EU Strategy for the Adriatic and Ionian Region
EUSAIR

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European Regional Development Fund - Instrument for Pre-Accession II Fund
EUSAIR FACILITY POINT

EUSAIR – Pillar 2

Technical Assistance for the development and implementation of the Flagship Project «Green and Smart Ports»

Final Report

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pts TPS PRO Systematica

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List of Abbreviations

5G: 5th Generation

ABP: Associated British Ports

AI: Artificial Intelligence

AIS: Automatic Information System

AMP: Alternative Maritime Power

APEC: Asia-Pacific Economic Cooperation

APSN: APEC Port Services Network

CAAP: Clean Air Action Plan

CBM: Cubic Meter

CMD: Chair Measurement Device

CMIT: Cai Mep International Terminal

CNG: Compressed Natural Gas

CNOOC: China National Offshore Oil Corporation

DC: Direct Current

DCS: District Cooling System

ECA: Emission Control Areas

EC/EDI: Electronic Commerce/Electronic Data Interchange

E- RTG: Electric Rubber-Tired Gantry Cranes

GBS: Gravity Based Structure

GHG: Greenhouse gas

GIS: Geographical Information Systems

GPAS: Green Port Award System

GPS: Global Positioning System

GSI: Guangzhou Shipbuilding International

H2PORTS: Implementing Fuel Cells and Hydrogen Technologies in Ports

HCM: Ho Chi Minh

HKGBC: Hong Kong Green Building Council

HPA: Hamburg Port Authority

IMO: International Maritime Organization

IoT: Internet of Things

JU: Joint Undertaking

Kwh: Kilowatt-hour

LBCT: Long Beach Container Terminal

LEED: Leadership in Energy and Environmental Design

LED: Light-emitting diode

LNG: Liquid Natural Gas

MPA: Montreal Port Authority

MSGI: Maritime Singapore Green Initiative

MSW: Maritime Single Window

MTTS: Multi Truck to Ship System

MW: Megawatts

NAP: New Amsterdam Water Level

NOx: Nitrogen Oxide

PAV: Port Authority of Valencia

PCS: Port Community Systems

PRA: Port of Rotterdam Authority

PSA: Port of Singapore Authority

RDM: Research, Design and Manufacturing

RTG: Rubber-Tired Gantry Cranes

Sox: Sulfur Oxides

SSP: Shore-to-Ship Power

STS: Ship-to-Shore

TCIT: Tan Cang - Cai Mep International Terminal

TEU: Twenty (foot) Equivalent Unit

TIPC: Taiwan International Ports Corporation

VTMIS: Vessel Traffic Monitoring and Information Systems

VTMIS NET: Vessel Traffic Management and Information System NETwork

WTE: Waste-to-energy

1. Introduction and objective of the study

The present Intermediate Report represents Deliverable 2 of the Study for the development and implementation of the Flagship Project «Green and Smart Ports».

On 10 June 2020, following the meeting of the EUSAIR Governing Board on the European Strategy for the Adriatic Ionian Region in the 2021-2027 programming period, the list of EUSAIR Flagships that can be supported by funding from European programming under the structural funds of the European Structural and Investments Funds and the Instrument for the Pre-Accession Assistance (IPA) pre-accession fund was defined. The list includes the initiative called "The Adriatic-Ionian Multimodal Corridors" through which the Flagship Project **"Adriatic-Ionian Green/Smart Port Hub Concept"** is supported aimed at establishing an integrated and interconnected port network from Greece to Italy that crosses all EUSAIR countries including all ports belonging to the core and global network of TEN-T Corridors involved capable of promoting sustainable development in line with the decarbonization objectives at European level with the Green Deal and the policies promoted by the development of TEN networks.

The present study has the ultimate objective of **supporting the Managing Authorities of European Programmes (mainstream and ETC) in improving their effectiveness in embedding the above-mentioned flagship by building a knowledge base on the status and outlook of initiatives in the field of "green" and "smart" projects in ports**.

