2.93 million passengers), the Balearic Islands (-2.50 million) and Las Palmas (-969,040 passengers).

The main operators of the Port of La Luz may be classified as follows:

Table 20 Port system of Gran Canaria

Operator's Name	Activity
Boluda Maritime Terminal Las Palmas	Container
Gesport Terminal Marítima	Multipurpose
Gramelcan, SL	Solid Bulks
La Luz Market, SL	Multipurpose
Operaciones Portuarias Canarias, SA	Container
Oryx Canarias	Líquid Bulks
Petrologis Canarias	Líquid Bulks
Cementos Especiales de las Islas, SA	Solid Bulks

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of La Luz.

- Boluda Maritime Terminal Las Palmas. The terminal has three berthing lines of 1,215 meters and an area of 173,480 m^2 with a draft between 9.50 and 15.50 meters. It has a maximum capacity of 629,000 TEUs/year. At the moment, the terminal has 4 post-panamax class, 3 panamax and 18 tractor heads.
- Gesport Terminal Marítima. It is located at Gran Canaria dock and it has 2 electrical cranes, 1 reach staker and it has a surface of 62,991 m^2 with a berthing line of 150 meters and a draft between 10 and 14 meters.
- Operaciones Portuarias Canarias, SA (OPCSA). The terminal is the biggest of the Port of La Luz with an area of 331,886 m^2 and there is 8 cranes under operation (2 super-post-panamax, 4 post-panamax and 2 panamax) and 22 transtainers.
- Cementos Especiales de las Islas, SA. The capacity is 16,160m^3 and it is specialized in the transport of cement and it is connected to the terminal with 4 pipelines.
- Oryx Canarias. The construction of the facilities was completed in September 2014, designed to offer over 220,000 m3 of storage capacity and provides access to a long, deep water jetty. It is specialized into the bunkering of fuel and gas oil.
- Petrologis Canarias. With a surface of 17,698 m^2 and 7 tanks can provide a capacity of 74,096 m^3, specialized mainly in Gasoil and Fuel Oil.

With respect to the main services provided at the port, the following table summarizes the most important ones:

Table 21 Services of Port of Gran Canaria

Operator's Name	Activity
>50 different ship agents	Consigning
Amarradores Puerto de La Luz y de Las Palmas, SL	Mooring
REBAPA - Remolcadores y Barcazas de Las Palmas, SA	Tugboats
Corporación de Prácticos del Puerto de La Luz y Las Palmas, SL	Piloting
Zamakona Group	Repairing ships and offshore platforms

Another important partners of a port are the set of associations which assist to the different activities, such as:

Table 22 Associations of Port of Gran Canaria

Association's Name
ASOCELPA – Asociación de Consignatarios y Estibadores de Buques de Las Palmas
ASEMTRA – Association of transport companies
ANACA – Asociación de Navieros de Cabotaje de Canarias
FEDEPORT – Association of port businesses in Canary Islands
ONEPORT – Association of logistics companies associated to the port.
ATEIA – Asociación de Transitarios, Expedidores Internacionales y Asimilados
The Maritime Cluster of the Canary Islands

Port of Huelva

The Port of Huelva is located in the southwest of the Iberian Peninsula, which makes it a strategic enclave as an import/export port and a hub for new trends in international maritime trade, especially from Europe to the Atlantic. It is integrated into the Trans-European Transport Network as a Core Port; and it is among the 7 first ports of the Spanish system in the movement of goods and 2nd in Andalusia. In addition, it is also the 2nd fastest growing port in Europe in the last decade.

The Port of Huelva is among the 5 ports with the highest volume of port traffic in Spain during the year 2020; currently occupying the eighth position. Operating 365 days a year without congestion, the port of Huelva is a benchmark in Europe as an energy port and in liquid and solid bulk traffic. It has currently made a firm commitment to diversifying its activity with containerized general cargo traffic through different regular lines to

Figure 9 Port of Huelva

Europe and the Canary Islands, highlighting its stability in traditional traffic (liquid and

solid bulk) and growth in containerized general cargo and filmed due to its commitment and commitment to logistics and intermodality.

The container terminal of the Port of Huelva, as well as the ro-pax terminal, are located in the so-called South Dock with a clear vocation to house containerized and rolled general cargo traffic such as those currently taking place in its facilities.

The dock is located in the outermost part of the Ría de Huelva. It is in an area very close to the entrance, which gives it great ease and speed of access and exit for ships.

The container terminal has been concessioned since 2018 and it covers an area of 5 hectares, with a capacity for a maximum of 200,000 TEUs and connections for more than 250 refrigerated containers.

These two terminals, container and rail, together with the ro-pax terminal also located on this dock, make up the South Dock Logistics Platform where shipping companies such as Containership, Alisios Shipping, FRS, Balearia, Fred Olsen, among others, currently operate; which fundamentally manage regular lines with northern Europe and the Canary Islands.

With the official designation of the Port of Huelva as a node of the Atlantic Corridor of the Trans-European Transport Network, the aforementioned terminal in its current conditions became the peninsular point of extension of said corridor by sea to the Canary Islands.

The main companies are: Bergé Marítima, Consignaciones y Graneles del Suroeste, Ership and Servicios Marítimos Aduaneros.

The main operators of the Port of Huelva may be classified as follows:

Table 23 Port system of Huelva

Operator's Name	Activity
Yilport Holding ING	Container
Bergé Marítima	Multipurpose
Algeposa Huelva, SA	Multipurpose
Servicios Marítimos Aduaneros, SL (Servimad)	Multipurpose
Consignaciones y Graneles del Suroeste, SA (Congrasur)	Solid Bulks
Ership, SA	Solid Bulks
Zalvide, SA	Fish Cargo
ESK, SA	Liquid Bulks
Molgas Energía	Líquid Bulks

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Huelva

- Yilport Holding ING. The terminal has an area of 5 hectares and a maximum capacity of 200,000 TEUs per year. It has the possibility also of plugging more thant 250 reefer containers.
- Bergé Marítima. The company also operates in the Port of Huelva and, concretely, it is located at Muelle Sur and Ingeniero Juan Gonzalo/Ciudad de Palos with 2 mobile cranes (Liebherr LHM 400).
- Algeposa Huelva. It has a warehouse with a surface of 52,000 m^2 and it operates at a dock line of 1,535 meters and a draft of 12 meters. It also operates with an specific area for food products with an dock line of 251 meters.
- Consignaciones y Graneles del Suroeste, SA (Congrasur). The company has at the Port of Huelva, a capacity of 34,000 m^2 in its warehouse and it has its own equipment to manipulate solid bulks including three belt

loadres with a loading rate of to 1,000 to 1,200 tonnes per hour.

With respect to the main services provided at the port, the following table summarizes the most important ones:

Table 24 Services of Port of Huelva

Operator's Name	Activity
>30 different ship agents	Consigning
Amarres Marítimos del Sur, SA	Mooring
Auxiliar Marítima del Sur, SA	Tugboats
Corporación de Prácticos del Puerto y Ría de Huelva	Piloting
Sertego Servicios Medioambientales, SLU	Waste Management

Another important partners of a port are the set of associations which assist to the different activities, such as:

Table 25 Associations of Port of Huelva

Association's Name
ANAMAR – Asociación Nacional de Armadores de Buques Congeladores
Fish Exporters Association
Association of Shipping Agents, Stevedores and Freight Forwarders
AIQBE – Association of Chemical, Basic and Energy Industries of Huelva
Cluster Marítimo-Marino of Andalusia

Port of Castellon

The Port of Castellón is in the Top 10 in container traffic thanks to its exceptional geostrategic position; as well as its two specific terminals that add up to 780 meters of berthing, five 35-meter-high cranes and specialized loading and unloading work. It has an area for containers of 225,000 m2.

The main operators of the Port of Castellón may be classified as follows:

Table 26 Port system of Castellon

Operator's Name	Activity
APM Terminales Castellón	Container
Noatum Terminal Castellón	Multipurpose
Portsur Castellón, SA	Solid bulks
Terminal Marítima del Grao, SL	Solid bulks
BP Oil España	Líquid Bulks

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Castellón

- **APM Terminals Castellón.** The APM Terminals Castellón occupies 120,000 m^2 with a berthing line of 780 meters and a draft of 14 meters. The maximum capacity is 250,000 TEUs per year and it is directly connected with railway to the terminal. The equipment includes 2 post-panamax cranes, forkligkts, reach stacker and 2 empty container handler.

- **Noatum Terminal Castellón.** The terminal occupies a surface of 166,000 m^2 and a dock line of 1,150 meters with a draft between 9,5 and 13 meters. It may load and unload containers but also another type of goods that can be also stored at its warehouse of 25,000 m^2.

- **Portsur Castellón, SA.** The surface is about 112,000 m^2 and it has more than 1,000 meters of dock line with a draft of 16 meters. It has a movement about 3,000,000 tns per year

- Terminal Marítima del Grao, SL. It is a relative new project that started in 2012 and is specialized in ceramic bulks.

With respect to the main services provided at the port, the following table summarizes the most important ones:

Table 27 Services of Port of Castellon

Operator's Name	Activity
>30 different ship agents	Consigning
Consulmar, SL	Mooring
Remolques del Mediterráneo, SA	Tugboats
Corporación de Prácticos del Puerto de Castellón Burriana, SLP	Piloting
Sertego Servicios Medioambientales, SLU	Waste Management

Table 28 Associations of Port of Castellon

Association's Name
Fundación PortCastelló
ACEP – Asociación de Consignatario y Empresas del Puerto
ASTRAPORT – Association of Transport of the Port of Castellon

Another important partners of a port are the set of associations which assist to the different

Figure 10 Port of Catellon

activities, such as:

Figure 11 Port of Gijon

Port of Gijon

The port of Gijón is one of the main seaports of the Atlantic Arc; and the leading port in the movement of solid bulk in Spain, transporting 13,615,944 tons in 2020. The port has infrastructures adapted to the new market requirements in terms of drafts, docks and storage surfaces; as well as a range of services with the best quality standards:

The main operators of the Port of Gijón may be classified as follows:

Table 29 Port system of Gijon

Operator's Name	Activity
APM Terminales Gijón	Container
Algeposa Asturias	Multipurpose
Arcelor Mittal (directly linked to the Algeposa Asturias Terminal)	Solid Bulks
C.L.H., S.A	Liquid Bulks
Comercial Asturiana de Graneles, SA	Solid Bulks
Enagás,SA	Liquid Bulks
Petróleos Asturianos, S.L.	Liquid Bulks
Terpor	Ro-ro

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Gijón

- **Algeposa Asturias.** It is a terminal specialized in metalworking products, general cargo and bulk cargo. It has a surface of 9,000 m^2 of located in 3 warehouses with 335 meters of berthing line and a direct railway connection to the ARCELOR MITTAL factory and the national railway network.

- **APM Terminals Gijón.** The APM Terminals Gijón offers direct connections to the Atlantic European coast and Canary Islands. With an annual container capacity of 200,000 TEUs, the terminal has a surface of 4 hectares, a berth line of 360 meters and a draft of 11.8

meters. It operates with 2 panamax cranes, 5 reach stackers and 30 reefer connections.

- Terpor. It is a terminal of ro-ro, specialized in short sea shipping with direct access to hairways and railways and with a surface of 42,000 m^2.

With respect to the main services provided at the port, the following table summarizes the most important ones:

Table 30 Services of Port of Gijon

Operator's Name	Activity
>10 different ship agents	Consigning
Amarradores Puerto de Gijón, SL	Mooring
Remolques Gijoneses, SA	Tugboats
Corporación de Prácticos de Gijón, SL	Piloting

Another important partners of a port are the set of associations which assist to the different activities, such as:

Table 31 Associations of Port of Gijon

Association's Name
FAPPYNDE – Federación de Asociaciones de Puertos, Pesca y Náutica Deportiva.

Port of Vigo

The port of Vigo is the leader as fishing port and it is a reference at international level. It manages a freight traffic above 4 million tonnes whose value exceeds 12,000 million euros. The composition of the traffic is about 85% (General Cargo), 7% (Bulk and Solids) and 1.5% (Liquid Bulk). They are very linked to the car manufacturer Stellantis (in the past PSA Peugeot).

Moreover, they have a very strong environmental commitment considering that the Bey of Vigo, where the port is located, it is part of the National Park of the Cíes Islands. The Port of Vigo is also involved in the TEN-T project "AtlanticaOptiMoS", which involves the Motorways of the Sea between Vigo and Nantes (FR).

The main operators of the Port of Vigo may be classified as follows:

Table 32 Port system of Vigo

Operator's Name	Activity
TERMAVÍ	Container
Estibadora Gallega	Multipurpose
Bergé	Multipurpose
Pérez Marítima, SL	Multipurpose
TAV Terminales Atlánticas Vigo, SL	Multipurpose
Alfacargo Shipping and Logístics, SL	Multipurpose
Termicar Vigo, SL	Ro-Ro

Figure 12 Port of Vigo

A brief description of the main facilities would be also useful to understand the ecosystem of the Port of Vigo:

- TERMAVÍ. The terminal has a warehouse area of 180,000 m^2 with a berthing line of 770 meters and a draft of 17 meters what allows to operate with more than 200,000 TEUs per year. It is directly connected with the AP-9 highway and it is equipped with Super-Post-Panamax, Post-Panamax and Panamax cranes, 9 reach stackers and 7 trastainers among other facilities.
- Pérez Marítima. It has an available surface of 20,000 m^2 with a berthing line of 1,500 m^2 and a draft of 15 meters. The company has covered warehouse of an area of 5,000 m^2 and three cranes.

With respect to the main services provided at the port, the following table summarizes the most important ones:

Table 33 Services of Port of Vigo

Operator's Name	Activity
>50 different ship agents	Consigning
BOTAMAVI	Mooring
REMOLCANOSA	Tugboats
Corporación de Prácticos del Puerto y Ría de Vigo, SL	Piloting
MARPOLGAL	Waste Management
TOYSAL	Waste Management
LEIBAR DEL NAVAL, SL	Waste Management

Another important partners of a port are the set of associations which assist to the different activities, such as:

Figure 13 Transeuropean network of transports

Table 34 Associations of Port of Vigo

Association's Name
ACLUNAGA – Cluster of Galician Naval
CEAGA – Fundation of automotive companies
CLUPESCA – Cluster of extractive and producer fishing sector
FEGATRAMER – Federation of Galician goods transport companies
ANFACO - CECOPESCA

The future of Spanish ports

Last years, the supply chain of ports has suffered disruptions in 2021 and it seems that the structural vulnerabilities affecting the market internationally are expected to continue over the coming years.

The situation will lengthen congestion problems at ports which will continue to affect other shipping-dependent sectors and further weaken the relationship between shipping lines and freight forwarders, already under pressure from current capacity constraints.

For customers, 2022 will be a key year to review their supply chain and transport networks to reduce their exposure to rate inflation. However, shipping lines' revenues point to an increase of more than 15% over the year, as the longer the current supply chain crisis lasts, the longer cargo rates will remain on the rise.

In the area of sustainability, it is worth noting the importance of the European Green Pact and the 'Fit for 55' package to achieve a reduction in greenhouse gas emissions by 2030.

Particularly, in the case of Spanish ports, the new Strategic Plan will be key to improve how

the infrastructures become safe, connected, intelligent and sustainable. To get this goals, it is expected to do a 11 billion investment plan until 2025 that combines public and private initiative, to advance in aspects such as digitization, innovation, security, sustainability and transparency.

Specifically, the Port Authorities' Investment Plans plan to allocate 4,556 million to new projects and those already undertaken. One of the main elements of the future plan of Puertos del Estado will be the Ports 4.0 project together with PERTE Naval.

The future of the the Spanish structural policy is based on Plan de Recuperación, Transfomación y Resiliencia that basically is the policy which is going to allocate the European Funds to repair the damage caused by the COVID-19 and the corresponding crisis.

In this strategy, there are some strategic and sectorial proyects to achieve the transformation of the spanish economy. There are several ones but this report focuses on two main ones (PERTE Naval and PERTE of renewable energies, hydrogen and storage).

- PERTE Naval. In order to improve the competitiveness in the medium and long term of the sector, it is essential to transform value chain, which wants to be carried out through its diversification towards marine renewable energies and ships of low emissions, its digitization, the improvement of its environmental sustainability and the training of its employees.

The PERTE Naval will act in two different areas:

- Projects to transform the chain value
- Measures to facilitate the transition to low emissions.. Included here are measures that will mobilize stakeholders

This is the buget proposed:

Table 35 Proposed budget for Spanish maritime sector

Area	Measures	Public Investment	Private Investment
Projects to transform the chain value	Comprehensive line of action for modernization and industry diversification	200 M€	800 M€
	Measures to apply technologies in the industry	30 M€	30 M€
SUBTOTAL		230 M€	830 M€
Measures to facilitate the transition to low emissions	Royal Decree 1071/2021, to regulate the concession aid to the sector of shipbuilding in matter of investigation and development and innovation		
		80 M€	320 M€
SUBTOTAL		80 M€	320 M€

TOTAL	310 M€	1.150 M€

- PERTE of renewable energies, hydrogen and storage. The main objective of this PERTE is the transition of the energy and of couse, the maritime transport is part of this process. However, there is no a particular measure or policy that is directly linked to the PERTE.

This PERTE has a buget of more than 16.000 millions of euros summing the public and private contribution. In fact, the maritime transport is considered only on a policy to facilitate the mobility with renowable gases with the budget of 80 milliones of euros as it was previously mentioned in the PERTE NAVAL.

However, there are a lot of uncertainty about economic future and trade evolution due to the inflation rates and the interest rate what may clearly affect to the investment plans and particularly, the private ones that may be under stress.

Transport: Characterization

The market structure of the port system is often out of the ideal situation of competition between companies. This is an important economic issue because the competition implies efficiency in the use of resources without the intervention of the public institutions.

However, this is not the basic assumption in the port system that is full of natural monopolies [1] where it is more efficiency to have only one regulated company. That is why an industrial policy that offers support to companies encouraging research, promoting the increase in the capacity of a particular sector, favouring the implementation of new technologies, etc. (Cabral, 1997; p.9).

That is one of the main reason why ports have a very large level of concentration and the different traffics are in hands of a few companies. Moreover, it is clearly observed that all types of traffic show a tendency towards a greater concentration in the last decade.

Operations and Terminals in Spanish Port System

At company level and getting more detail of the port characterization, it is important to underline that in the Spanish Port System, there are more than 30 companies to provide handling services, highlighting the operators of Valencia, Algeciras and Barcelona ports.

Regarding the container traffic, the market is dominated by five major international operators. These are APM Terminals (belonging to Maersk), Cosco Shiping Ports, Mediterranean Shipping Company (MSC), Hutchison Ports and Hyundai Merchant Marine (HMM).