2. Identification of themes within the "Green/Smart Port" concept

Since the "Green/Smart Port" concept is a broad definition that involves very different issues (from Onshore Power Supply systems to the circular economy, to the digitalization of ports with the common goal of ferrying maritime transport and the infrastructures connected to it, ports in the first place, towards a "zero emissions" system), a first step towards the ultimate objective is to give a more detailed definition of the themes that can be included in the concept and will therefore be the object of the various phases of the study.

To this end, the specific strategic objectives outlined by the European Union's recent Sustainable and Smart Mobility Strategy (whose objectives as shared by the Western Balkans' document by the same name) as concerns the maritime field are considered.

In 2021, the EU[1] and the Transport Community[2] have settled their vision for the transport system of the future and the action plan to follow. Their documents "**Sustainable and Smart Mobility Strategy**" are structured around three key objectives:

- **Sustainable Mobility**: zero-emission mobility by making all transport modes more sustainable, ensuring wide availability of the most sustainable options and giving users incentives to make sustainable choices;
- **Smart mobility**: supporting digitalization and automation to achieve seamless, safe and efficient connectivity;
- **Resilient mobility**: create a Single European Transport Area that is affordable and accessible for all citizens and businesses and resilient against possible crises and future challenges.

These objectives support the aim to deliver a 90% reduction in the transport sector's emissions by 2050. This vision includes 10 flagship areas with an action plan that will help to reach the objective.

- ***Sustainable mobility challenges***
  - Flagship 1 - Boosting uptake of zero-emission vehicles, renewable & low-carbon fuels and related infrastructure
  - Flagship 2 - Creating zero-emission airports and ports
  - Flagship 3 - Making interurban and urban mobility healthier and more sustainable
  - Flagship 4 - Greening freight transport
  - Flagship 5 - Pricing carbon and providing better incentives for users
- ***Smart mobility challenges***
  - Flagship 6 - Making connected and automated multimodal mobility a reality
  - Flagship 7 - Innovation, data and AI for smart mobility
- ***Resilient mobility challenges***
  - Flagship 8 – Working towards the single market
  - Flagship 9 - Making mobility fair and just for all
  - Flagship 10 - Enhancing transport safety and security

The themes directly concerning maritime ports included in the Strategy have been considered as the main reference to define the list of themes relevant for the present Study. Moreover, the list – presented in the following box – Is integrated with more detailed sub-themes defined on the basis of a preliminary analysis of initiatives currently being developed by Port Authorities in the region.

[1] European Commission, "Sustainable and Smart Mobility Strategy – putting European transport on track for the future", COM(2020) 789 final

[2] Transport Community, "STRATEGY FOR SUSTAINABLE AND SMART MOBILITY IN THE WESTERN BALKANS", Transport Community Treaty Permanent Secretariat – Staff Working Document, July 2021

LIST OF THEMES INCLUDED IN THE "GREEN/SMART PORT" CONCEPT

Scope	Theme
IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS	• **Improvement of the energy efficiency and reduction of emissions of vessels**, including: o Deployment of Liquid Natural Gas (LNG) fuelled vessels o Test and deployment of full electric vessels and tugs • **Creation of a comprehensive network of recharging and refuelling infrastructure**, including: o Construction of LNG depots and facilities o Deployment of LNG bunkering vessels • **Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power**, including: o Electrification of quays and deployment of onshore power supply systems (cold ironing)
PORTS AS GREEN HUBS	• **Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels**, including: o Use of renewable energy sources to feed the power system of ports and terminals o Deployment of new, more efficient port lighting systems o Creation of green hydrogen sites for production and distribution of hydrogen power o Creation of central power management systems to regulate the energy network of the port o Deployment of public charging points for electric vehicles • **Greening ground port services and operations**, including: o Deployment of low emission cranes, front-loaders and other service vehicles o Deployment of Mobile LCNG Stations serving the purposes of refuelling CNG fuelled port heavy duty vehicles and buses o Greening port spaces o Optimisation of port operations to reduce ground vehicle mobility o Deployment of innovative handling systems to reduce the impact of port operations on air pollution • **Promotion of ports as testbeds for waste reuse and the circular economy**, including: o Use of secondary materials in production and construction o Deployment of waste-to-energy facilities o Reconversion of industrial and port areas into eco-districts, exploring possibilities to set up ship decommissioning operations
SAFETY IN PORTS	• **Enhancing transport safety and security**, including: o Improvement of infrastructure resilience and deployment of measures to contain the impact of extreme weather events o Planning and implementation of measures to reduce the impact of pandemics and other sanitary emergencies
DIGITALISATION IN PORTS	• **Development of efficient capacity allocation and traffic management systems**, including: o Further deployment of Vessel Traffic Monitoring and Information Systems (VTMIS) o Deployment of solutions for enabling multimodal travel planning o Safe deployment of automated and autonomous maritime operations • **Diffusion of innovation, data and AI for smart mobility and cybersecurity, including:** o Diffusion and integration of Port Community Systems at the port, port cluster, and national levels o Diffusion of Maritime Single Window solutions and deployment of automated and paperless procedures and solutions to speed up processes (incl. custom, security, phytosanitary checks etc.) o Deployment of IT solutions for planning and management of rail traffic within the port o Diffusion of solutions involving virtualisation (digital twin), Internet of Things, Artificial Intelligence, automated/unmanned terminal operations and blockchain o Deployment of IT solutions for the improving the effectiveness of port operations, including infrastructure maintenance and waste management

3. Analysis of the regulatory and policy framework

The main purpose of this activity includes the analysis and synthesis of the regulatory framework, relevant policies and Financial instruments for the development and implementation of the Flagship Project which are strongly related to the following activities.

This is an important element as an in-depth knowledge of the political and regulatory framework is brought by 'Green and Smart' terms underlining that the development of effective solutions must be in accordance with the Regulations of the European Parliament and the Council, the EU Directives and generally the decisions including all the regulatory acts at Community level.

Alongside, the aforementioned solutions in terms of legislative and regulatory framework must be in line with each individual's nation legislation namely outlined by the border of Adriatic-Ionian Macro Region. Although that common policies and strategies have not been developed in terms of normative meaning, many initiatives and actions in common interest between the member states have been carried out by national governments with support of European Institutions.

The ordering elements of the entire regulatory Framework, both regarding legislation and financial instruments, are THEMES INCLUDED IN THE "GREEN/SMART PORT" CONCEPT.

For the Legislative and regulatory framework the SCOPE level was used:

- Improving sustainability in maritime vessel operations,
- Ports as green hubs,
- Safety in ports,
- Digitalisation in ports

For the Financial instruments framework the TOPICS level was used:

- Improvement of the energy efficiency and reduction of emissions of vessels, Creation of a comprehensive network of recharging and refueling infrastructure,
- Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power,
- Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels,
- Greening ground port services and operations,
- Promotion of ports as testbeds for waste reuse and the circular economy,
- Enhancing transport safety and security,
- Development of efficient capacity allocation and traffic management systems,
- Diffusion of innovation, data and AI for smart mobility.

The operative objective is twofold: on the one hand to support the Identification and evaluation of initiatives within the "Green/Smart Port" field and on the other to provide elements for the definition of recommendations.

3.1 Legislative and regulatory framework

For the analysis of the EU and non-EU regulatory framework it was decided to consider the main Regulatory, Policy and Strategy documents referring to the individual states belonging to the Adriatic-

Ionian Macro Region, as well as policies and strategies adopted by international organizations and transnational cooperation which are a great shift to promote the development of the Adriatic-Ionian area with respect to certain issues, as presented on Scope Themes. For the aggregation and systematization of this analysis, the Themes Scope of the Flagship Project were chosen as the ordering element.