Table 36 Operations and Terminals in Spanish Port System

INTERNATIONAL OPERATORS	TERMINALS
APM Terminals – Maersk	Algeciras, Barcelona, Castellón, Gijón and Valencia
Cosco Shipping Ports	Malaga, Valencia, Bilbao and Zaragoza (intermodal terminal)
Mediterranean Shipping Company	Valencia, Bilbao, Las Palmas and Alicante
Hutchison Ports and Hyundai Merchant Marine (HMM).	Barcelona and Algeciras

According to a 2018 report, with data from 2015, by the International Transport Forum, in Spanish ports more than 60% of container traffic is managed in terminals controlled by shipping companies, the highest percentage among the main European countries, only surpassed by Greece .

Currently, this percentage has grown due to the entry of Cosco Shipping Ports in the ports of Bilbao, Malaga and Valencia, as well as the arrival of Hyundai in Algeciras, which was added to the presence of Maersk in Algeciras, Barcelona, Castellón, Gijon and Valencia; and MSC in Las Palmas and Valencia.

The only major container operator in Spain that does not belong to a shipping company is Hutchison Ports, which has the BEST terminal in the port of Barcelona.

The only Spanish operator with a significant presence in different Spanish ports is the

[1] Natural monopoly where there is only one company because of the existence of scale economies that provides a clear advantage to the existent company in the market. Under these conditions, it is possible that the multiplication of companies entails a productive inefficiency. And therefore, given the circumstance that a structure monopolistic reduce the costs caused by the existence of many companies.

Noatum group which operates with specialized bulk terminals (Tarragona, Castellón, Cartagena, Sagunto, Málaga, A Coruña, Santander, Bilbao, Gijón, Avilés and Huelva), multipurpose terminals (Tarragona, Castellón, Sagunto, Cartagena, Málaga, A Coruña, Ferrol, Santander, Bilbao, Gijón, Avilés and Huelva), container terminals (Castellón, Cartagena , Malaga and A Coruña) and ro-ro terminals (Barcelona, Tarragona, Sagunto, Malaga, Santander and Pasaia).

Another Spanish operator that has port terminals is Bergé, which handles, in addition to containers, other goods such as paper, fertilizers, vehicles, steel products, agri-food products and industrial bulk.

This operator is present in the ports of Pasaia, Bilbao, Santander, Gijón, Avilés, A Coruña, Ferrol, Marín, Huelva, Seville, Cádiz, Málaga, Algeciras, Cartagena, Alicante, Valencia and Sagunto, Castellón, Tarragona and Barcelona.

Passengers Maritime Transport

Spain s ferry industry is among the biggest and most comprehensive in Europe. The country has an ideal maritime geography for short-sea passengers and there are a number of well-established domestic and international ferry companies serving and competing in this market, highlighting the ferry and ro-ro networks connecting the mainland with the Balearic Islands, Canary Islands, and North Africa, Spain.

Major ferry passenger traffic is concentrated in the Strait of Gibraltar, where there are several links between Spanish mainland ports and various North African ports, including the Spanish enclaves of Ceuta and Melilla. The competition in this region is intense, with a few ferry companies engaged in tit for tat route expansions in recent years. In the Balearic Islands and Canary Islands, there are companies engaged in inter-island ferry services.

"Major ferry passenger traffic is concentrated in the Strait of Gibraltar, where there are several links between Spanish mainland"

Foreign ferry and ro-ro companies such as Brittany Ferries and Grimaldi Lines, too, operate to and from Spanish ports such as Santander, Bilbao, and Barcelona.

The Spanish ferry sector, carried more than 20 million travellers before the pandemic, while the ocean cruise traffic figure to and from Spanish ports is about 9 millions.

The main players of companies of the passenger maritime transport are Transmediterránea, Naviera Armas, Balearia,

Table 37 Operations and Terminals in Spanish Port System

INTERNATIONAL OPERATORS	MAIN PORTS
Transmediterranea	Barcelona, Valencia, Las Palmas de Gran Canaria, Algeciras, Ceuta, Melilla and Morocco
Naviera Armas	Canary Islands, Almería, Cadiz, Algecira, Málaga and Morocco
Fred Olsen	Canary Islands
Balearia	Barcelona, Valencia, Balearic Islands, , Ceuta and Morocco

Fred Olsen Express. Moreover, there are other local and international operators such as Grimaldi Lines, Britanny Ferries and GNV, among others.

One important event is that Naviera Armas bought in 2017 Transmediterrénea and they operate with different brands but belonging to the same group reducing the effective competition of some routes.

In the case of Trasmediterranea, it operates passenger and freight services between the Spanish mainland and the Canary Islands, Balearic Islands, and North Africa. It also operates its own terminals and maritime stations in Barcelona, Valencia, Las Palmas de Gran Canaria, and Cadiz. The company has signed a Good Environmental Practices agreements with eight port authorities, aiming at carrying out a series of measures to protect the environment and marine life, accompanied by periodic awareness campaigns.

Naviera Armas, after the acquisition of Trasmediterranea becomes the first ferry company in Spain. Considering Naviera Armas as the commercial brand has a major presence in the Canary Islands, competing principally with Fred. Olsen Express for inter-island services.

Balearia is the youngest among the top players and it is also the Spanish ferry company with the most global presence. Its Caribbean ferry service connecting Fort Lauderdale in Florida with Freeport on Grand Bahama is most notable in this context. The company specialises in passenger and rolling cargo transport in the Balearic Islands and it is also one of the largest players in the Strait of Gibraltar. Currently the line operates routes from Barcelona, Valencia, and Dénia to the Balearic Islands, as well as inter-Balearic island services. In the south, it operates the Algeciras-Tangier Med and Algeciras-Ceuta routes – east of the Gabraltar Strait it also connects Almeria and Malaga with Nador as well as Valencia with Mostaganem in Algeria.

Fred Olsen Express is owned by Norway's Olsen family, which has been involved in the shipping business since the 19th century. Fred. Olsen ofers services on six routes throughout the Canary Islands: Tenerife-Gran Canaria, Tenerife-La Gomera, Tenerife-La Palma, Gran Canaria-Fuerteventura, La Palma-La Gomera and Lanzarote-Fuerteventura. It is in direct competition with Armas.

Beside the top four domestic companies, the Spanish ferry market is served by a number of other local and international operators: some of whom are major international players and they normally link Spain with international destinations. On the purely domestic front, one smaller operator is worth noting: the 40-year-old, Ibiza-based Trasmapi. It operates seven generally pax-only fast ferries between the Balearic Islands of Ibiza and Formentera. In the Strait of Gibraltar, The German-owned FRS Group has been operating ferry service from the Spanish mainland to Morocco and Ceuta since 2000.

In the Mediterranean, two Italy based companies, Grimaldi Lines and GNV, are most noticeable in their presence. They dominate international ferry and ro-ro connections from Barcelona and Valencia (Grimaldi Lines only) to various ports in Italy and North Africa, offering services to Civitavecchia, Porto Torres, Cagliari, Savona, Genoa, Livorno, Salerno and Tangier (Med). GNV recently added the Barcelona-Nador service to its offering.

Other players are Africa Morocco Link which offers up to eight services a day between Algeciras and Tangier Med. and its nearest comparable competitor, Inter Shipping which offers comprehensive high-speed, ro-pax and ro-ro services on Algeciras-Tangier Med and Tarifa-Tangier Ville routes. Finally, on the Bay of Biscay coast, Brittany Ferries operates the long-standing Santander-Portsmouth and Bilbao Portsmouth routes.

To understand the whole picture of the maritime transport, it is important to consider also that the government operates an inclusive subsidy scheme for both travelers and ferry operators in the Balearic, Canary Islands and the autonomous cities of Ceuta and Melilla.

Subsidies for trips between islands and/or trips between the mainland and islands are

very common practice around the world, and especially in Europe. There are three main objectives for this legal practice: to improve internal cohesion; to reduce the transport costs of consumers located in remote regions, especially those affected by 'double-insularity'; and to improve external trade[2].

In this sense, the subsidy police is the following one. Passengers with residence in non-peninsular territories in Spain are nowadays entitled to receive a 75% discount on the ticket price of all domestic maritime trips departing/arriving to their place of residence. In order to enjoy the subsidy, passengers need to facilitate the relevant data to the company, which in turn, will obtain the money corresponding to this subsidy directly from the Spanish Government on a yearly basis

The 75 percent discount applies to the standard fare charged in regular services, including luggage and other auxiliary services, taxes and fees, with the exception of the infrastructure use fee and the safety fee.

There is no limit on the number of tickets that each individual can buy per year. Moreover, apart from the place of residence, there is no other requirement to be fulfilled by the beneficiaries of the subsidy such as level of income or trip purpose.

Another important policy is the existence of Public Service Obligation (PSO) in the maritime transport inter islands that are subsidied by the regional governments to be provided as it is the case of the Tenerife-El Hierro maritime line. In that case, the company receives a direct subsidy to guarantee the PSO.

Off-shore operators in Spanish ports

Considering the chain value of the Spanish ports, the off-shore activities are fundamental. The level of competition or disaggregation is greater than infrastructures or passenger transport.

One of the most important offshore activities in Europe is the production of energy with the floating offshore wind. Spain is already the second most important country in Europe for onshore wind, with 27 GW of installed capacity. Wind contributes more than €3bn to Spain's GDP and provides more than 27,500 jobs. Spain's exports of wind energy technology are worth more than its exports of wine.

"Spain is already the second most important country in Europe for onshore wind, with 27 GW of installed capacity."

The Spanish Government has approved an Offshore Wind Roadmap which aims to install up to 3 GW of floating offshore wind in Spanish waters by 2030. To help achieve this the Spanish Government has pledged to invest at least €200m in research and innovation. The Roadmap also aims to further enhance the circularity of offshore wind and to make it more compatible with other maritime activities.

Moreover, Spain is the European state with the most R&D facilities for floating wind and other marine energies, such as the Canary Islands Oceanic Platform (PLOCAN) and the Vizcaya Marine Energy Platform (BiMEP) or the Punta Langosteira Experimental Marine

[2] For example, Article 349 of the Treaty on the Functioning of the European Union allows for the special situation of the outermost regions to be taken into account when defining EU policies (Solbes-Mira 2011): "Taking account of the structural social and economic situation of Guadeloupe, French Guiana, Martinique, Réunion, Saint-Barthélemy, Saint-Martin, the Azores, Madeira and the Canary Islands, which is compounded by their remoteness, insularity, small size, difficult topography and climate, economic dependence on a few products, the permanence and combination of which severely restrain their development, the Council, on a proposal from the Commission and after consulting the European Parliament, shall adopt specific measures aimed, in particular, at laying down the conditions of application of the Treaties to those regions, including common policies"

Energy Exploitation Zone (A Coruña), the second tested in the world for wave energy.

Other off-shore activity that is very important in the Spanish port system is the support to oil platforms and vessels where Las Palmas port is a world hub for the repair of large ships and oil platforms. It is an stable business because oil platforms are required to undergo a review every five years and are subject to constant adaptation, such as to adapt the structures to work in any type of adverse conditions and protect their vital points.

In addition, the trend is for platforms to integrate more and more into the marine environment in order to minimize any environmental impact and make possible a sustainable growth of this activity in a context of booming blue economy, that is, one that recognizes the importance of the seas as economic engines due to their great potential for innovation and growth.

Characterization of Spanish maritime fleet

Another important issue of the spanish maritime structure is the maritime fleet and its own characteristics.

This point provides a description of the main variables and a brief comparison with the international situation.

At national level, in 2021, the fleet registered in the Special Registry of the Canary Islands (REC) increased by 4 units to 113 vessels; (2.3% more than the previous year).

The foreign-flagged fleet was composed by 101 vessels with a decrease of 5 units.

At the beginning of 2022, and by fourth consecutive year, the fleet controlled under foreign flags (52.4%) exceeded that registered in the REC (47.6%).

With respect to the fleet of merchant transport ships controlled by shipping companies. Spanish was composed, as of January 1, 2022, by 214 vessels, totaling 5,057,604 GT and 4,923,733 DWT.

During 2021, several ships of regular ferries (regular line) have undergone modifications (installation of scrubbers, liquefied natural gas repowering and installation of connections for the supply of electricity in port).

At the beginning of 2022, more than 4% (of the number of vessels and GT) of the Spanish control fleet, uses alternative fuels (LNG) against a 1% of the world merchant fleet. In these percentages are not found including methane tankers.

Additionally, more than 4% of the ships controlled by Spanish shipping companies have an electrical connection to land, compared to less than 2% in the case of the world merchant fleet.

Another significant aspect is the average age of the controlled fleet rose from from 16.0 years at the beginning of 2021, up to 16.6 years on January 1, 2022. The youngest fleet segments are oil tankers (10.3 years of

medium) and gas carriers (10.6) followed by bulk carriers (11.6), chemical tankers (11.9) and container ship (14.8). exceed the middle age of the fleet ships general cargo (18.1), passenger cargo (18.5), ro-ro ships (20.4) and refrigerated ships (34.6).

The average age of the fleet registered in the REC is held slightly for below that of the total controlled fleet and was, as of January 1, 2022, 16.1 years old (+0.5). The youngest fleet segment was the gas carriers.

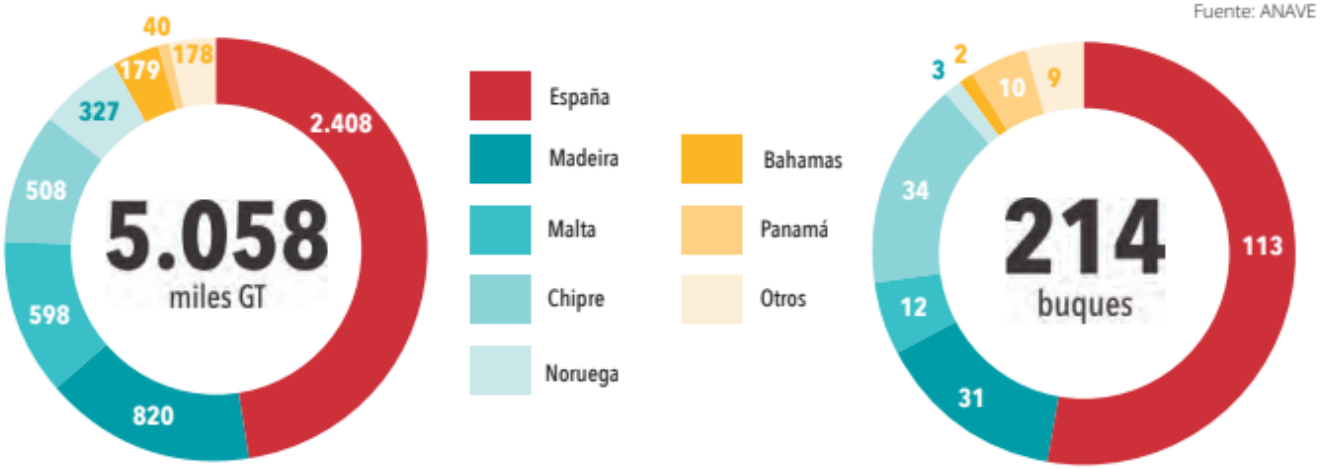
At international level and according to HIS Markit report, in 2021, the world merchant fleet of ships transportation grew by 3.2%.

According to Alphaliner, the excellent conditions of the container ship market during 2021 reduced the fleet inactive up to just over 600,000 TEUs, 58.1% less than in 2020, which accounted for 2.4% of the world fleet of this type of ships.

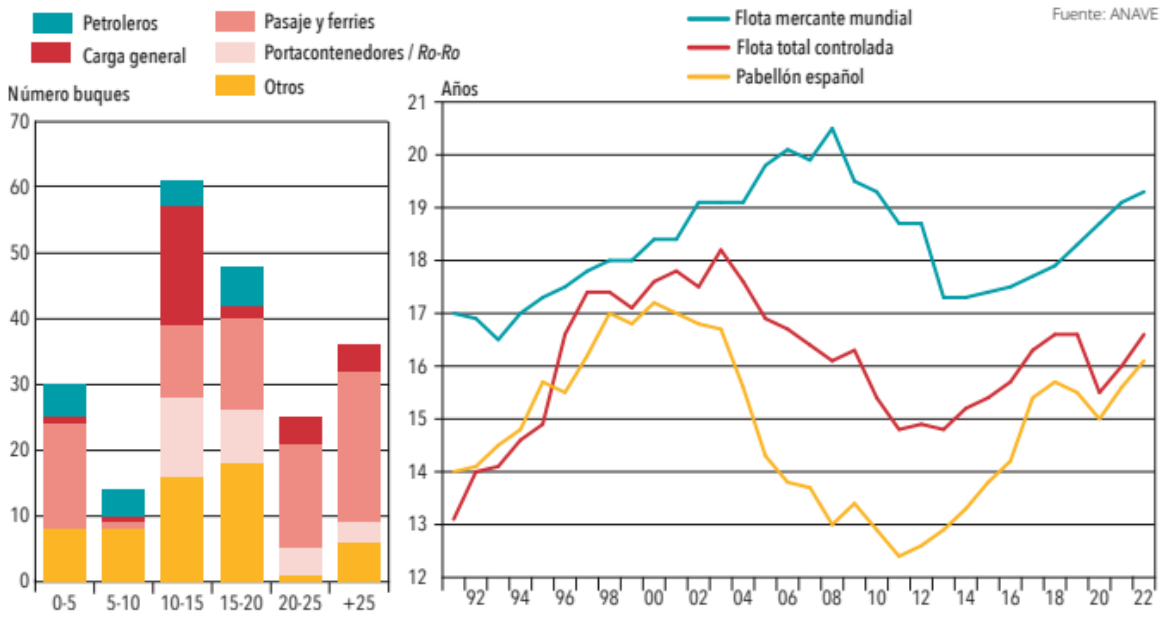
Ship-owners have continued to invest in improving behavior environment of its ships and, according to Clarksons, as of January 1, 2022, about 1% it was prepared to consume alternative fuels (fundamentally LNG, excluding LNG carriers); and the 1.6% of the vessels with 3.9% of the GT had an electrical connection to Earth. In addition, 61.7% of the GT already have installed a management system ballast water.

This figures are under the spanish ones where the adaptation to the alternative fuels is more advanced than international one. Another aspect to highlight is that the average age of the spanish fleet is younger than international one where the average age is 19.3. Therefore, it is important to conclude that the average age and the implementation of alternative fuel is in favor of the spanish fleet that is more modern than international one.

Fuente: ANAVE



Fuente: ANAVE



The Green Maritime Transport: Analysis and Evolution

In recent decades, maritime transport has expanded considerably, thanks to the growth of trade and globalization, and continues to be the predominant mode of international transport of traded goods and constitutes the backbone of global supply chains, representing more 80% of the volume of world trade.

Maritime transport has been a process of liberalization and reduction of obstacles after the Uruguay Round. The negotiations, which covered international shipping, ancillary services and access to and use of port facilities, were originally due to end in June 1996, but participants failed to agree on a set of commitments. The talks resumed as part of the services round of negotiations that began in 2000.

However, as it is already stated, the maritime transport industry faces a tough challenge in terms of efficiency.

The European Union imports more than half of all energy it consumes (68% in the case of Spain, 2020) therefore, there is a commitment to reduce these figures and to achieve the sustainability. This is the main reason why European Commission (EC) released its Energy Security Strategy, which comprised of a number of measures aiming to ensure energy supply, in May 2014. That year, the European Council agreed on a new 2030 Climate and Energy Framework establishing three objectives:

After that, in 2018, the European Commission also presented its long-term strategy for moving towards a climate-neutral Europe by 2050. Finally, in July 2021, the European Commission adopted a series of legislative proposals to deliver the European Green Deal setting out how it intends to reduce its net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

The main objective of the European Green Deal is to improve the well-being and health of citizens and future generations by providing:

- fresh air, clean water, healthy soil and biodiversity
- renovated, energy efficient buildings
- healthy and affordable food
- more public transport
- cleaner energy and cutting-edge clean technological innovation
- longer lasting products that can be repaired, recycled and re-used
- future-proof jobs and skills training for the transition
- globally competitive and resilient indu

Particularly, the European Green Deal set some objectives form maritime transport such as:

- Transport by inland waterways and short sea shipping will increase by 25% by 2030
- The internalisation of external costs of transport at the latest by 2050 will ensure that those who use transport will bear the full costs rather than leaving others in our society to meet them.

In terms of maritime transport, the most important proposals to address the environmental issue are the following ones:

- Extending the EU Emissions Trading System (ETS) to maritime transport creating a carbon price signal that should foster the reduction of GHG emissions in a flexible and cost-effective manner. To ensure that the maritime transport sector contributes to the EU's increased climate ambition, the proposal is to extend the scope of the EU's Emissions Trading System to cover CO_2 emissions from large ships (above 5000 gross tonnage), regardless of the flag they fly. The extension will include all emissions from ships calling at an EU port for voyages

within the EU (intra-EU) as well as 50% of the emissions from voyages starting or ending outside of the EU (extra-EU voyages), and all emissions that occur when ships are at berth in EU ports. The proposal would cap maritime transport emissions as part of the overall ETS cap. It would result in a price signal that should incentivise improvements in energy efficiency and low-carbon solutions and reduce the price difference between alternative fuels and traditional maritime fuels. To ensure a smooth transition, according to the proposal, shipping companies will only have to surrender allowances for a portion of their emissions during an initial phase-in period, reaching 100% after 3 years.

- Boosting demand for marine renewable and low-carbon fuels, by setting a maximum limit on the greenhouse gas content of energy used by ships calling at European ports and by encouraging zero-emission technology at berth.

- Boosting alternative fuel, which would set, among others, mandatory targets for shore-side electricity supply at maritime and inland waterway ports.

- Accelerating the supply of renewables in the EU which increases the current EU target of at least 32% of renewable energy sources in the overall energy mix to at least 40% by 2030.

- Revising the existing Energy Taxation Directive which aims to align the taxation of energy products with EU's climate objectives and remove outdated exemptions, such as those for the intra-EU maritime transport sector.

It is important to highlight that the final text has not been adopted yet. Hence, the previous points are still subject to discussion between co-legislators including the starting year for the inclusion of shipping in the EU ETS.

Out of the European Union, the International Maritime Organization follows also an strategy of pollutant emissions reduction strategy.

In line with the internationally agreed temperature goals under the Paris Agreement, the strategy includes objectives to reduce total annual GHG emissions from shipping by at least 50% by 2050 compared to 2008 levels and to pursue efforts to phase them out as soon as possible in this century.

In October 2018, the IMO Marine Environment Protection Committee agreed on a programme of follow-up actions to implement the initial strategy, with timelines for consideration and agreement on GHG reduction measures:

- Short-term measures are to be decided between 2020 and 2023.

- Proposals for mid- and long-term measures are to be considered, without mentioning the timelines for agreement.

This strategy will be revised in 2023.

Another important document and strategy that is directly linked with the green maritime transport is the EU Fuel Maritime. In Europe, the renewables share in the transport sector has to increase through the development of electrification, advanced biofuels and other renewable and low carbon fuels as part of a holistic and integrated approach, and that hydrogen based synthetic fuels will be crucial for the decarbonisation.

In this sense, the role of the alternative and sustainable fuels is essential. Currently, the fuel mix in the maritime sector relies entirely on fossil fuels. This can be explained by insufficient incentives for operators to cut emissions and by the lack of mature,

affordable, and globally utilisable technological alternatives to fossil fuels in the sector.

In this sense, the FuelEU Maritime initiative proposes a common EU regulatory framework to increase the share of renewable and low-carbon fuels in the fuel mix of international maritime transport without creating barriers to the single market.

At national level, in Spain, the general framework of the European Union is directly imposed on the national laws and national ports. But, there is under debate an exception in the FuelEU Maritime Regulation, such as the exception in the application of the Regulation to 50% on a permanent basis in outermost regions such as the Canary Islands and 100% until 2030 in island regions with less than 200,000 inhabitants, such as Ibiza and Menorca. The basic argument is that the difficulties of these ports and the need to protect the competitiveness and the employment of these ports, avoiding carbon leakage towards the so-called "evasive ports" out of the EU.

The Green Maritime Transport: An Economic View.

Maritime transport enables more than 80% of world trade in volume and more than 70% in value and the need of a transition to a greener industry has been clearly remarked previously.

In this sense, to work on the alternative fuels is one of the most important points. However, there are some important threats from an economic point of view that need to be analyzed in order to reduce the number of obstacles to achieve the goals. This is crucial because ambitious goals may reduce the competitiveness of the EU ports or Spanish ones producing a partial shift of the traffic to less strict ports in terms of sustainability or green requirements.

Considerations on possible obstacles to the single market, distortion of competition between operators and diversion of trade routes are particularly relevant to fuel requirements, since fuel costs make up a substantial share of ship operators 'costs. The proportion of fuel costs in the operating costs of ships can range from around 35% of the freight rate of a small tanker to around 53% for container/bulk vessels. Therefore, variations in marine fuel prices may impact significantly the economic performance of ship operators.

In this sense, it is very important the price differential between conventional marine fuels of fossil origin and renewable low-carbon fuels that still remains high. To maintain competitiveness while still steering the sector towards the fuel transition that it must inevitably undertake, clear and uniform obligations are needed on ships 'use of renewable low-carbon fuels.

Moreover, a number of market failures partly cause and reinforce these problems.

These include:

An important starting point would be to increase the predictability of the regulatory framework what is expected to stimulate technology development and fuel production and help the sector unlock the existing endogeneity issue between demand and supply of renewable and low-carbon fuels.

In this sense, clear and uniform obligations on ship's use of energy is necessary to mitigate the risk of carbon leakage, which maritime transport is prone to due to its international nature and the possibility to bunker fuel out of the boundaries.

At European level, it is fundamental the EU legislation must turn into national laws to keep the market unity. Exactly, the same problem is clearly faced at national level considering the different regions of the country.

Owing to the cross-border and global dimension of maritime transport, a common maritime regulation is preferred, over a legal framework requiring EU Member States to turn EU legislation into national law. The latter could result in a patchwork of national measures with differing requirements and targets.

In this sense, it is important to remark the importance of the FuelEU Maritime that is part of the package of measure previously discussed. On one hand, the FuelEU Maritime initiative aims at increasing the demand for renewable and low-carbon fuels, trying to ensure cost-effective emission reductions and that the price of transport reflects the impact it has on the environment, health and energy security.

Looking in more detail at the proposed actions, there is currently no mechanism, either at the IMO level or at EU level, to correct for the presence of negative externalities (the indirect costs of emissions that are otherwise not considered) in the sector. This prevents operators from taking into account, in their operational and investment choices, the social cost of their activity in terms of climate change and air pollution.

In this sense, it is important to consider pricing mechanisms as the instruments of choice to 'internalise 'external costs. The main

examples would be a tax fixed at the level of the external cost, or a 'cap and trade' instrument, such as the EU Emission Trading System (ETS), that sets a limit to the overall emissions and lets the market determine their appropriate price. Both are described as 'market-based measures.

Nowadays, there is an important discussion in the European Union (EU) to include ports from third countries in the control of carbon emissions from maritime transport. The proposal of the new Regulation has been debated in the Council of Ministers of Transport and Energy of the EU, held in Luxembourg, in June of 2022.

The new Regulation proposes that the reduction of carbon emissions and the use of different energy sources in maritime transport, to meet the objectives against climate change, be applied in a way that does not entail a loss of competition for our ports. Specifically, the agreement is to include ships that dock in ports outside the EU and that are less than 300 miles from another community port.

At Spanish level, in case of final inclusion of these conditions, it would be very important for the ports of Algeciras and Valencia that face the competition with Tanger in the container traffic. An important aspect to consider is that the deviation of traffic to ports out of the European Union it would not only diminish the expected environmental benefits and significantly undermine the objectives pursued, but could give rise to additional emissions due to the distance additional route travelled to evade its application.

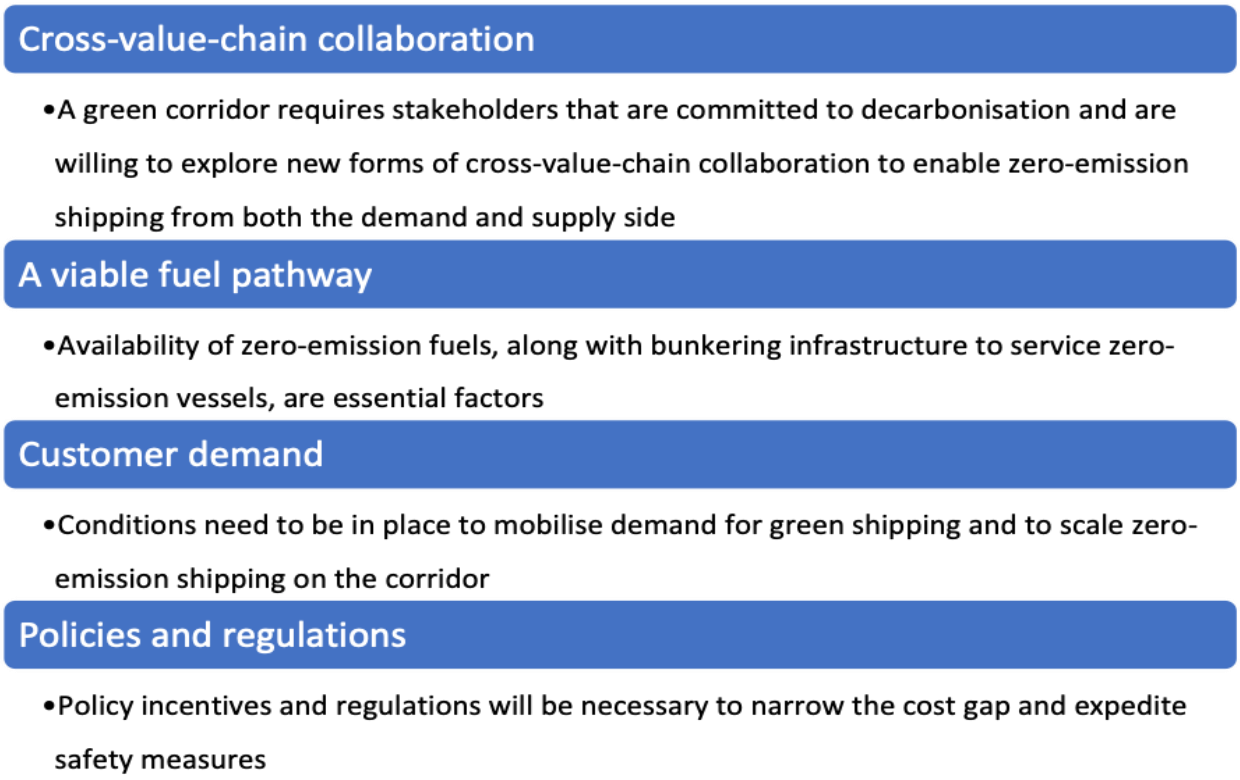
Moreover, additional policy actions are needed to ensure that the level playing field in maintained while removing obstacles to investments in clean energy technologies and infrastructure, in turn reducing abatement costs and complementing the action of the EU ETS. This is particularly relevant to support mitigation measures that have a high potential to reduce emissions in the future but which, presently, face high abatement costs as well as specific market barriers.

While extending the EU ETS to the maritime sector will further drive energy efficiency improvements and narrow the price gap between conventional and low-emission technologies, its ability to support the rapid deployment of green technologies in the maritime sector strongly depends on its actual price level, which is unlikely to reach sufficient levels for this purpose in the short to medium term. There is currently no EU regulatory framework specifically addressing this issue.

At Spanish level, Spain is part of the EU initiative and regulation framework and is also part of Clydebank Declaration to develop green corridors in the maritime transport. Spain signed, together with 21 other countries and during the Climate Summit, COP26, which took place in Glasgow. In addition to Spain, major maritime powers such as the US, Japan, Germany, Norway, the Netherlands, the UK or Australia have joined the agreement.

This declaration establishes the objective of developing at least 6 'green' corridors by the middle of this decade, when the signatories plan to carry out an evaluation. In the longer term, it is contemplated to increase the number of routes, that these be longer and with a greater number of ships. These corridors will be established by agreement between two or more signatories of this Declaration, who will identify and take joint measures with the ports, operators and other links in the logistics chain, to decarbonize a specific maritime route. The designation of green corridors in national cabotage lines within the jurisdiction and control of a signatory is also foreseen.

For a route to be selected as a candidate for a green corridor, it needs to have potential for large-scale decarbonisation, thereby creating the necessary impact to help the shipping sector achieve its decarbonisation goals. This also needs to be feasible from an implementation viewpoint. This report suggests that four critical building blocks need to be in place to establish a green corridor:



Pre-feasibility studies have been undertaken on two corridors: the Australia-Japan iron ore route and the Asia-Europe container route. The findings suggest that the green corridor concept, when applied to both routes, provides sufficient scale for impact and the necessary specificity—across fuel pathway, cargo, policy-making environment, and vessel type—to enable a feasible, accelerated decarbonisation roadmap for the shipping industry.

A third route—the Northeast Asia-US car carrier route—is presented as a case study, given its relative impact and strong stakeholder commitment to decarbonisation. On this route, there are significant opportunities for industry players to collaborate end to-end across the value chain to reduce emissions, even before zero-emission fuels become available.

Beyond these initiatives there is no a different framework or a particular measure in economic terms and there is no any green corridor where Spain ports are involved.

However, and recently, the European Commission has approved the 60 million plan of the Government of Spain to promote maritime freight transport, within the framework of the Recovery and Resilience Plan.

The plan seeks to promote shipping by sea to reduce freight by road until 2026 and employ greener merchant ships. The aid will be direct and can be requested by road carriers to compensate for external costs when using maritime transport.

The first call of the plan was proposed by the national Government the last September. The aid of this first call had a budget of 20 million of euros and is aimed at carriers, loaders or logistics operators, both companies and freelancers, who choose to ship semi-trailers, trailers or heavy rigid vehicles on a ro-ro, con-ro or ro-pax ship. , instead of exclusively using the road to move the merchandise to its final

destination, between September 21, 2022 and March 31, 2023[3].

The program represents an indirect stimulus to the shipping companies that operate eligible services to improve the environmental performance of these services and in the case of being part of one of the eligible routes.

In this sense, the potential beneficiaries will be able to board the trucks in certain maritime services operated by the shipping companies Brittany Ferries, Suarzdiaz Atlántica, Flota Suardiz, CLD Roro, Grimaldi Euromed SpA and Finnlines Oyi, which have been chosen collaborating entities of the program through a first call.

Specifically, the eligible services run through the Mediterranean and the Atlantic arc, connecting a Spanish port and one from another Member State of the European Union, as long as there is an alternative road route for the line, including those that involve a crossing of canals or narrows.

The services with which this program begins depart from the ports of Barcelona, Bilbao, Valencia, Sagunto, Santander and Vigo to ports located in other EU countries such as Italy, Ireland, Finland, Belgium and France.

In this sense, for each embarked unit and journey made, an eco-incentive will accrue, which is calculated based on the savings in external costs (greenhouse gases, air pollution, congestion, accidents and noise) generated within Spain for using maritime mode instead of highway to route truck traffic.

Moreover, Brussels perceives this measure as beneficial for the environment and mobility, pointing out that it will contribute to the coordination of transport and will facilitate changes to the maritime environment, in line with the Spanish plans and the objectives set by the sustainable mobility strategy and the European Green Deal.

[3] This call is part of PERTE Naval as it was aforementioned in the brief description of the policy.

The Green Maritime Transport: Environmental Aspects

As we already mentioned in this report, the green maritime transport is boosted due to the concern and the compromises of the countries to fight against climate change as it is signed in the Agreements of Paris, among others document and agreements.