3.1.1 UE Countries

UE			
Improving sustainability in maritime vessels operations			
REFERENCE	YEAR	TYPE	DETAILS
Regulation (EU) No 1315/2013 – Guidelines for the development of the trans-European transport network	2013	POLICY	Pag.7: "'Maritime services' means services using advanced and interoperable information technologies in the maritime transport sector to simplify administrative procedures and to facilitate the throughput of cargo at sea and in port areas, including single-window services such as the integrated maritime single window provided for in Directive 2010/65/EU of the European Parliament and of the Council (3), port community systems and relevant customs information systems"
COM(2019) 640 final - The European Green Deal	2019	STRATEGY	Pag.12: "In parallel, the Commission (nda) will consider applying European emissions trading to road transport, as a complement to existing and future CO2 emission performance standards for vehicles. It will take action in relation to maritime transport, including to regulate access of the most polluting ships to EU ports and to oblige docked ships to use shore-side electricity."
DIRECTIVE (EU) 2019/883 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - on port reception facilities for the delivery of waste from ships	2019	POLICY	Pag. 6: "The Sub-group on Port Reception Facilities, which was set up under the European Sustainable Shipping Forum, and which brought together a wide range of experts in the field of ship-source pollution and the management of waste from ships, was adjourned in December 2017 in view of the start of interinstitutional negotiations"
COM(2020) 789 final – Sustainable and Smart Mobility Strategy — putting European transport on track for the future	2020	STRATEGY	Pag.5: "4. Sustainable mobility. The EESC agrees that in order to achieve this systemic change, it takes three pillars of actions, namely: '(1) make all transport modes more sustainable"
COM(2021) 550 final – 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality	2021	POLICY	Pag.8: "New requirements for ships, regardless of their flag, arriving to or departing from EU ports, by imposing a maximum limit on the greenhouse gas content of the energy they use and making these limits more stringent over time."
COM(2021) 557 final	2021	POLICY	Pag. 24: "in order to promote the use of advanced biofuels and biogas and renewable fuels of non-biological origin in the aviation and maritime modes, which are difficult to electrify, it is appropriate to keep the multiplier for those fuels supplied in those modes when counted towards the specific targets set for those fuels."

UE			
Improving sustainability in maritime vessels operations			
REFERENCE	YEAR	TYPE	DETAILS
COM(2021) 551 final	2021	POLICY	Pag.51: "Those implementing acts shall apply the sustainability and greenhouse gas emission saving criteria for the use of biomass established by Directive (EU) 2018/2001 of the European Parliament and of the Council(*), with any necessary adjustments for application under this Directive, for this biomass to be zero-rated."
COM(2021) 559 final – on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU of the European Parliament and of the Council	2021	POLICY	Pag.5: "A broader availability of infrastructure and a faster rollout of zero- and low- emission vehicles will indirectly facilitate the deployment of clean vehicles in public fleets."
COM(2021) 560 final – A strategic rollout plan to outline a set of supplementary actions to support the rapid deployment of alternative fuels infrastructure	2021	STRATEGY	Pag.13: "the development of further specifications for electricity supply, including shore-side battery recharging points, port-to-grid communication interface in automated OPS for each technical category of vessels and battery swapping and recharging at onshore stations for inland waterways vessels"
COM/2021/812 final – repealing Regulation (EU) 1315/2013	2021	NORMATIVE	Pag.1: "The aim of the TENT Regulation is to build an effective EU-wide and multimodal network of rail, inland waterways, short sea shipping routes and roads which are linked to urban nodes, maritime and inland ports, airports and terminals across the EU" Pag.22: "Shortsea shipping can make a substantial contribution to the decarbonisation of transport by carrying more freight and passengers. The European Maritime Space should be promoted by creating or upgrading short-sea shipping routes and by developing maritime ports and their hinterland connections as to provide an efficient and sustainable integration with other modes of transport."
COM(2021) 400 final - Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'	2021	STRATEGY	Pag.8: "The proposed 'Mission Healthy Ocean, Seas Coastal and Inland Waters', will aim to support innovation and implementation of EU policies and laws, to achieve healthy, pollution-free ocean, seas and waters. The Commission will also adopt an "Inland Navigation Action Plan 2021-2027" (NAIADES III), to support a gradual modal shift towards zero emission inland waterways transport. The Commission will review the Marine Strategy Framework Directive by 2023, taking into account the state of implementation of EU laws addressing key pollution sources and the need to reduce plastic and other litter, underwater noise and contaminants. Building upon the success of the recently agreed EU threshold value on beach litter, the Commission will work with Member States on EU threshold values for maximum levels of underwater noise stemming from maritime transport, construction, dredging and other offshore activities.

UE			
Improving sustainability in maritime vessels operations			
REFERENCE	YEAR	TYPE	DETAILS
EUSAIR bringing the Green Deal to the region	2022	STRATEGY	Pag.11: "A set of indicators, with relating milestones and target values, to be monitored on an annual basis so as to verify the progress towards the reduction of EUSAIR activities' impacts on the environment and the promotion of more sustainable practices during the Strategy implementation"

UE			
Digitalisation in ports			
REFERENCE	YEAR	TYPE	DETAILS
COM(2019) 640 final – Il Green Deal Europeo – European Green Deal	2019	STRATEGY	Pag. 10: "Digitalisation also presents new opportunities for distance monitoring of air and water pollution, or for monitoring and optimising how energy and natural resources are used. […] Automated and connected multimodal mobility will play an increasing role, together with smart traffic management systems enabled by digitalisation."
DIRECTIVE (EU) 2019/883 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - on port reception facilities for the delivery of waste from ships	2019	POLICY	Pag.6: "Monitoring and enforcement should be facilitated through a system based on electronic reporting and exchange of information […] in particular the Union Maritime Information and Exchange system (SafeSeaNet)"
COM(2020) 789 final – Sustainable and Smart Mobility Strategy — putting European transport on track for the future	2020	STRATEGY	Pag.16: "People should enjoy a seamless multimodal experience throughout their journey, through a set of sustainable mobility choices, increasingly driven by digitalisation and automation." .
COM(2021) 559 final – on the deployment of alternative fuels infrastructure, and repealing Directive 2014/94/EU of the European Parliament and of the Council	2021	POLICY	Pag.24: "It is crucial that all actors in the electric mobility ecosystem can interact easily through digital means to provide the best service quality to the end user."

UE			
Ports as green hubs			
REFERENCE	YEAR	TYPE	DETAILS
Regulation (EU) No 1315/2013 – Guidelines for the development of the trans-European transport network	2013	POLICY	Pag.14: "Motorways of the sea, representing as they do the maritime dimension of the trans-European transport network, shall contribute towards the achievement of a European maritime transport space without barriers. They shall consist of short-sea routes, ports, associated maritime infrastructure and equipment, and facilities as well as simplified administrative formalities enabling short-sea shipping or sea-river services to operate between at least two ports, including hinterland connections […] may also include activities that have wider benefits and are not linked to specific ports, such as services and actions to support the mobility of persons and goods, activities for improving environmental performance, such as the provision of shore-side electricity that would help ships to reduce their emissions, making available facilities for ice-breaking, activities ensuring year-round navigability, dredging operations, and alternative fuelling facilities, as well as the optimisation of processes, procedures and the human element, ICT platforms and information systems, including traffic management and electronic reporting systems."
COM(2019) 640 final – The European Green Deal	2019	STRATEGY	Pag.12: "In parallel, the Commission (nda) will consider applying European emissions trading to road transport, as a complement to existing and future CO2 emission performance standards for vehicles. It will take action in relation to maritime transport, including to regulate access of the most polluting ships to EU ports and to oblige docked ships to use shore-side electricity."
DIRECTIVE (EU) 2019/883 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - on port reception facilities for the delivery of waste from ships	2019	POLICY	Pag.11: "Member States shall ensure that an appropriate waste reception and handling plan is in place and has been implemented for each port following ongoing consultations with the relevant parties, including in particular with port users or their representatives, and, where appropriate, local competent authorities, port reception facility operators, organisations implementing extended producer responsibility obligations and representatives of civil society."
COM(2020) 789 final – Sustainable and Smart Mobility Strategy — putting European transport on track for the future	2020	STRATEGY	Pag.6: "Ports and airports should become multimodal mobility and transport hubs, linking all the relevant modes. This will improve air quality locally thereby contributing to improved health of nearby residents."
COM(2021) 550 final – 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality	2021	POLICY	Pag.8: "New requirements for ships, regardless of their flag, arriving to or departing from EU ports, by imposing a maximum limit on the greenhouse gas content of the energy they use and making these limits more stringent over time."