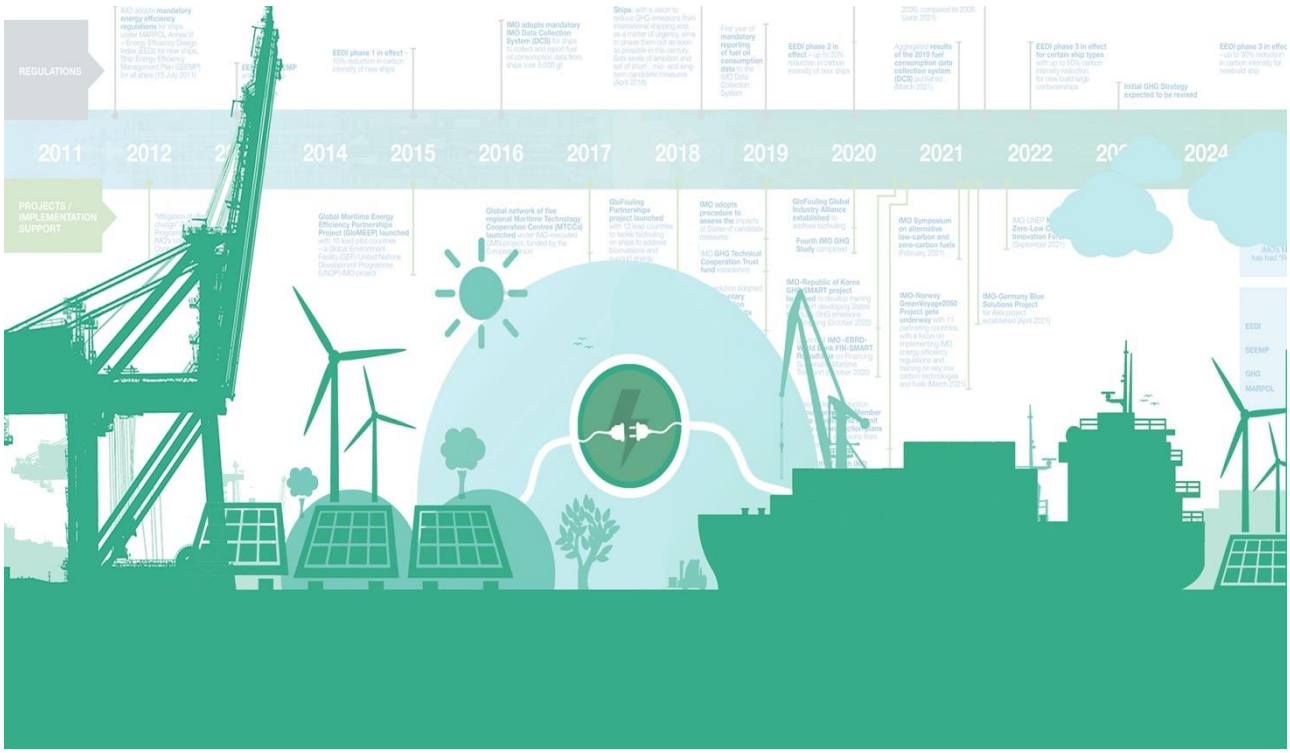
Therefore, it is fundamental to recognize that the main of role of the green maritime transport is to reduce the GHG emissions, though is not the only aspect to consider. It is important to take into account other important effects associated to the marine wildlife or the quality of the air in the surroundings urban areas of the ports.

The European Green Deal is the basis to the fight of the climate change of the European Union and as a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use what is clearly an ambitious challenge.

This previous figure represents clearly the challenges that the green maritime transport face in the present and the near future.

In this sense, the main transition is based on changing the use of fossil fuels by alternative ones. This may hold the challenge established by the International Maritime Organization (IMO) which has decided to cut greenhouse gas emissions from international shipping by at least 50% compared to 2008

Figure 14 Expected benefits for the European Community with the European Green Deal. Source: European Commission, 2022



levels. In this sense, the fight of the IMO to reduce the GHG emissions started at the beginning of 2000s as depicted in the next figure.

Considering these two previous objectives, it is important to know what is the situation in Europe. The European Maritime Transport Environmental Report launched by the European Maritime Safety Agency marks the first comprehensive health-check of the sector.

The report estimates that the main impacts are the following ones:

- Greenhouse gas emissions: in total, ships calling at EU and European Economic Area ports generated around 140 million tonnes of CO_2 emissions in 2018 (approximately 18 % of all CO_2 emissions generated by maritime transport worldwide that year).

- Air pollution: In 2019, sulphur dioxide (SO_2) emissions from ships calling in European ports amounted to around 1.63 million tonnes, approximately 16 % of the global SO_2 emissions from international shipping.

- Underwater noise: Ships create noise which can affect marine species in different ways. It is estimated that between 2014 and 2019, the total accumulated underwater radiated noise energy more than doubled in EU waters. Container ships, passenger ships and tankers generate the highest noise energy emissions from propeller use.

- Non-indigenous species: Overall, since 1949, the maritime transport sector has accounted for the largest proportion of non-indigenous species introduced into seas around the EU — close to 50 % of all species, with the largest number found in the Mediterranean. A total of 51 species are all classified as high impact, meaning that they can affect ecosystems and native species. The report also notes the limited data available in assessing the full impact on habitats and species.

- Oil pollution: out of a total of 18 large accidental oil spills in the word since 2010, only three were located in the EU (17 %); better monitoring, enforcement and awareness is helping to reduce oil pollution events even though the amount of oil transported by sea has been steadily growing for the past 30 years.

The joint report also assesses the current state of emerging maritime transport sustainability solutions, including alternative fuels, batteries and onshore power supply, and provides a

Figure 15 Expected benefits for the European Community with the European Green Deal. Source: European Commission, 2022.

comprehensive picture of their uptake in the EU. It also outlines future challenges posed by climate change for the industry, including the potential impact of rising sea levels on ports.

EU maritime transport faces a crucial decade to transition to a more economically, socially and environmentally sustainable sector. Already, most ships calling in the EU have reduced their speed by up to 20 % compared to 2008, thereby also reducing emissions. In addition, non-traditional fuels and energy sources, such as biofuels, batteries, hydrogen or ammonia, are emerging as possible alternatives for shipping, with the potential to decarbonise the sector and lead to zero emissions. Onshore power supply (where ships shut down their engines and connect to a power source on land while berthed at port) can also provide a clean source of energy in maritime and inland navigation ports.

While steps have been taken already based on European and international policies, much more is needed for a fundamental shift towards a sustainable maritime transport sector that contributes to secure the future well-being and survival of our most sensitive ecosystems and coastal areas, and the well-being of Europeans.

Diversifying sources	Saving energy	Clean energy
• Work with international partners to find supplies; • Alternative supplies for oil, gas and coal in short-term; • Looking for new sources, e.g. reneable hydrogen.	• Every citizen, business and organization; • Small behaviours changes; • Contigency measures for supply interruptions.	• Enabling industry and transport to substitute fossil fuels faster to reduce GHG emissions and dependencies from suppliers; • Reducing the need of energy import.

Sustainability in the Spanish Maritime Transport Sector

Green technologies transition background in the maritime transport sector

European Green Deal

The European Green Deal was established in 2019 to endorse the need for taking action to stop climate change and environmental degradation from further effects. The deal aims on transforming Europe in a modern, resource-efficient, and competitive economy whilst ensuring no net emission of greenhouse gases (GHG) by 2050, an economic growth decoupled from resource use, and that no person and no place is left behind (A European Green Deal, 2022).

According to the European Commission, the actions taken regard the environment and oceans, climate, transports, agriculture, energy, finance and regional development, industry, and research and innovation. The expected benefits for the European community with the Green Deal are shown in the figure.

Regarding the transportation sector, the Green Deal objectives are to provide efficient, safe and environmentally friendly alternatives. The transport emissions represent around 25% of the European Union's (EU) total GHG emissions, and these emissions have increased over recent years (Transport and the Green Deal, 2022).

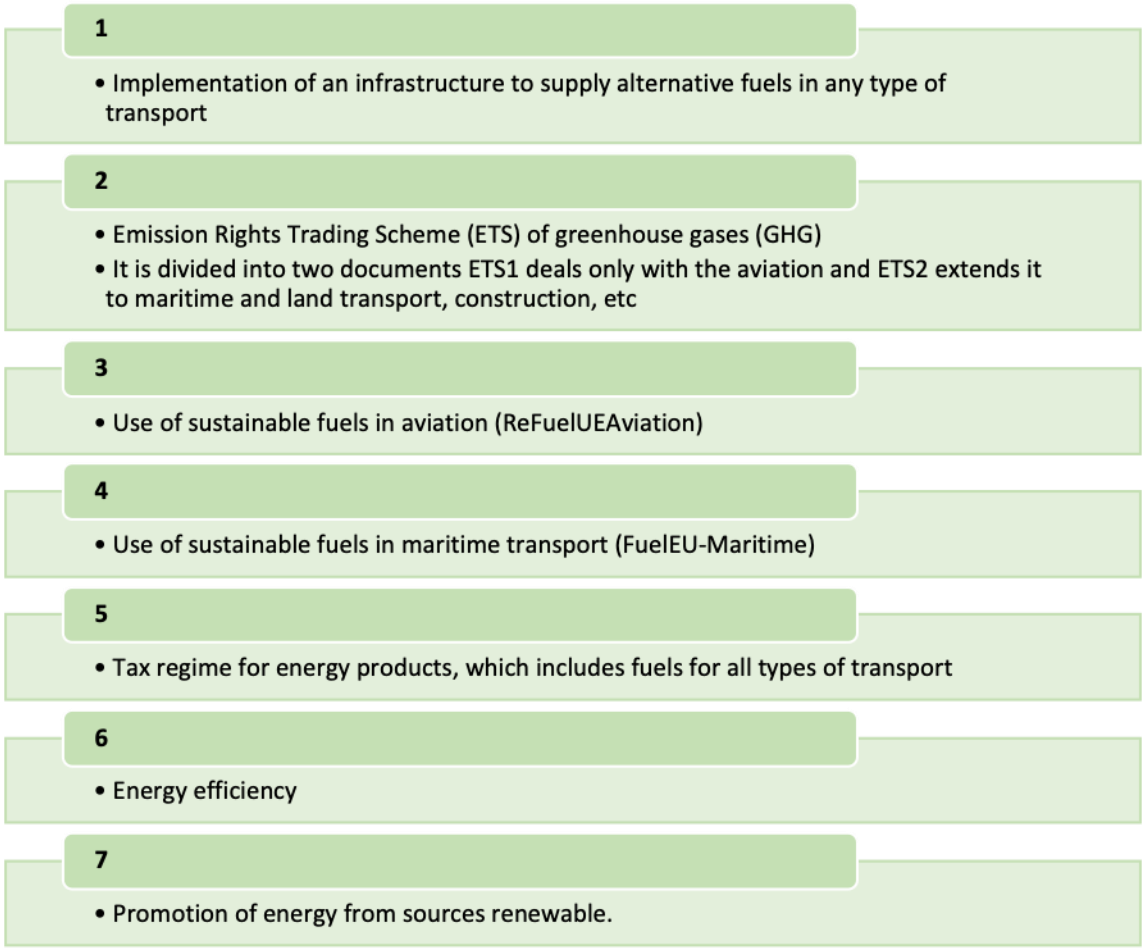
As for the world merchandise trade and globalization, the maritime transport remains the foundation. It is responsible for over 80% of the world trade, whilst in Europe it reaches nearly 40% of the volume within the member States. Furthermore, the naval transport is essential to help European companies compete in a global level, as the EU is the most important exporter and the second largest importer (Internal Market, n.d.; International Cooperation and Coordination, n.d.).

Moveovermore, every year, 400 million passengers embark and disembark in European ports. According to the Climate Action European Commission webpage, "*maritime transport plays an essential role in the EU economy and is one of the most energy-efficient modes of transport, it is also a large and growing source of greenhouse gas emissions. In 2018, global shipping emissions represented 1,076 million tons of CO_2, and were responsible for around 2.9% of global emissions caused by human activities".* Alone, the maritime transport contributed with 3 to 4% of EU total CO_2 emission in 2019 (Reducing emissions from the shipping sector, n.d.). As the first step to control the GHG emission, since January 2018, large ships over 5,000 gross tonnage loading or unloading cargo or passengers at ports in the European Economic Area (EEA) must monitor and report their related CO_2 emissions and other relevant information.

In this sense, the main transition is based on changing the use of fossil fuels by alternative ones. This may hold the challenge established by the International Maritime Organization (IMO) which has decided to cut greenhouse gas emissions from international shipping by at least 50% compared to 2008 levels. In this sense, the fight of the IMO to reduce the GHG emissions started at the beginning of 2000s as depicted in the previous figure.

Nevertheless, on the scope of the European Green Deal, the REPowerEU Plan was presented in May 2022, as a response to the Russian's invasion in the Ukrainian territory. The plan's purpose is to accelerate the clean energy transition and to increase Europe's energy independence from suppliers and fossil fuels before 2030 (REPowerEU, 2022). Furthermore,

Table 38 Fit for 55 package initiatives. Source: Fit for 55 package.



it aims to increase the resilience of EU-wide energy system by implementing the measures exposed in the Table.

Fit for 55 package

In September 2020, the European Commission announced a set of proposals to revise and update EU legislation and to put in place new initiatives with the aim of ensuring that EU policies are aligned with the climate 2030 goals agreed by the Council and the European Parliament. In July 2021, the European Commission adopted a series of legislative proposals – The Fit for 55 package - to deliver the European Green Deal, setting out how it intends to reduce its net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels (Reducing emissions from the shipping sector, n.d.; CEOE, 2022).

The package considers seven initiatives; they are summarized in the next Table. Further information about The Fit for 55 package can be found here.

The FuelEU-Maritime promotes the use of renewable and low-carbon fuels in maritime transport sector. The proposal aims to increase demand for the consistent use of renewable and low-carbon fuels in the maritime sector, while ensuring the smooth operation of maritime traffic and avoiding distortions in the internal market. In addition, the project is based on the principle of technology neutrality, given the wide range of technologies used in the maritime sector, and therefore focuses on fuel demand (Council of the European Union, 2022).

According to the Regulation (EU) 2021/0210 (COD) of the Council of the European Union of 24th of May 2022, the initiative stresses that the stability and prosperity of the maritime transport market, and its economic actors rely

on a clear and harmonized policy framework where maritime transport operators, ports and other actors in the sector can operate based on equal opportunities. Where market distortions occur, they risk putting ship operators or ports at a disadvantage compared to competitors within the maritime transport sector or in other transport sectors. In turn, that can result in a loss of competitiveness of the maritime transport industry, and a loss of connectivity for citizens and businesses.

To produce an effect on all the activities in the maritime transport sector, the FuelEU-Maritime Regulation should thus apply to:

- Half of the energy used by a ship performing voyages arriving at a port under the jurisdiction of a Member State from a port outside the jurisdiction of a Member State.
- Half of the of the energy used by a ship performing voyages departing from a port under the jurisdiction of a Member State and arriving at a port outside the jurisdiction of a Member State.
- The entirety of the energy used by a ship performing voyages arriving at a port under the jurisdiction of a Member State from a port under the jurisdiction of a Member State.
- The energy used at berth in a port under the jurisdiction of a Member State.

Furthermore, the rules laid down in the mentioned Regulation should apply in a non-discriminatory manner to all ships regardless of their flag. For reasons of coherence with the European Union and international rules in maritime transport, this Regulation should focus on ships with a gross tonnage above 5 000 gross tonnage (GT) and should not apply to warships, naval auxiliaries, fish-catching or fish-processing ships, wooden ships of a primitive build, ships not propelled by mechanical means, or government ships used for non-commercial purposes. Even though these latter ships above 5 000 GT represent only approximately 55% of all ships calling at ports under the Regulation (EU) 2015/757 of the European Parliament and of the Council, they are responsible for a large majority of carbon dioxide (CO_2) emissions from the maritime sector. The Commission should regularly reassess the situation, with a view to eventually extending the scope to ships with a gross tonnage below 5000.

Considering the special characteristics and constraints of the outermost regions of the Union, notably their remoteness and insularity, special consideration should be given to preserving their accessibility and efficient connectivity by maritime transport. Therefore, only half of the energy used on voyages departing from or arriving to a port of call located in an outermost region should be included in the scope of this Regulation. For the same reasons, temporary exemptions should be allowed for voyages between a port of call located in an outermost region and another port of call located in an outermost region, and to the energy used during their stay within the port of calls of the corresponding outermost regions.

In order to take into account the specific situation of island regions, as underlined in Article 174 of the Treaty, and the need to preserve connectivity between islands and peripheral regions with central regions of the Union, temporary exemptions should be allowed for voyages performed by passenger ships other than cruise passenger ships between a port of call under the jurisdiction of a Member State and a port of call under the jurisdiction of the same Member State located in an island with less than 200.000 permanent residents.

Spanish scenario

The maritime transport is essential for the Spanish socioeconomical development, as most of the strategic resources, such as energy, are imported. The Spanish maritime transport also ensures the connectivity between the islands and the outermost

maritime regions with the mainland [4]. Nevertheless, Spain also exports agricultural and manufacture goods, and through the Short Sea Shipping, the European Union reinforced the usage of maritime transport due to its higher environmental and economic efficiency rates, when compared to road transportation (Transporte Marítimo, 2019).

As most ships, the Spanish maritime transport hardly uses sustainable fuels, whose technologies have not yet reached the appropriate degree of development. If we add to this the fact that fuel represents between 35% and 53% of navigation operating costs, and the long useful life of ships and supply infrastructure, becomes easier to understand the technical complexity of any proposal regarding reducing emissions and replace the energy source in this sector (CEOE, 2022).

According to a study from Transport & Environment in 2019, presented at the COP25 in Madrid, about the GHG emissions from ships navigating in the European maritime space, the supply ships travelling to and from Spain emit more CO_2 than the 30 biggest cities of the country altogether. Therefore, Spain was ranked the second European country that emits more carbon dioxide to the atmosphere in 2018, falling behind The Netherlands only. The study gathered data about the emissions of the maritime transport which counted with 17,11 Mt, whilst the road transport with 12,21 Mt of CO_2 (La Voz de Galicia, 2019).

The uptake of Spain in the Fit for 55 package regarding the maritime transport sector is to gradually increment the use of sustainable fuels, which will reduce the GHG and the CO_2 emissions. The challenges related to the implementation of the low-carbon-emission fuels, the renewable fuels and the innovative projects are delineated in the upcoming sections.

Challenges in the Spanish Scenario

In energy generation and propulsion

According to the Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Directive (EU) 2018/2001 of the European Parliament and of the Council, Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, to achieve the European Green Deal target – EU becoming climate neutral in 2050 - there needed a revision in the Renewable Energy Directive (REDII), as it had to increase from 32% to 38 - 40% of renewable energies by 2030, according to the Climate Target Plan.

The overall objectives of the revision of REDII are to achieve an increase in the use of energy from renewable sources by 2030, to foster better energy system integration and to contribute to climate and environmental objectives including the protection of biodiversity, thereby addressing the intergenerational concerns associated with global warming and biodiversity loss. As referred to in the proposal, an EU approach is needed to provide the right incentives to Member States with different levels of ambition to accelerate, in a coordinated way, the energy transition from the traditional fossil fuel-based energy system towards a more energy-efficient energy system based on renewables-based generation. Considering the different energy policies and priorities among Member States, action at EU level is more likely to achieve the required increased deployment of renewables than national or local action alone.

With regards to the use of renewable and low-carbon fuels in the maritime transport, the

[4] Propuesta de Reglamento del Parlamento Europeo y del Consejo relativo al uso de combustibles renovables y combustibles hipocarbónicos en el transporte marítimo y por el que se modifica la Directiva 2009/16/CE

achievement of the targets are ensured by Regulation (EU) 2021/562 on the use of renewable and low-carbon fuels in maritime transport - FuelEU Maritime and Regulation (EU) 2021/562 on ensuring a level playing field for sustainable air transport.