UE			
Ports as green hubs			
REFERENCE	YEAR	TYPE	DETAILS
COM(2021) 557 final	2021	POLICY	Pag.25: "the greenhouse gas emission saving criteria should also apply to existing biomass-based installations to ensure that bioenergy production in all such installations leads to greenhouse gas emission reductions compared to energy produced from fossil fuels."
COM(2021) 551 final	2021	POLICY	Pag.5: "At the EU level, CO2 emissions from ships above 5000 gross tonnage travelling to or from ports located within the EEA are being monitored, reported and verified (through the EU Maritime MRV Regulation)12 since 2018"
COM(2021) 562 final – on the use of renewable and low-carbon fuels in maritime transport and amending Directive 2009/16/EC	2021	POLICY	Pag.10: "the subject matter of the proposed Regulation, which lays down rules to reduce the greenhouse gas intensity of energy used on-board by ships arriving at, within or departing from ports under the jurisdiction of a EU Member State, to promote the harmonious development and consistent use of renewable and low-carbon fuels across the Union, without introducing barriers to the single market to promote the reduction of greenhouse gas emissions from maritime transport."
COM(2022) 185 final - outlining the progress made in implementing Directive 2014/89/EU establishing a framework for maritime spatial planning	2022	STRATEGY	Pag.15: "MSP (maritime space planning) will also need to reflect potentially increased use of maritime transport, in particular short sea shipping, as envisaged by the Commission's sustainable and smart mobility strategy. MSP is a key tool to achieve the MSFD's good environmental status objectives for EU waters and to help preserve biodiversity."

UE			
Safety in ports			
REFERENCE	YEAR	TYPE	DETAILS
COM(2019) 640 final – The European Green Deal	2019	STRATEGY	Pag. 24: "As the world's largest single market, the EU can set standards that apply across global value chains. […] It will work with global partners to ensure the EU's resource security and reliable access to strategic raw materials."
DIRECTIVE (EU) 2019/883 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL - on port reception facilities for the delivery of waste from ships	2019	POLICY	Pag.10, art.4: "The port authorities concerned or, failing them, the relevant authorities shall ensure that waste delivery or reception operations are carried out with sufficient safety measures to avert risks to persons and the environment at ports covered by this Directive."

UE			
Safety in ports			
COM(2020) 789 final – Sustainable and Smart Mobility Strategy — putting European transport on track for the future	2020	STRATEGY	Pag.6: “The Commission will propose measures to make our airports and ports clean […] The Commission will also follow-up on the measures suggested in the European Union Aviation Safety Agency (EASA) report in relation to the updated analysis of the non-CO2 climate impacts of aviation.
COM(2021) 551 final	2021	POLICY	Pag.16: “Administering authorities may request the assistance of the European Maritime Safety Agency (EMSA) to carry out their obligations under this Directive, in particular as regards the approval of monitoring plans and the verification of emissions”

(scrivere testo e commento…)