According to the Regulation (EU) 2021/0210 (COD) of the Council of the European Union of 24th of May 2022, the development and deployment of renewable and low-carbon fuels with a high potential for sustainability, commercial maturity and a high potential for innovation and growth to meet future needs should be promoted. This will support creating innovative and competitive fuels markets and ensure sufficient supply of sustainable maritime fuels in the short and long term to contribute to Union transport decarbonisation ambitions, while strengthening Union's efforts towards a high level of environmental protection.

In Spain, today, the powers are regulated and collected in Article 7 of Royal Decree 61/2006 where the sampling of fuels is specified to control their technical specifications and sampling in the supply, to subsequently notify Energy and the DGMM. Likewise, Articles 10 and 11 collect the powers in this matter for the DGMM, the Port Authorities and the Autonomous Communities. Also, according to EU Directive 2016/802 on the reduction of the sulfur content of certain liquid fuels, it indicates that the fuel of 10% of ships and the sampling and analysis of 20% must be controlled, a percentage that will rise up to 30% of the vessels inspected from 01/01/2020 onwards.

Coal imports recorded the highest decrease (-44.8%) due, on the one hand, to the drop in demand due to the stoppage of some thermal power plants to carry out the transformations necessary to adjust to the new European regulations, and due to the lack of competitiveness of electricity generated with coal. The reduction in the cost of renewable sources and, above all, the increase in the cost of emission, which have gone from an average of 5.83 €/t CO_2 in 2017 to €24.8/t in 2019, motivated that coal only covered 5% of the demand for electricity, compared to 17.2% in 2018 (ANAVE 2019/2020).

In the energetic efficiency

According to Repsol, the Very Low Sulfur Fuel Oil (VLSFO) is more difficult to produce than conventional fuels as some of its properties, such as stability, may be compromised during the production process, which is one of the concerns of shipping companies looking to adopt this fuel. Nonetheless, the Spanish company ensures the quality of its product at every steep and at every facility, which have already been recognized in the market.

Relatively to the VLSFO prices, the *Autoridad Portuaria de Valencia* published in September 2021, that as far as fuel prices are concerned, mixed trends can be observed. The average price of a barrel of European Brent crude oil fell by 6.07% in August compared with the previous month, from $75.17 in July to $70.16 in August. About the price of bunkering – the refueling of ships at sea – in the 20 main ports of the world and according to the data offered by Ship&Bunker, the average price of IFO 380 (Intermediate Fuel Oil) has gone from $448 in July to $449.50 in August, as which represents an increase of 0.34%. Conversely, VLSFO (Very Low Sulphur Fuel Oil) decreased by 3.13% from $559.50 in July to $542 per tons in August. Thus, the urgent need to start producing more VLSFO, so its price becomes more competitive to HFO or IFO.

Regarding the bio-methanol, Rafael Gutiérrez Fraile, from the Littlefire Castle SL, when attending to the round table in July 2022 of the *Asociación de Ingenieros Navales y Oceánicos* (AINE) about the use of methanol, made a comparison of how much fuel should be produced from each alternative to cover the annual needs of the country. This is where the main disadvantage of the bio-methanol lies: its volume is twice that of fuel commonly used nowadays and thus tanks twice the size would be needed to achieve the same autonomy (Milena Giorgi, 2022).

In other words, between 14 and 15 million tons of methanol should be produced to supply

the marine fuel market. But Gutiérrez Fraile mentioned that this option is much more viable than the hydrogen fuel - although the hydrogen would be more convenient since with only 2 million tons per year it could meet the markets 'needs.

The commercial and business development director from Seaplace, Pedro Lopez Viscayno, stated that exists the capacity in Spain to build vessels that work with renewable energies. But in the case of Lopez Vizcayno pointed out that, in terms of shipbuilding, the price can vary between 10 and 30 percent for methanol-ready ships. The biggest question then is whether the bio-methanol price will be competitive or not. "*To know if this cost is significant, it would be necessary to balance the price of methanol and the price of CO_2 emissions as the market develops*" concludes the Seaplace manager (Milena Giorgi, 2022).

In addition, Rafael stated that "Ammonia and methanol are two products that are already produced on an industrial scale (150 million tons (Mt) in the case of the former and 100 Mt in the case of the latter). But the key is to make the production of both with renewable energies.". And he added "Ships spend 300 million tons of fuel per year. Both ammonia and methanol have approximately half the calorific value of fuel oil or gas oil. If today, one hundred million tons of methanol are being produced, it would be necessary to multiply said production by a factor of six to cover the demand of the maritime sector" (Ingenieros Navales, 2022).

Regarding the ammonia (NH_3) as a fuel source, DNV forecasts that green ammonia, blue ammonia and bio-methanol are the most promising carbon-neutral fuels in the long run. This suggests a mid-term reliance on LNG, and if ammonia becomes the leading fuel for the shipping industry by 2050, there will be extensive need for new bunkering infrastructure. The current ammonia infrastructure - currently 192 ports worldwide - is not sufficient for this demand and some ports will be retrofitted, but there will be a substantial need for additional flexible and scalable infrastructure. Constructing this infrastructure with conventional methods for bunkering, such as using jetties, represents significant costs and environmental interventions.

In relation to other alternative renewable energies, Díaz (2020) it suggested that for wind-propulsion systems, there is no point in referring to percentages of fuel savings since any of these systems provides of a power that depends only on itself and not on the ship. The percentage saved relies on the ship but not the absolute value of the thrust generated. The fuel savings should be given in absolute value for every ship case once the characteristics of the engine and the vessel are known.

In safety

Hydrogen in its natural state is unscented, non-toxic and invisible, therefore leakage can be difficult to detect. This is a concern as H2 is explosive, with a flammability range of between 4% and 77% when mixed with air (McKinlay, Turnock and Hudson, 2020).

Ammonia, in its turn, has fewer challenges related to temperature due to its non-cryogenic boiling temperatures, its higher explosion limit and superior storage characteristics, compared to hydrogen and batteries, for example. Storage tanks for liquefied NH_3 pose little technical difficulties since NH_3 is in a liquid state at temperatures below -33.6°C at atmospheric pressure and at 10 bar, the condensation/boiling point is 25 °C. It is, however, a toxic substance, which can be lethal at even small concentrations. However, all fuels are hazardous to some sort of degree, and ammonia presents a different set of hazards to the alternatives. It is less flammable than other fuels, so poses a lower fire risk and risks from cryogenic burns are lower than for liquid hydrogen or liquefied natural gas (Magnusson and Murphy-Canella, 2021).

New fuels

Very low sulfur fuel oil (VLSFO)

The International Maritime Organization (IMO) have pushed new challenges in 2020 regarding the decreasing of emissions for the maritime transport. Since January 2020, the IMO limits the highest concentration of sulfur in marine fuels to 0.5%, compared to the current 3.5% allowed.

One of the biggest energy companies in Spain, and most effective and active refineries in Europe, Repsol, have started taken the lead in producing and commercializing new alternatives fuels, such as the VLSFO. Repsol counts with refineries in Spain that have been producing the VLSFO and the company has been commercializing it in the ports of Barcelona, Valencia, Algeciras, A Coruña, as well as in other cities outside the European Community (Grupo Repsol, 2021).

Repsol have commercialized approximately 150,000 ton de VLSFO within Spanish ports so far. The International Energy Agency envisioned that this fuel would replace at least half of the volume of the High Sulfur Fuel Oil (HSFO) commercialized for bunkers in 2019. However, ships companies can still choose to install scrubbers, an exhaust gas cleaning system to eliminate the SO_x emissions, thus the demand for HSFO still exists. In this sense, two issues arose: the limited availability of these devices and the high cost to maintain ships using old fuels. Thus, it is expected a usage decrease of HSFO within time and with fuels technologies further development (Grupo Repsol, 2021).

In general terms, a scrubber sprays seawater or fresh water mixed with a caustic chemical into the exhaust gas stream in several stages. The pollutant, mainly sulfur dioxide (SO_2), instead of going directly to the atmosphere, which can cause acid rain and harm people wildlife and human's health, is removed from the exhaust gases from maritime transport (Maritime Impact, 2018; LIQTECH [1], n.d.). The scrubbers found in vessels can work with a closed-loop or an open-loop cycle, or even with a hybrid cycle.

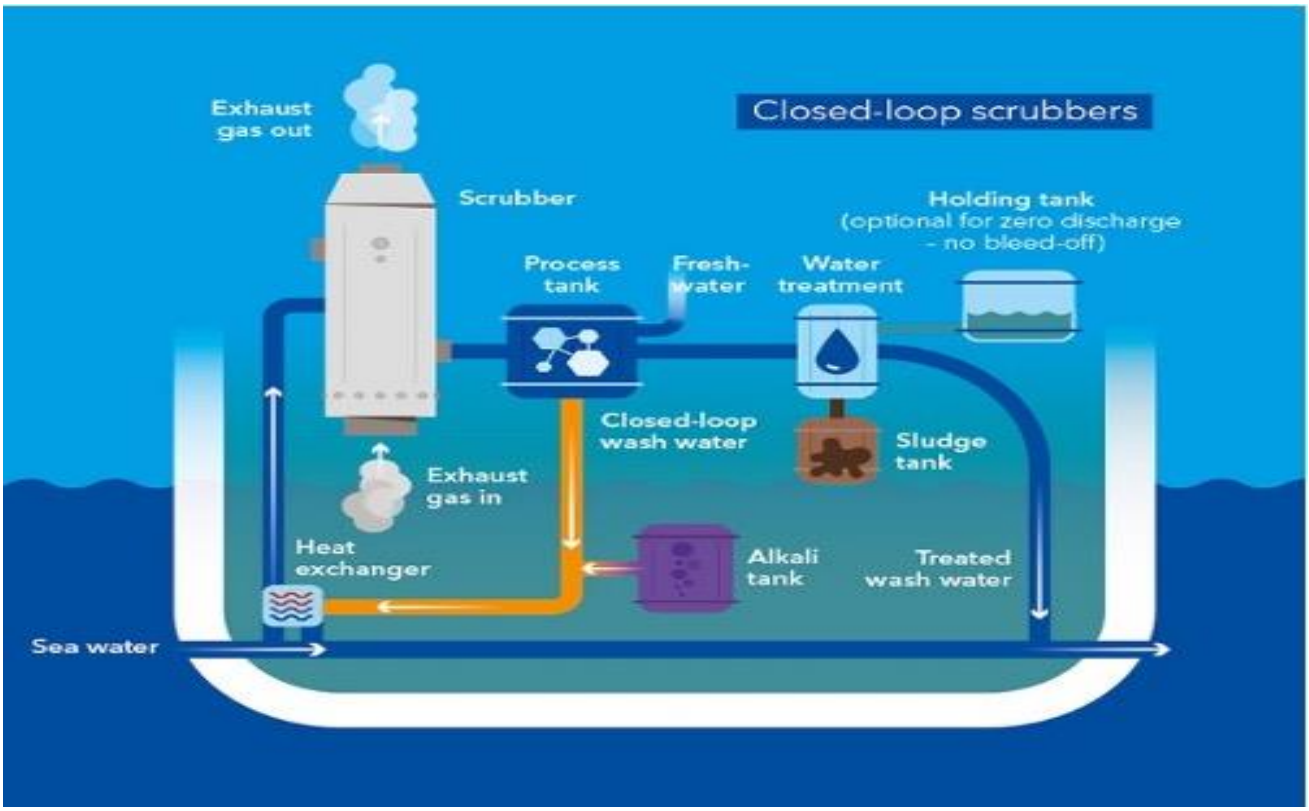


Figure 16 Diagram of a Closed-loop scrubber in ships. Source: DNV, 2018.

Technical data from LIQTECH explains how the different scrubber's work. The close-loop scrubber system, Figure 16, the exhaust gas streams move through a scrubber tower in a closed-loop scrubber.

The exhaust gas intake is always at the bottom of the scrubber tower as this design ensures that the SO_x emissions in the exhaust gas stream pass through the scrubbing liquid to deliver the most thorough scrubbing. The exhaust gas is scrubbed with a watery substance utilizing many nozzles inside the scrubber tower. A closed-loop scrubber typically employs seawater with added alkalis such as sodium hydroxide (NaOH), also known as caustic soda, or magnesium hydroxide (MgOH) to scrub the exhaust gases. Yet, a closed-loop scrubber can also utilize fresh water.

The wash water will move downstream to the process tank. Through automatic monitoring and control, alkali is automatically dosed directly into the process tank to maintain the process pH and, thereby, the SOx removal efficiency. The alkaline and the specific amount highly depend on where and how the vessel operates. This pH adjustment is the primary environmental advantage as it ensures to neutralize the sulfuric wash water. Additionally, the water quality is reached by maintaining a low temperature by cooling the scrubber water with fresh seawater in a heat exchanger.

A small amount of the wash water is bled off from the process tank to a water treatment unit to remove the accumulated impurities from the scrubber wash water. The treatment of scrubber wash water consists of suspended solids removal. The water treatment will treat the bleed flow from the scrubber's process tank to remove polycyclic aromatic hydrocarbons (PAH), particulate matter (PM), and harmful elements stemming from the combustion process, such as oil, ash, and soot.

The many nozzles ensure that the alkaline-dosed seawater is distributed effectively within the scrubber tower. By scrubbing the exhaust gas, high percentage of sulfur is removed from the exhaust gases. The SO_x are turned into sulfates such as Na_2SO_4, which are harmless to the environment. In addition, nitrogen oxides (NO_x) and particulate matter are also reduced.

An Open-loop scrubber system is shown in Figure 16. This system is found in approximately 80% of exhaust gas scrubbers system installed on vessels due to the low installation and operational costs (LIQTECH). The Open-loop system uses seawater, which is alkaline by nature, to wash the SO_x out of the exhaust. The resulting wash water must meet the MARPOL requirements before being discharged back into the sea (Maritime Forecast to 2050, n.d.).

In order to obtain this water quality, huge quantities of seawater are pumped into the system. This ultimately delivers low turbidity, low pH, low temperature, as well as a low concentration of polycyclic aromatic hydrocarbons (PAHs). As this process demands large quantities of seawater, much wash water is generated, which is both more acidic and turbid than natural seawater. This is discharged overboard without any wash water treatment, which harms ecosystems and wildlife as the water can contain gaseous and particulate emissions, particulate matter (PM), PAHs, heavy metals, nitrate, and unwanted particulates such as soot and ash. Moreover, as this solution requires much water, it requires a large pumping capacity (LIQTECH [2], n.d.).

Simply put, open-loop scrubbers move the pollution from air to sea, causing ocean acidification. To combat ocean acidification, several countries have adopted an open-loop scrubber ban. In areas and ports where open-loop scrubbing is prohibited, ships must convert to a hybrid or closed-loop scrubber and collect the accumulated sludge on board for subsequent disposal at a suitable in-port facility (Maritime Impact, 2018; LIQTECH [2], n.d.).

Hybrid scrubber systems can operate either in closed-loop or in open-loop mode, offering more flexibility. A multi-inlet scrubber can treat the exhaust gas from several engines, whereas a single-inlet scrubber serves one

engine only. It is important to weigh all options for a given ship and trading pattern carefully to ensure the economic sustainability of the chosen solution (Maritime Impact, 2018).

Furthermore, Spain, amongst other European countries, imposes restrictions for ships that work with open-loop or hybrid scrubbers. Thus, ships need to switch to either closed-loop mode or to compliant fuel before the ship's arrival at such ports as the discharge of wash-water is prohibited from open-loop (Safety4sea, 2020).

Bio-methanol

The bio-methanol, or green methanol, has potential as a neutral carbon emission fuel. It is liquid at ambient temperature and at sea level pressure, making it an ideal fuel to transport. In addition, the methanol handling and power of conversion technologies are mature, and there is a strong level of infrastructure already existing in ports. However, there are inconvenient to this fuel as it is highly flammable and toxic (Bureau Veritas Marine & Offshore, 2022; Milena Giorgi, 2022).

Furthermore, it is among the 6 world-class commodities and, therefore, it is available worldwide. However, it is predicted not to be enough for the entire world fleet. Thus, it is expected the vessels to operate with different sustainable fuels, but the specialists, says the bio-methanol will be the protagonist (Milena Giorgi, 2022).

Nowadays, Spain is the second largest supplier of fuel for ships in Europe and fifth in the world, as stated by Gutiérrez Fraile at the AINE round table. In this sense, it is relevant to understand that not all methanol is produced using the same materials or via the same processes (Table 39 and Figure 17). This leads to variations in the sustainability of methanol as fuel when considering well-to-wake GHG emissions (Bureau Veritas Marine & Offshore, 2022):

Table 39 Different methanol types and their origin.

Fuel	Origin
Brown methanol	is produced from coal and may not significantly reduce well-to-wake carbon dioxide emissions.
Grey methanol	is produced from natural gas and may not significantly reduce well-to-wake carbon dioxide emissions.
Blue methanol	is produced using blue hydrogen in combination with carbon capture technology, vastly reducing well-to-tank carbon dioxide emissions.
Green methanol	may be bio-methanol produced from biomass or e-methanol produced from green hydrogen, captured CO_2 and renewable electricity. Both ways may be considered as enabling neutral well-to-wake carbon dioxide emissions.

Methanol does hold a sustainability advantage over heavy sulfur fuel oil (HFO) and low sulfur fuel, as it contains no sulfur and produces limited nitrous oxides (NO_x) and minimal particulate matter when burnt. However, its tank-to-wake GHG emissions

remain high, typically reported as averaging only a 7% decrease in CO_2 emissions as compared to HFO – markedly less than the theoretical 22% reduction possible with liquefied natural gas (LNG). About 99% of methanol is currently obtained by the oxidation of methane or the gasification of coal (Benny Mestemaker, n.d.; Bureau Veritas Marine & Offshore, 2022).

This means that the tank-to-propeller CO_2 emissions of the grey methanol are comparable to those of other fossil fuels green methanol, such as bio-methanol and e-methanol, significantly reduce CO_2 emissions by about 85%, however production volumes are still limited. In the future, green methanol may be produced from a wide variety of feed stocks and through different pathways (Benny Mestemaker, n.d.).

To achieve effective CO_2 emissions reduction, shipowners will need access to blue or green methanol, which is significantly more expensive than brown/grey methanol or HFO and is currently in limited availability (Bureau Veritas Marine & Offshore, 2022).