3.1.2 Non UE

non UE - WESTERN BALKANS			
Improving sustainability in maritime vessels operations			
REFERENCE	YEAR	TYPE	DETAILS
COM(2020) 641 final – An Economic and Investment Plan for the Western Balkans	2020	STRATEGY	Pag 9 - V. Investing in clean energy "[...] At the heart of new gas infrastructure must be new pipelines, including the extension of the Trans Adriatic Pipeline, which could be an opportunity for diversifying the gas sources to the European market and bring gas to the region to speed-up transition from coal in energy production. [...]"
SWD(2020) 223 final – Guidelines for the Implementation of the Green Agenda for the Western Balkans	2020	POLICY	Pag. 6 - Cap 2 Decarbonisation: climate, energy, mobility "[...]There should be a focus on the deployment of Intelligent Transport System solutions (ITS) aimed at making transport operations more efficient, and reducing CO2 emissions. Wide availability and use of data technologies in public transport systems has the potential to make them smarter, less polluting and customer friendly. The promotion of multimodal transport solutions and modal shift, through targeted policies, including investment in inland waterways, will be needed. The infrastructure connections between sea/inland waterways ports and the rail network are currently weak or non-existent. "
Transport Community: Strategy for Sustainable and Smart Mobility in the Western Balkans	2021	STRATEGY	Pag. 14 - 3.2 Smart mobility " [...] Ministries in charge of Transport, public authorities with Transport Community Permanent Secretariat’s support are being encouraged to investigate piloting and deploying digital solutions such as Mobility as Service for freight to enable sharing information among the first-last mile actors such as ports and inland terminals."

non UE - WESTERN BALKANS			
Digitalisation in ports			
REFERENCE	YEAR	TYPE	DETAILS
WB6 – Multi-Annual Action Plan For A Regional Economic Area	2017	STRATEGY	Pag. 4 - IV Digital integration "[...] the digital agenda aims at: digital infrastructure development and improved regional connectivity; harmonized spectrum policies; coordinated roaming policies towards a roaming free region; enhanced cyber security, trust services and data protection; cooperation in policies that stimulate data economy; upgraded digital skills and accelerated digitization and uptake of smart technologies in our region."; Pag 13 - II Investment "[...[ii) with the active participation of the business and research & innovation communities, engage with EU-wide work on digitalisation, to develop and implement digital growth strategies [...]"; Pag 17. IV Digital integration "Strengthen regional coordination on use, exchange and safe and reliable flow, access and transfer of data and integration within the European data ecosystem and economy"
SWD(2020) 223 final – Guidelines for the Implementation of the Green Agenda for the Western Balkans	2020	POLICY	Pag. 2 - Cap 1 Intoduction "Digitalisation will be a key enabler for the above five pillars in line with the concept of the dual green and digital transition. The objectives of these pillars should be pursued through concrete actions and supported by mechanisms and financial instruments set out in the following sections."
Transport Community: Strategy for Sustainable and Smart Mobility in the Western Balkans	2021	STRATEGY	Pag. 15 - Flagship 7 "Data represent the basic element for digital transformation. Enabling seamless exchange of data across modes for both freight and passenger transport will allow for integrated planning, ticketing, online purchasing, improved capacity utilisation, optimised costs, energy consumption and environmental impact. Interoperability is a precondition for successfully linking data flows and distribution systems across."

non UE - WESTERN BALKANS			
Ports as green hubs			
REFERENCE	YEAR	TYPE	DETAILS
COM(2020) 641 final – An Economic and Investment Plan for the Western Balkans	2020	STRATEGY	Pag 11 "The region should embrace innovative green and digital technologies that create new business models, allow industry to be more productive, provide workers with new skills and support the decarbonisation of the economy. [...] The region also needs to shift towards the circular economy, where recycling and reuse are the rule while the use of natural resources is significantly reduced."
SWD(2020) 223 final – Guidelines for the Implementation of the Green Agenda for the Western Balkans	2020	POLICY	Pag. 8 - Cap 3 "Further efforts are therefore needed to develop a comprehensive approach to foster sustainable lifestyles and consumption, and to accompany consumers and public authorities towards sustainable choices"; Pag. 9 - Cap 3 "Support the region in developing circular economy strategies looking at the entire lifecycle of products, waste prevention, modern waste management and recycling, re-use, repair and remanufacturing."
Transport Community: Strategy for Sustainable and Smart Mobility in the Western Balkans	2021	STRATEGY	Pag. 8 - Flagship 2 "To achieve sustainability, they have been encouraged to start transitioning to zero-emission nodes, the best practices followed by the most sustainable airports and ports should become the new normal and enable more sustainable forms of connectivity.": Pag. 9 Flagship 2 "By 2050, greenhouse gases emissions from waterborne transport to be largely eliminated [...]".