Green Hydrogen

In line with IMO's emission reduction goals, hydrogen (H_2) is one of the most viable fuels in the long term. A few hydrogen-powered ships have been developed, but all so far have been designed for relatively short distances. The majority of this fuel is produced using a technique called steam reforming, this uses fossil fossils such as methane or natural gas and is therefore quite carbon intensive. It is, however, quite a mature technique and has a relatively high efficiency, thus the resistance to change (McKinlay, Turnock and Hudson, 2020).

It is possible, though, to produce emission free hydrogen using electrolysis with electricity from renewable sources. Electrolysis technology has developed considerably in recent years, with several sources suggesting that the PEM electrolyser should now be considered commercially viable (McKinlay, Turnock and Hudson, 2020). The different production types of renewable hydrogen are shown in Table 40.

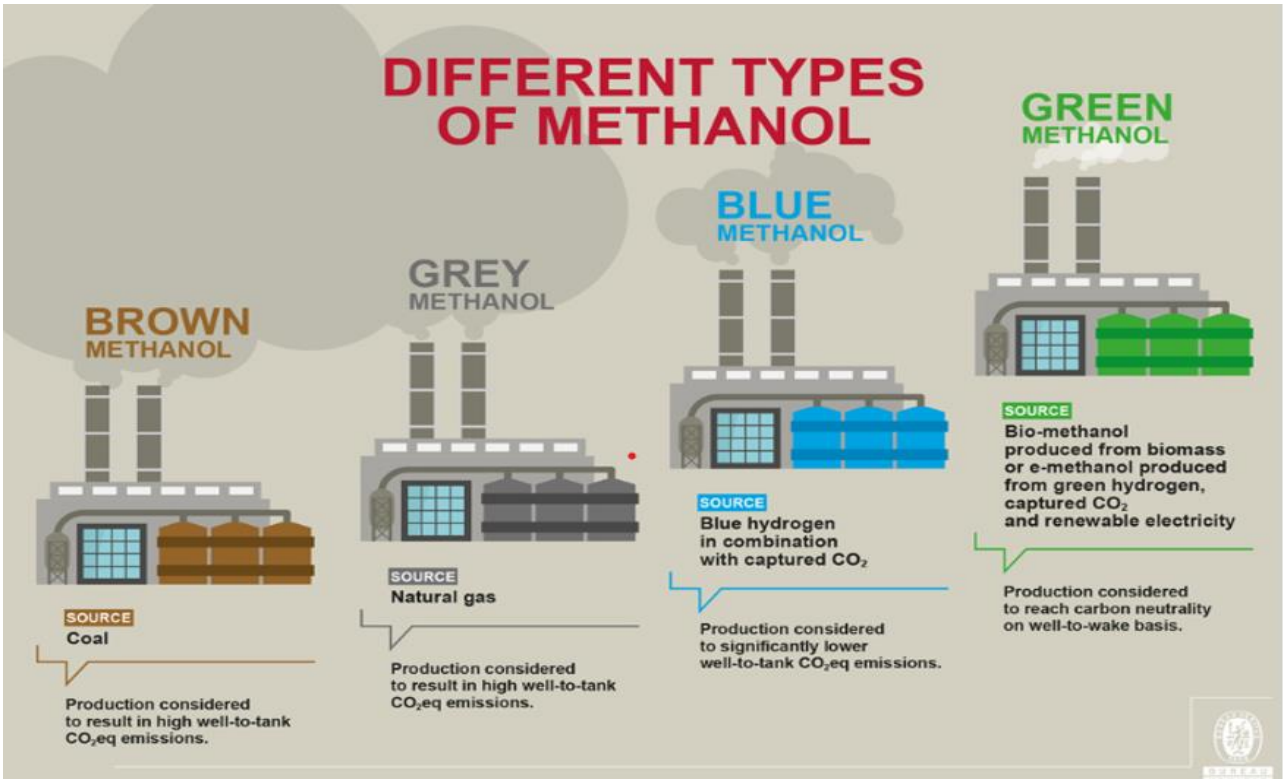


Figure 17 Different ways of producing methanol. Source: Bureau Veritas Marine & Offshore.

Table 40 Types of hydrogen production. Source: Magnusson and Murphy-Canella, 2021.

Fuel	Origin
Brown hydrogen	is produced from coal
Grey hydrogen	is produced from methane
Blue hydrogen	is produced using grey hydrogen but also uses CCS technology to capture and store CO_2
Green hydrogen	is produced using renewable energy and electrolysis to split water

Globally, H_2 is mainly produced through reforming NG, which produces high quantities of CO_2. This method is known as steam methane reforming, which produces grey H2. When the CO_2 is captured, it is called blue H_2. Green H_2 produced from renewable energy through the process of electrolysis is the only viable option as an alternative shipping fuel, as it produces net-zero life cycle emissions. Avoiding the use of grey H_2 is essential because it is not in line with sustainability goals, it uses non-renewable resources, and it is not carbon neutral (IRENA, 2021).

Currently the main global application of hydrogen is to produce ammonia, accounting for around 53% (26.5 billion kg) of total usage. This ammonia is mainly used for fertilization though. Therefore, production and distribution of hydrogen would have to increase; Some estimates predict a scale-up of three times the current production of H2 is needed to supply the shipping sector alone with fuel. (McKinlay, Turnock and Hudson, 2020; IRENA, 2021).

H_2 will play a significant role in the shipping sector in the near future through indirect use, which allows for the development of renewable fuels from green H_2. Direct use through H_2 FCs and ICEs will play a minor role in deep-sea shipping, but there are opportunities to use H_2 in short-distance shipping (IRENA, 2021).

Ammonia

The volumetric energy density of ammonia is 150% that of liquid hydrogen and these hydrogen densities can be achieved under near ambient storage conditions. Furthermore, ammonia has lower explosive limits in air than pure hydrogen. This substance is classified accordingly to the carbon emission resulting from production into "brown", "grey", "blue" and "green" ammonia, however, despite the different methods, the final NH_3 product is the same. Yet, the most common method of producing ammonia is through hydrogen from fossil fuels. Nevertheless, the most sustainable and zero-carbon production methods for a clean energy shift include blue and green production methods (Ash and Scarbrough, 2019; Magnusson and Murphy-Canella, 2021).

In Figure 18 the green ammonia production process is shown. According to Ash and Scarbrough (2019), in the traditional method, hydrogen is obtained from carbon-based feedstocks like natural gas, oil or coal. However, the green ammonia process uses the electrolysers to separate hydrogen atoms from oxygen atoms within water. The Haber-Bosch process is the most common method for producing ammonia from hydrogen and nitrogen on an industrial scale and is well understood. It is used in the traditional (fossil-fuelled) and the green ammonia production processes. The Haber-Bosch process involves an exothermic reaction, as it creates heat, that works best when it continues uninterrupted, so it is not amenable to frequent stopping and starting. The Haber-Bosch process only represents about 6% of the electricity demand of a typical green ammonia plant, while the

electrolysers consume about 92%. Nevertheless, nitrogen is usually harvested from air using an air separation unit, which is also an established technology that is used in the traditional and green ammonia production techniques

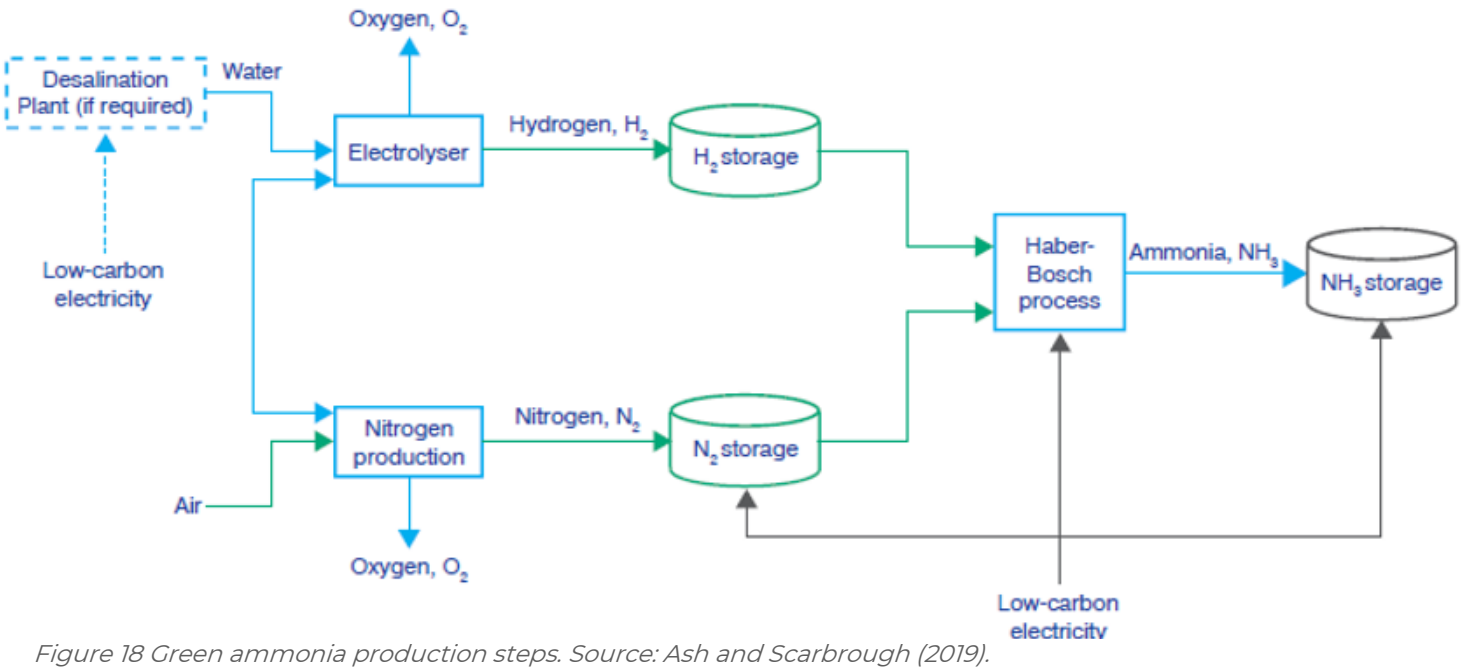


Figure 18 Green ammonia production steps. Source: Ash and Scarbrough (2019).

These characteristics give them high operational flexibility, which is well suited to renewable electricity with fluctuating output. Also, a desalination plant can be incorporated, which is useful for the marine fuel application because the ammonia plants are likely to be located close to seawater ports. A hypothetical green ammonia plant is show in Figure 19.

This fuel can be used for storing and transporting chemical energy, releasing energy directly or through the decomposition of ammonia to release hydrogen, where the resulting hydrogen or the combination of ammonia and hydrogen then reacts with oxygen in the air to release energy; as a transportation fuel by combustion in engines or by chemically reacting with oxygen in a fuel cell to produce electricity; and for storing thermal energy by capturing the energy in the transformation of phase changes from solid to liquid and gas (Magnusson and Murphy-Canella, 2021).

Currently there are no regulations addressing the use of ammonia as fuel, and as there is an ongoing process for IMO to define NH_3 as a fuel, there are currently no regulations for NH_3 bunkering. Within a few years, it is expected that ammonia can both be burned directly in an internal combustion engine and to be used in fuel cells (Magnusson and Murphy-Canella, 2021).

For use in fuel cells, ammonia must be reconstituted into hydrogen to be used in

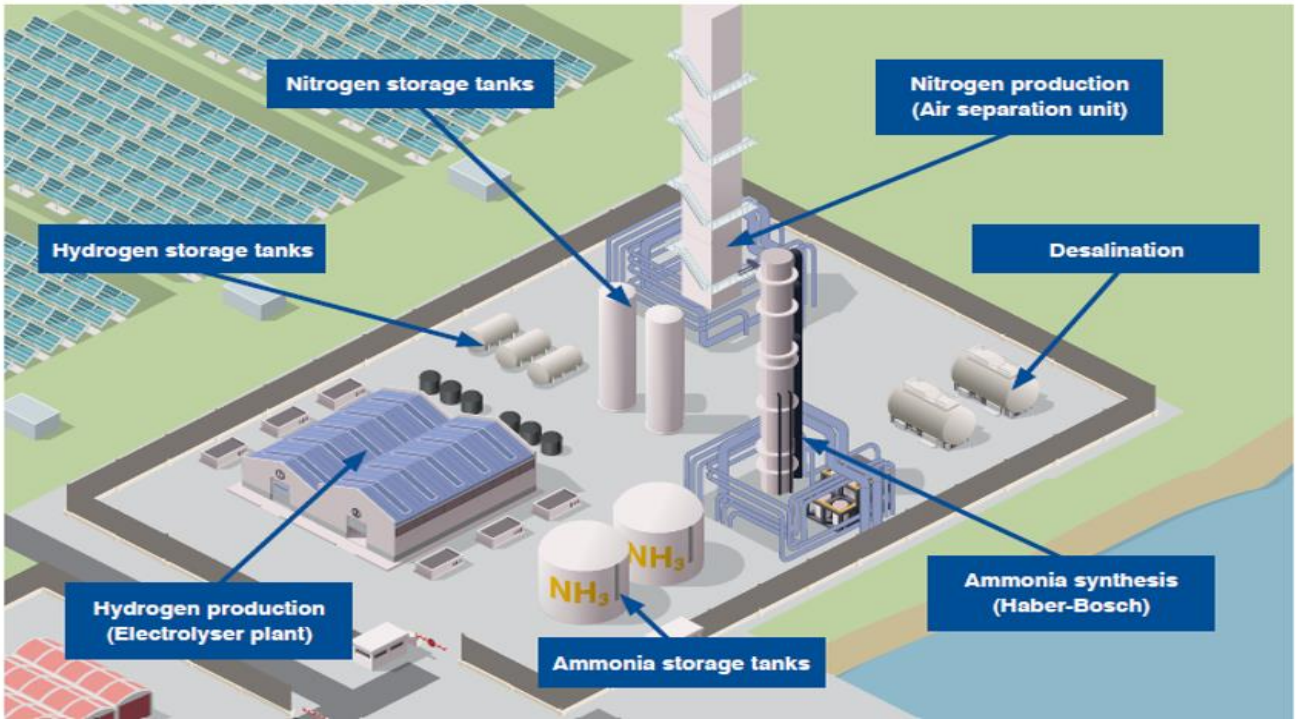


Figure 19 Hypothetical green ammonia plant. Source: Ash and Scarbrough (2019).

low-temperature fuel cells. While still in the infancy of the development and commercialization of fuel cells, today's fuel cells use hydrogen stored in ammonia. As NH_3 is yet to be adopted as a marine fuel at scale, industry experts believe that the technologies under development should be demonstrated within a few years (Magnusson and Murphy-Canella, 2021).

Other alternatives

Solar panels

Solar panels – which are cheap to produce and easy to install – are now being fitted onboard vessels, enabling ships to run on solar energy. At this stage, however, there are some drawbacks, most notably around efficiency. Ships that run on solar energy have yet to achieve speeds beyond 5 knots, and vessels must have a secondary energy source available outside of daylight hours. While solar energy may be a workable solution for smaller and inland vessels, it will likely need to be combined with other onboard technologies for use on larger vessels (Bureau Veritas Marine & Offshore, 2021).

Wind-assisted propulsion systems

Wind-assisted propulsion is the practice of decreasing the fuel consumption of a vessel using sails or some other wind capture device. The thrust required to propel the ship through the water comes from combining this device with the ship's engine. This reduces the amount of effective propulsion power needed to achieve a given speed. Although wind-assisted propulsion technology is nowadays mostly used for large yachts, marine stakeholders are interested in applying it for sails cargo and containers ship in the future (Díaz, 2020; Bureau Veritas Marine & Offshore, 2021).

According to Díaz (2020) the main advantages of wind-assisted propulsion are the following:

- Reduces fuel consumption, thus reducing CO_2 and other air pollutant emissions;
- This fuel reduction also leads to economical savings;
- For reduced engine powers, wind power maintains ship speed saving fuel;
- For bigger engine powers, wind power increases ship speed, thus reducing voyage times.

- Increases ship profitability.
- Wind, as the green power source, has demonstrated more savings in maritime transport.

These propulsion systems can be rotating sails, kite sails, Flettner rotors, marine wind turbines, rigid sails (or wingsails), etc. installed onboard (Díaz, 2020; Bureau Veritas Marine & Offshore, 2021). In XX some examples are shown. The wind power technology installed onboard should consider which system fits the vessel better accordingly, for instance, to its route, port destination, amount of money saved, legislation and technology already available aboard.

However, IMO has recognized wind assisted propulsion technology and its potential impact on energy savings and has included the effects of wind propulsion into the Energy Efficiency Design Index (EEDI) calculation in MEPC.1/Circ. 815, in which wind assisted propulsion technology is considered a method of reducing main engine power requirements. Thus, a to-be-consider limitation for the implementation of wind propulsion systems is that the vessels would need to come or suitable for a routing technology that enables the vessel to change direction accordingly to the wind (Bureau Veritas Marine & Offshore, 2021).

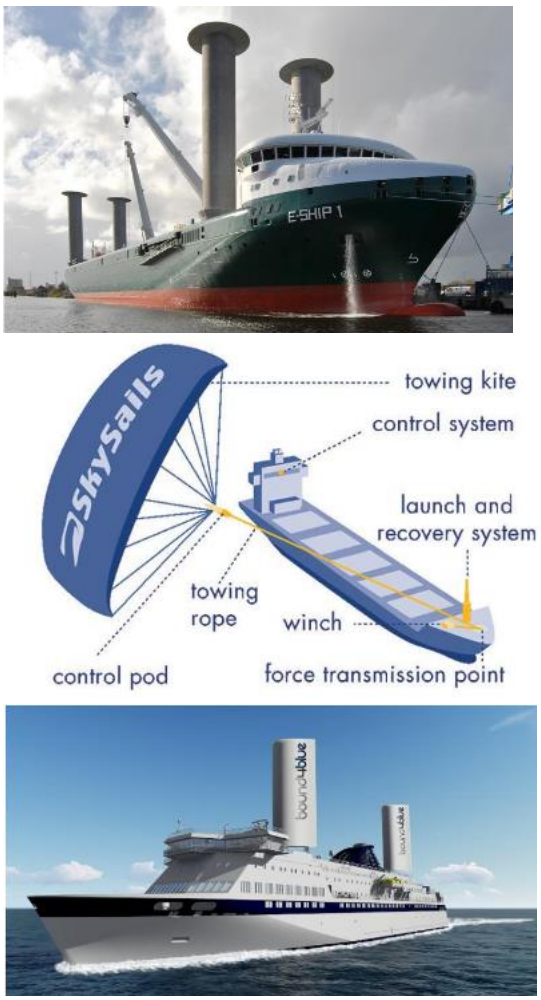


Figure 20Examples of wind propulsion systems. Extracted from: Díaz, 2020.

Nuclear-powered systems

Nuclear energy, meanwhile, is another lesser-known possibility for alternative propulsion, one that has already been used for naval and cargo ships. By placing a small nuclear reactor onboard, ships can run on electricity produced by the turbines, offering a carbon-free energy source. While this is a strong solution from a sustainability perspective, nuclear-powered vessels come with many challenges. First, building and installing a reactor onboard is costly, requiring high CAPEX investments. Second, safety is a key concern for crewmembers, who need specific training to handle everyday operations. Finally, the uranium powering the reactor must be replaced every five years, making it a high-maintenance energy source (Bureau Veritas Marine & Offshore, 2021).

Innovative projects in the Spanish maritime sector

Onshore Power SUpply (OPS) MASTER PLAN FOR SPANISH PORTS

As part of the National Action Framework for the development of infrastructures for the use of alternative fuels in the transport sector, in compliance with Article 13 of Directive 2014/94 EU, the Project 2015-EU-TM-0417 OPS Master Plan was **developed to supply Spanish Ports with electric power** at berth. The three-year-long project was concluded on the 31st of December of 2021; approximately 4.4 million euros were invested, and 1.2 million euros were co-financed by CEF (Connecting Europe Facitily) program for the construction of the Europen Union's Trans-European Transport Networks (TEN-T) (OPS Master Plan Spanish Ports, n.d).

It counted with five activities, such as Project Management, Cross Sectional Studies, Technical studies for OPS Pilots, OPS Master Plan, and Communication and Dissemination of knowledge. The Project was coordinated by Puertos del Estado and involved expertise and specialization of maritime intelligence consultancy firms and several academic institutions.

The OPS Master Plan aimed on reducing GHG emission and generating cleaner air and less noise pollution for the port-city environment. The OPS Pilot Technical Studies' objectives were to identify strategic keys and Spanish ports where onshore power can be supplied to berth for ships, to then be able to transfer the knowledge to other ports facilities in Spain. Detailed information related to the pilot ports is described in Table 41.

Table 41 OPS Pilot Ports to develop technical studies.

Pilot Project	Pilot Project short description
Canary Islands	Port Authority of Tenerife approved the implementation of OPS in Santa Cruz de Tenerife, Santa Cruz de La Palma and Sán Sebastián de La Gomera together with passengers and cargo line of Fred Olsen. The Port Authority of Las Palmas (Gran Canaria) may also supply electricity to these type of vessels.
Palma de Mallorca - Barcelona	Balearic Port Authority and Port Authority of Barcelona will offer power OPS in two berths in Palama and Barcelona Ports respectively to the DIMONIOS ship from ACCIONA-TRANSMEDITERRANEA. The supply be at 60 Hz and 6.6 kV, where the eletro-mechanical equipment will be supplied by ENDESA.
Pasaia Port	The Port Authority of Pasaia will offer OPS at its Roll on Roll off (ro-ro) vehicles specialized berth. Together with UECC shipping line, three similar vessels were adapted for the cable handling equipment to supply the electric power at 60 Hz and 6.6 kV by Iberdrola.

According to the OPS Master Plan, the perks of connecting ships to electric power at berth were:

- Avoid impacts of noise and vibration to population who lives in the Port/berth surroundings.
- Remove local pollution affecting health and quality of life of said population.
- Reducing CO2 emissions, contributing to decarbonization of economy.
- Become driver for facilitating other alternative fuels like hydrogen, methanol, and ammonia.
- Bring electric power close to the coastal facilities where other activities take place with same need of clean energy like electric cars and buses.

And the measures adopted to overcome the barriers so that the plan of the new facilities are easier executed were:

- APLICABLE: Legal framework for OPS provision by PPAA at RD Ley 15/2018; 50 % discount on port fees granted to ships using OPS; elimination of electricity tax 5 % –> 0,5 €/MWh; subvention of 9.6 Euros/CO2 ton not released at berth into the atmosphere.

In Figure 21, a table extracted from the OPS Master Plan for Spanish Ports webpage shows the most convenient ports to install OPS facilities. Ideally, for 2029 the three types of fleets (ferris Roll on Roll off, container and cruisers) should have connection for OPS, and the achievements of the OPS Master Plan for Spanish Ports will be revised in 2025. This is in alignment with the Directive 2014/94/EU of the European Parliament and the Council that stated "Member States shall ensure that the need for shore-side electricity supply for inland waterway vessels and seagoing ships in maritime and inland ports is assessed in their national policy frameworks. Such shore-side electricity supply shall be installed as a priority in ports of the TEN-T Core Network, and in other ports, by 31 December 2025, unless there is no demand and the costs are disproportionate to the benefits, including environmental benefits.".

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Promotor	Port	Terminal	Fleet				Available								
			Ferris ro-ro ...	Container	Cruisers	Others	2021	2022	2023	2024	2025	2026	2027	2028	2029
AP	Algeciras	APM		√						√					
AP	Algeciras	TTI		√						√					
AP	Algeciras	La Galera: berths 7 & 8	√							√					
AP	Tafira	Tanger: berths 2 & 3	√						√						
AP	Alicante	Terminales 11,13,15,y 17	√	√		√			√						
AP	Almería	Muelle nº6	√				√								
AP	Barcelona	BEST		√					√						
AP	Barcelona	San Beltrán	√						√						
AP	Bilbao	Espigón Central	√							√					
AP	Bilbao	Contenedores		√						√					
AP	Bilbao	Cruceros			√					√					
Privado	Cádiz	Alfonso XIII-Reina Sofia - Ciudad			√						√				
Privado	Castellón	Costa Sur				√				√					
AP	Motril	Pasajeros	√				√								
Privado	Pasaia	Capuchinos	√							√					
AP	Sevilla	El Centenario	√							√					
Privado	Valencia	MSC		√						√					
Privado	Valencia	Pasajeros	√		√						√				
AP	Palma de Mallorca	Paraires	√				√								
Privado	Ibiza		√							√					
Privado	Formentera		√							√					
AP	Las Palmas	Antiguo Muelle de la Pesca				√	√								
AP	Las Palmas	Muelle Grande				√				√					
AP	Sta. Cruz La Palma	Adosado dique	√				√								
AP	SS Gomera	Adosado dique	√				√								
AP	Sta. Cruz Tenerife	Pasajeros	√				√								
AP	Sta. Cruz Tenerife	Pantalán	√				√								
AP	Melilla	Sur	√							√					
AP	Melilla	Pasajeros	√				√								

Figure 21 List of onshore power OPS facilities for ships included in the OPS MASTERPLAN for Spanish Ports

- APPROVED: Electric grid fee on power 'a prorrata' on daily/hourly basis (OJ 24/01/2020).
- IMPLEMENTED: Granting 'extra points' to tenders including OPS for new terminals.
- PROPOSED: Exemption of port fees on land that is occupied by conduits, etc.

Besides the electric power supply, the **OPS Master Plan Coordinator have participated and assisted test with H2 fuel cell generator to power Punta Salinas at berth in Santa Cruz de Tenerife.** The vessel is owned by SASEMAR. Puertos del Estado granted a contract to company SGS for technical assistance certify CE marking of this 100 kW electric generator. OPS at berth to Punta Salinas with H2 fuel cell pilot resulted from collaboration between EVERYWH2ERE and OPS Master Plan for Spanish ports project, both financed by the European Union.

A total of 20 GW of new green power capacity will be generated until 2025 to meet PNIEC (National Integrated Plan for Energy and Climate, explanation to follow) objectives - which aims at zero emissions in ports -, and **the requirements of the Fit for 55 package**.

Electricity transport network Plan 2021-2026

As part of the PNIEC (Plan Nacional Integrado de Energía y Clima, or National Integrated Plan for Energy and Climate), which is the plan for achieving the Spanish national objectives proposed in article 3 of the 121/000019 Proyecto de Ley de cambio climático y transición energética , the Eletricity Transport Network Plan is established to be running from 2021 to 2026. The PNIEC **will run from 2021 to 2030 and it should include the national contribution for GHG emission, energetic efficiency improvements and the increase of renewable energy power in the final energy consumption share.**

As it for other Member States of EU, this Spanish National Plan, ensures EU community is coherently behaving towards the objectives and goals with the Paris Agreement (Gobierno de España, Ministerio para la Transición Ecológica y el Reto Demográfico, n.d). Farther reading about the PNIEC can be found on the Annex 1. PNIEC 2021 – 2030.

Regarding Electricity Transport Network Plan, almost seven million of euros were invested and it was officially adopted in April 2022 . BOE n° 93 de 2021 establishes the guiding principles on which planning should be based, such as:

- Compliance with the commitments on energy and climate will be specify at the national level in the PNIEC 2021-2030.
- The maximization of renewable penetration in the electrical system, minimizing the risk of spills, and in a way that is compatible with the safety of the electric system.
- The movement of renewable energy in those areas where there are high renewable resources, and it is environmentally possible to exploit and transport of the generated energy.
- The contribution, about the electricity transmission network, to guarantee the security of supply of the electrical system.
- The compatibility of the development of the electricity transport network with the environmental restrictions. The elimination of existing technical restrictions in the transportation network of electricity.
- Compliance with the principles of economic efficiency and the principle of economic and financial sustainability of the electricity system.
- The maximization of the use of the existing network, renewing, expanding capacity, using new technologies and reusing the uses of the facilities existing.
- The reduction of losses for the transport of electrical energy to the centers of consumption.

Related to the maritime sector, the draft planning document assumes **maritime ports electrification together with transition to electric vehicles, rail infrastructure electrification,** and high-speed electrification play key role for decarbonization of transport

of passengers and cargo. Planning of the transport network for 2021-26 will allow (OPS Master Plan Spanish Ports, n.d):

- Extensive incorporation of new generation of renewables at a pace required and set by PNIEC in the medium and long term.
- Maintain level and improve security of supply by Spanish electrical system as set by applicable regulations.
- Satisfy new demand needs including those associated with the electrical connection of transport infrastructure such as rail or maritime ports.
- Overcome grid technical constraints affecting programming of power generation.
- Satisfy technical needs associated with international and isolated territories connections to the grid in the Peninsula.

LNGHIVE2

The LNGHIVE2 Global Project is part of an initiative for the Liquefied Natura Gas (LNG) marine fuel market development in Spain. It is one of the National Action Framework for Alternative Energies in Transport measures approved by the Council of Ministers in December 2016. It aims to comply with Directive 2014/94 of the European Commission, which represents a clear commitment to the use of alternative fuels in the transport sector, which is expected to run until 2022. The project counts with a total investment in the project will be around 14 million euros, of which close to three million euros will be financed by European funds. (Enagas, 2018).

This is a project co-financed by the EU through the CEF facility coordinated by Enagás, and spearheaded by the shipping company Knutsen OAS Shipping AS, Port de Barcelona and Scale Gas, a subsidiary of Enagás. The initiative also features the participation of six other partners: the Port Authority of Huelva, RENFE Mercancías, ADIF, Saggas, Marflet Marine, and the Valenciaport Foundation (LNGHIVE2 Infrastructure and Logistics solutions, 2022; LNG, n.d.).

The Action aims at offering holistic solutions to the new requirements of the shipping industry, as well as the rail sector. The main benefit will be in terms of completion of the adaptation of all LNG regasification plants in Spain and ensuring that all sizes of bunkering barges and ships can load LNG at Spanish plants. A ship will be built at the Armon Shipyard in Gijón and once operational - scheduled for 2022 -, it will be chartered by Shell España SA and will use the LNG terminal that Enagás has at Barcelona Port for the loading and subsequent supply of LNG to ships docking at the port or making refuelling stops before continuing their route. This will allow Spain to consolidate its position as a European benchmark in LNG bunkering (Enagás, 2021; LNGHIVE2 Infrastructure and Logistics solutions, 2022).

According to the European Commission webpage, the project foresees the adaptation of the LNG regasification plants in Huelva and Valencia to offer bunkering and small-scale services and the introduction of LNG fuel in a maritime-rail green corridor between the Port of Huelva and the dry port of Seville by retrofitting a diesel-hauled locomotive to LNG and building a LNG station. The Action also foresees the installation of a multi-truck to ship system to provide efficient LNG bunkering services in Huelva port.

HyDeal España

HyDeal España is the first industrial implementation of the HyDeal Ambition platform. Officially incorporated as an industrial joint venture on January 10th, 2022 following a one-year feasibility study, HyDeal España will manage the development, funding and construction of green hydrogen production and transmission infrastructures. Anchor sponsors include Enagás Renovables and DH2 Energy (project development), Enagás (transmission and storage) as well as ArcelorMittal and Fertiberia (industrial

applications) as well as Soladvent (management).

HyDeal España will supply an industrial complex in Asturias from facilities based in Northern Spain at a price competitive with fossil fuels. Production will start in 2025 and total installed capacity will reach 9.5 GW of solar power and 7.4 GW of electrolyzers by 2030. The project also features the establishment of an electrolyzer gigafactory. ArcelorMittal and Fertiberia – together with other large off-takers set to join the project - will commit to purchasing 6.6 million tons of green hydrogen over 20 years.

Mass-scale green hydrogen will be able to replace fossil fuels in industry, energy and mobility and provide Spain with a domestically produced, secure, competitive and zero-carbon energy alternative. Spain's green energy transformation is at a tipping point, bringing about industrial revival and sustainable jobs in collaboration with local communities, fulfilling the ambitions of its government to make the country a global pioneer, in line with Europe's Fit for 55 agenda. Furthermore, HyDeal España will enable the production of green steel, green fertilizers, and other zero-carbon industrial and energy products, positioning its sponsor companies as European leaders on their respective markets.

Digital Twins for Green Shipping (DG4GS) – Fundación Valenciaport

The Fundación Valenciaport is participating in the Digital twins for Green Shipping Project (DT4GS), an initiative to apply the digital twin technology in the maritime transport sector and to contribute to improving its efficiency and reducing carbon emissions by 20% in 2026. The project aim is to develop digital twin realistic representations of ships, to be then tested and validates in four Living Labs with different ship types (tankers, containers, bulk carriers and ROPAX) looking forward optimizing processes from navigation to energy management. Research will focus on applying the technology to the entire lifecycle of ships and will contribute towards the Fit for

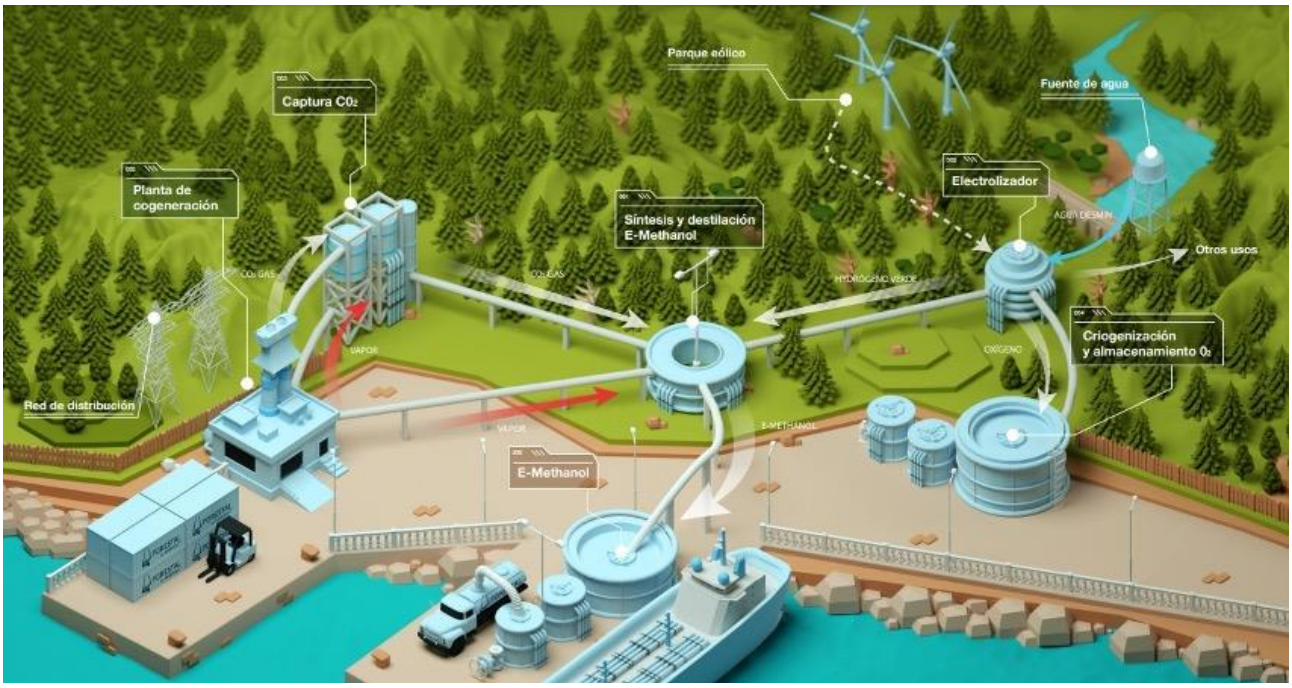

Figure 22 Project Triskelion Biomethanol production plant facilities from Forestal del Atlántico. Source: Renewable Energy Magazine, 2022.

55 package goals (Fundación Valenciaport, 2022; AOHNA, 2022).

Coordinated by Inlecom, with partners such as Fundación Valenciport and its spin-off SEAPort Solutions, the project counts with a total of 22 partners from nine countries (Italy, Belgium, France, The Netherlands, Poland, Greece, Spain, Ireland and Cyprus) and has the duration of 36 months, starting from June 2022. The Spanish foundation will participate actively as the Living Labs work package coordinator, which is fundamental to feed back the digital model. It will as well drive the project's cluster and define the collaborative models with ports and other stakeholders in the sector (Fundación Valenciaport, 2022).

Triskelión Project - Murgados, a coruña

The Project Triskelión, which consists of the production of green methanol, obtained from atmospheric CO_2, for selling it as raw material to produce biofuels, as the biofuel itself or as raw material for the chemical sector. The project, from the galician company *Forestal del Atlántico*, counts with financial investments of the Innovation Found and the Next Generation Funds, summing up to approximately 130 million euros. The company also estimates the creation of 200 new jobs during the construction phase, and around 120 direct or indirect jobs related to the green methanol production itself (Renewable Energy Magazine [1] [2], 2022).

The Project counts with several technical units, as seen in Figure 22, such as the electrolysis unity, the oxygen storage unity, cogeneration plant, the CO_2 capturing plant and the methanol synthesis and distillation plant (Renewable Energy Magazine [1], 2022). The plant is predicted to be finished by 2025 and the aim is to produce around 40.000 ton per year of green methanol from carbon dioxide captured from the atmosphere in the already existent company's facilities located in Punta Promontoiro in Murgados, Puerto Ferrol, A Coruña (Renewable Energy Magazine [2], 2022).

The project also considers the production of green hydrogen from renewable electric energy and obtaining, in the process, oxygen, which will be liquefied and stored for future sales. In addition to the green methanol production, the facilities built in the scope of Triskelión Project will produce approximately 60.000 ton of oxygen per year (Renewable Energy Magazine [2], 2022).

To obtain the green methanol, the CO_2 capturing plant will treat the emissions from the existent company's cogeneration plant, which will prevent the emission to the atmosphere of 50.000 tons of CO_2 yearly. Also, the green hydrogen plant will be used in the green methanol production process. The biofuel will then be used for the company's own processes and will be sold, being able to substitute the methanol obtained from fossil fuels (Renewable Energy Magazine [2], 2022).

Some recommendations and conclusions

As it is has been highlighted in this document, there is an increasing concern about the situation and the future of the climate in the world. The forecasts of an increase of the global temperature force to every institutions and governments to work for reducing the emissions of GHG.

The European Union wants to lead this process and it has set ambitious objective in the Green Deal where maritime transport is also involved. In this sense, it is fundamental to establish what are the main incentives to achieve the transition of a fuel based industry to a greener one.

The policies can be summarized into two main ones:

- Public Policies based on market schemes.
- Introduction of a tax policy penalizing the use of traditional fuel and subsidizing the green oil.
- To incorporate the maritime in the ETS System is also a market policy because it allows to internalize the environmental costs associated to the emissions of pollutants.
- Public Policies based on regulation

Moreover, it is important to incentivize the growth and the investment in "green" fuel research and development because one of the main problems is the long periods of amortization of investments in ships. This is the main reason why the process in the reduction of emissions has been low despite the role of industry in producing carbon emissions.

The technological changes to achieve the desired transitions is almost ready to be massive implemented but, there are always resistances because of two main reasons. On one hand, the needs of investments by the operators are huge. On the other hand, the risk of being less competitive than the traditional operators because of the overcosts of the greener option.

At the same time, the real situation is that the level of implementation is scarce and that the national government has not an specific plan for the green maritime transport without considering the funds of the National Plan of Resilience. However, the subordination of the regulatory framework to the European one forces to the national government to adopt the Directives and the legislation that is in progress at European level.

Moreover, Spain has signed all the international agreements and it is member of the International Maritime Organization. This fact implies that the set of objectives set by the IMO, the FuelMaritime UE or the European Green Deal imply directly to the National and Regional Governments.

Another aspect to consider is that the national port system allows an important degree of autonomy to the different Port Authority and hence, the levels of implementation of alternative fuels or the policies of sustainability depend widely on the Port Authority Plans. In this sense, there is also a lack of public information of the future plans of the green investment and sustainability plans at port level that allows clearly to define the objectives of the different Port Authority and the degree of compliance.

However, this report collects the main initiatives in the Spanish Port System regarding to alternative and green sources of energy. In this sense, it is important to highlight the only global programs that are under consideration. On one hand, PERTE NAVAL and the plan of incentives to subsidy indirectly the carries and the maritime lines and, on the other hand, the OPS Master Plan whose main goal is to electrify the berks.

Moreover, this report is also a brief and useful guide of the steps to follow in order to create green business and to participate in public tenders, that is the main reason why it is included two Annexes with the basic steps to participate in public tenders and some businesses contacts that are an important part of the Port Systems.

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Annex 1

Process of Public Tenders in Spain.

Public Tenders and Procument Procedures are a basic for any international company which wants to expand the business in its particular sector, in our case the maritime sector.
In the case of Spain, the Public Sector Contract Law (law 9/2017) is the one that regulate all the procedures and obligation for public contracts and it includes the following aspects:

- The publication in the Contractor's Profile is mandatory for all tenders except those procedures which do not require publicity. In this sense, it is basic to follow the Plataforma de Contratacion (www.contrataciondelestado.es) that is the public website where the announcements will be published:
- It is basic to understand that the call for all tenders must be published on the Public Sector Contracting Platform, regardless of whether the Autonomous Communities and their instrumental entities have their own profile or web to contract with third parties.
- The terms begin to compute from the publication on the Internet of the aforementioned platform.

Another important aspect is that public sector contracts may be awarded only to natural or legal persons with full legal capacity, whether from Spain or abroad, that are not excluded from procurement procedures and can prove their economic and financial standing, and technical or professional standing, or, where required by this Law, are duly classified.
Legal persons may be awarded a contract only where performance of that contract is, according to their articles of association or founding rules, included within their purpose, objects or field of activity.

Regarding to the exclusion from procurement procedures, the grounds for exclusion from procurement procedures are very diverse and cover reasons such as criminal convictions for certain offences, administrative penalties for particular infringements, bankruptcy or insolvency proceedings, or having caused the termination of a previous public contract.

With relation to standing and classification, economic and financial standing may be established by the means laid down by law and set out in the specifications or by means of the relevant certificate of classification as a works contractor or service provider, registered in the Official Register of Tenderers and Classified Undertakings (ROLECE).

For works contracts with an estimated value of EUR 500 000 or more, the contractor must be duly classified as a works contractor by the contracting authority. For those with an estimated value of less than EUR 500 000, the classification of the undertaking will attest to its economic, financial and technical standing to enter into a contract.

For service contracts, classification of the undertaking is not required. However, the undertaking may establish its standing either by means of its classification or by proving that it fulfils the specific standing requirements.

To obtain a classification certificate it is necessary to submit the relevant application to the body responsible for the Official Register of Tenderers and Classified Undertakings (ROLECE), which will process it as quickly as possible.

The process of the tender must usually follow these steps:

- Previous Announcement
- Published
- Previous Evaluation
- Awarded Evaluation
- Provisional Awarded
- Resolved.

The duration of each step depends crutially on the contract and it regulated under the Law 9/2017 previously mentioned.
Considering the subject of this report, there is a list with the main tenders in the last year to understand as an example the commercial opportunities which may appear at the www.contrataciondelestado.es

- **Title: Improvement of energy efficiency in the market**
  - Name of the entity: Autoridad Portuaria de Vigo
  - Web: https://contrataciondelestado.es/wps/wcm/connect/1336d3ae-99f0-408c-bb42-6e8295e63d82/DOC_CN2022-988282.pdf?MOD=AJPERES
  - Status: Resolved.
  - Price: 961.348,76 euros
  - Date: 24/07/2022

- **Title: Technical Assistance for the study of photovoltaic power generation capacity**
  - Name of the entity: Autoridad Portuaria de Melilla
  - Web: https://contrataciondelestado.es/wps/wcm/connect/9f1dedf6-b240-4505-ada3-a7676d3bbf76/DOC_CN2022-724601.pdf?MOD=AJPERES
  - Status: Resolved
  - Price: 15.470,00 euros
  - Date: 06/05/2022

- **Title: Supply of natural gas to the facilities of the Port Authority of Valencia**
  - Name of the entity: Autoridad Portuaria de Valencia
  - Web: https://contrataciondelestado.es/wps/wcm/connect/46157888-cc08-42c8-9302-e5a7c1541724/DOC_CN2022-976598.pdf?MOD=AJPERES
  - Status: Resolved (No bids)
  - Price: 12.000,00 euros
  - Date: 20/07/2022

- **Title: Installation of photovoltaic energy in the car park next to the Malaga Port Authority building**
  - Name of the entity: Autoridad Portuaria de Málaga
  - Web: https://contrataciondelestado.es/wps/wcm/connect/c7bd1d1a-8cbf-4ddf-bf89-dbc7b92d1978/DOC_CN2021-135860.pdf?MOD=AJPERES
  - Status: Resolved
  - Price: 612.235,48 euros
  - Date: 29/07/2022
- **Title: Supply of liquefied natural gas (LNG) for the facilities of the new secondary inspection area (ZIS)**
  - Name of the entity: Autoridad Portuaria de Barcelona

  - Web: https://contrataciondelestado.es/wps/wcm/connect/2ef23251-9c97-49d8-9f87-1373870700fd/DOC_CN2022-362798.pdf?MOD=AJPERES
  - Status: Announced
  - Price: 400.000,00 euros
  - Date: 16/10/2022

- **Title: Drafting service of the preliminary project or basic project for the construction of a substation in the Port of Malaga and the implementation of OPS (On-Shore Power Supply) systems for energy supply to ships in port (Cold Ironing) that contribute to the decarbonisation of the Port from Malaga**
  - Name of the entity: Autoridad Portuaria de Málaga
  - Web: https://contrataciondelestado.es/wps/wcm/connect/2ef23251-9c97-49d8-9f87-1373870700fd/DOC_CN2022-362798.pdf?MOD=AJPERES
  - Status: Announced
  - Price: 612.235,48 euros
  - Date: 14/10/2022

Annex 2

PNIEC 2021 – 2030

According to PNIEC (Plan Nacional Integrado de Energía y Clima) 2021 – 2030, which is a strategic and indicative planning for the development of the electricity transmission network in the short and medium term, the need for electricity transmission in Spain is conditioned by its forecasts of changes in the demand and supply of electricity. The Plan was officially adopted in March 2021 .

In this sense, the general objective of the PNIEC for 2030 are:

- 23% reduction in GHG emissions compared to 19903;
- 42% of renewables in the final use of energy;
- 39.5% improvement in energy efficiency;
- 74% renewable energy in electricity generation.

Whilst for specific objectives there are:

- Advance in the transition of the Spanish energy system in order to meet the objectives in terms of energy efficiency, renewable energies and climate change;
- Comply with the objectives and commitments established for 2030 in the PNIEC in terms of:
    - The reduction of emissions, participation of renewables in final consumption and energy efficiency.
    - A special effort in the electrification of final energy uses.
- Allow the massive integration of new renewable generation at the rate necessary to achieve the objectives in the medium and long term, guaranteeing the safe operation of the electricity system at the minimum cost for consumers;
- Maintain and improve the security of supply of the Spanish electricity system based on what is established in the legislation, in particular considering:
    - The reliability of the electricity transmission network.
    - The elimination of the structural technical restrictions of the transport network that cause economic inefficiencies in the system
    - International interconnection needs.
- Provide an adequate response to the needs of new demand that are identified, including those derived from the development of high-speed rail infrastructures, thus contributing to the generation of wealth, employment, and the structuring of the territory.

As delineated in the Planning, with the expected results mentioned in the general objectives, it is expected that the long-term climate neutrality on the GHG emissions in 2050 is reached. The PNIEC is divided into two large blocks:

- The first details the process, the national objectives, existing policies, and measures and those necessary to achieve the objectives of the Plan, as well as the analysis of the economic, employment, distributive and benefits impact on the health;
- The second block consists of detailing scenarios, such as a trend scenario and a specific scenario, as well as the descriptions of the different models that have made analysis possible, providing robustness to the results.

The Plan also highlights the sources of the different energy in Spain, and states that 73% of the energy came from abroad in 2017, with a dominance of the fossil fuels. As for the national production, in 2017, was produced 23 ktep of Natural Gas and 122.000 ton of crude oil, counting for, respectively, 0.09% and for 0.21% of national demand. Regarding the other energetic sources, details are shown in Table 43. The conclusion of the analysis was that Spain has one of the most diversified suppliers networks for oil and gas in the EU. Hence the importance of the energetic transition plans for building a sustainable future and to stop depending on other suppliers as much as in the present.

Table 42 Energy sources in Spain in 2017. Source: PNIEC 2021-2030 (2020).

Energy source	Description
Electricity	Spain counts with interconnections with France, Portugal and Morocco.
Natural Gas	In 2017, 53% of imports were made through gas pipelines, compared to 47% in methane tankers (in the form of Liquefied Natural Gas through regasification plants). Currently, the most relevant international gas pipelines are the Maghreb (Maghreb-Europe), Medgaz (Algeria-Almería) and the interconnections with France and Portugal. The breakdown by country of origin of natural gas imports in 2017 it was as follows: Algeria (48%), Nigerian (12%), Peru (10%), Qatar (10%), Norway (10%), and Others (10%).
Oil-bearing	The main countries of origin of crude oil in 2017: Mexico (15%), Nigerian (14%), Saudi Arabia (10%)

Annex 3

Stakeholders

An important task of this report is to identify those stackeholders who we consider essential in a process of sharing knowledge and possibilities of trade.
To get that information, the consultant team has identified and contacted with stackeholders in order to do a brief survey with a few answers to get the interest information. The brief survery contains the following questions:

1. Is your entity involved or is it part of any project or investment related to Green Maritime Transport? If the answer is yes, write a brief description of the project.
2. Has your entity a sustainability plan?
3. Do you plan to carry out a tender related to Green Maritime Transport in the coming months? If the answer is yes, determine whether it is a public investment or a public-private partnership and provide a brief description of it.

Another important was to identify the main stakeholders, this annex provides you a list of contacts:

- **AP Baleares**
  - Chief of Quality, Innovation and SRC. Jorge Martín: (jmartin@portsdebalears.com)
  - Araceli Gutiérrez (araceligutierrez@portsdebalears.com)

- **AP de Algeciras**
  - Francisco Iglesias Andrades (figlesias@apba.es)

- **AP Valencia**
  - Vice-Principal: Federico Torres Monfort (ftorres@valenciaport.com);
  - Representative of AP Valencia in the GT World Ports Climate Action Plan: Raúl Cascajo (rcascajo.externo@valenciaport.com)

- **AP Huelva**
  - Chief of Facilities and Operations: César López Martín (cesarlopez@puertohuelva.com)
  - Rocio López Picón (rlp@puertohuelva.com)

- **AP Gijón**
  - European Proyects and Development of Business: Ainhoa Puebla González (apuebla@puertogijon.es)
  - Chief of Susteinability: Mónica González Arenales (mgarenales@puertogijon.es)

- **AP Bilbao**
  - Javier Álvarez: (jaalvarez@bilbaoport.eus)
  - Ekaitz López (ekaitzl@bilbaoport.eus)
  - Julia Coppla (julia.coppla@bilbaoportlab.eus)

- **AP Vigo**
  - Chief of Susteinability: Carlos Botana (carlosbotana@apvigo.es)
  - Ignacio Velasco (ivelasco@apvigo.es)

- **AP Gran Canaria**
  - Chief of Infrastructures, Facilities and Innovation.
  - César Martín Fuentes. Tlf: +34 928.214.575. Mail: cmartin@palmasport.es

- **Spanish Ministry of Transport.**
  - National Ports Agency. Julio de La Cueva. Tlf: +34 648 977 563. Mail: jcueva@puertos.es

- **Naviera Armas – Transmediterranea**
  - Jaime Cabrera del Pino. Mail: jcabrera@naviera-armas.com

- **ANAVE**
  - Eleno Seco García-Valdecasas. Mail: eseco@anave.es

- **ACLUNAGA.**
  - Óscar Gómez. Mail: ogomez@aclunaga.es

After contacting many stakeholders and insist on the feedback, there are some of them who answer the aforementioned brief survey. In this section, we collect the answers:

AP LAS PALMAS

- **Is your entity involved or is it part of any project or investment related to Green Maritime Transport? If the answer is yes, write a brief description of the project.**

In the year 2022 the OPS facilities have been put into operation in the Port of Las Palmas, with the title: "MEDIUM AND LOW VOLTAGE INSTALLATIONS FOR ELECTRICAL SUPPLY TO SHIPS IN THE FISHING DOCK", as a pilot action within the project " Master Plan for the supply of electricity to ships mooring in Spanish ports, whose code is 2015-EU-TM-0417-S (OPS Master Plan for Spanish Ports), co-financed with the Connecting Europe Facility (CEF) program in the Transportation sector.

Description: The OPS facility in the Port of Las Palmas is located in the old Fishing Dock and serves medium-sized ships that remain docked for long stays, either to stock up or to carry out maintenance or repair operations on board. The installation consists of 16 double shots located on both sides of the Dock; all the sockets allow the supply of up to 80 kW of power, but there is one socket in each of the two alignments of the Dock that allows a maximum supply of 200 kW, which represents the maximum contracted power available; the total design power of the transformation center built where the connection voltage to the grid is lowered from 20 kV to 400 V to which the supply is delivered is 600 kW; the supply is at 50 Hz.

- **Has your entity a sustainability plan?**

The APLP has a Sustainability Plan within the entity's Strategic Plan.
At the end of 2022, the AP wants to analyze the feasibility of continuing to implement OPS (Onshore Power Supply) systems in the port of Las Palmas, for which it is necessary to globally analyze the electrical power demands of the ships, the necessary infrastructures in the docks,

the availability of energy and search for renewable solutions, analyze the operation and profitability of the installations, including the environmental benefits.

- **Do you plan to carry out a tender related to Green Maritime Transport in the coming months? If the answer is yes, determine whether it is a public investment or a public-private partnership and provide a brief description of it.**

The project "Installation of electrical supply to ships (Cold Ironing) in the Muelle Grande del Puerto de Las Palmas" project is currently in the adjudication phase.
The project is undertaken by the APLP and has funding from the EU through the Recovery, Transformation and Resilience Plan – Next GenerationEU.
Description: The installation consists mainly of equipping the Muelle Grande with six electrical outlets for supplies to ships of 350A (140kW) each and a seventh double of 350A, distributed four on the West side and three on the East side of the Big Pier.
The installation will have frequency converters for the sockets (50Hz or 60Hz), which allow feeding with one or another frequency, according to the needs of the ship.
The entire system is powered by a 630 kVA Transformation Center, which transforms electrical energy from medium voltage 20 kV to low voltage 400V.
The entire system will be controlled through the implementation of an energy supervision system, in order to be able to remotely control, monitor and automate the complete operation of the installation.

ACLUNAGA

- **Is your entity involved or is it part of any project or investment related to Green Maritime Transport? If the answer is yes, write a brief description of the project.**

The Initiative Blue Growth at Vigo Port.

- **Has your entity a sustainability plan?**

It is in progress.

- **Do you plan to carry out a tender related to Green Maritime Transport in the coming months? If the answer is yes, determine whether it is a public investment or a public-private partnership and provide a brief description of it.**

The Port of Vigo is planning to do it in the near future related to employment and energy supply.

ANAVE

- **Is your entity involved or is it part of any project or investment related to Green Maritime Transport? If the answer is yes, write a brief description of the project.**

There are no proyects in this sense where the entity is involved.

- **Has your entity a sustainability plan?**

No.

- **Do you plan to carry out a tender related to Green Maritime Transport in the coming months? If the answer is yes, determine whether it is a public investment or a public-private partnership and provide a brief description of it.**

ANAVE is an association of companies, that is why it does not participate in tenders.