non UE - WESTERN BALKANS			
Safety in ports			
REFERENCE	YEAR	TYPE	DETAILS
SWD(2020) 223 final – Guidelines for the Implementation of the Green Agenda for the Western Balkans	2020	POLICY	Pag. 6 - Cap 2 Decarbonisation: climate, energy, mobility " Support the implementation of the road safety action plan and the road action plan, including road maintenance and resilience; "
Transport Community: Strategy for Sustainable and Smart Mobility in the Western Balkans	2021	STRATEGY	Pag. 4 - 2. Vision "[...] including the areas of technical standards, interoperability, safety, security, traffic management, social policy, public zrocurement, and environment and, the development of the Trans-European Transport Network (TEN-T)."; Pag 18 - Flagship 10 "The National Road Safety Strategies based on the Safe System approach are the key to improving road safety."

3.2 Funding instruments: European Territorial Cooperation programmes

This second type of analysis mainly aims to provide elements for the definition of the recommendations for the subsequent phases.

Two analyzes have been carried out, one relating to countries and one relating to key themes, and two summaries, one again by country and one by European Territorial Cooperation (ETC) Programme.

3.2.1 Analysis of ETC by country

The work carried out starts with a breakdown by state (Italy, Slovenia, Croatia, Greece, Montenegro, Albania, Bosnia Herzegovina), thus producing a total of 7 tables.

The objective of the analysis is to understand how the specific ‘themes’ identified within the "green and Smart Ports" project are contained in the different ETC programmes and around each EUSAIR country

In order to carry out an effective assessment to achieve this objective, it was decided to consider the cogency of the Indicatives and main action of Specific Objectives contained in the various ETC programmes 21-27 as a qualitative/quantitative indicator. Their identification is the result of a cross between those identified in the Eusair Embedding Process phase and a careful re-reading of the documents relating to the various calls of each ETC Program.

The Indicatives and main action have been crossed with each of the 9 ‘themes’ included in the “green/smart port” concept through a qualitative-quantitative weighing.

The table below represents for each country the mere presence of Indicatives and main actions within each ETC Programme and the specific objectives related to it, the ERDF (European Regional Development Fund) relating to each objective is also reported.

ITALY				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
Italy-Croatia	SO 1.4	Pillar 1 and 4	7,08	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 2.4	Pillar 3	37,63	• Enhancing transport safety and security.
	SO 2.7	Pillar 3 and 4	25,23	• Greening ground port services and operations.
	SO 3.2	Pillar 2	33,56	• Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power; • Greening ground port services and operations; • Promotion of ports as testbeds for waste reuse and the circular economy; • Development of efficient capacity allocation and traffic management systems.
	SO 4.6	Pillar 2	31,1	• Promotion of ports as testbeds for waste reuse and the circular economy.
	ISO 1 - 6.6	All	10,5	• Enhancing transport safety and security.
Italy-Slovenia	SO 2.4	Pillar 3	9,34	• Enhancing transport safety and security.
	SO 2.6	Pillar 2	5,29	• Improvement of the energy efficiency and reduction of emissions of vessels; • Promotion of ports as testbeds for waste reuse and the circular economy; • Diffusion of innovation, data and AI for smart mobility.
	SO 4.6	Pillar 2	29,85	• Enhancing transport safety and security.
	ISO 1 - 6.2	All	3,65	• Greening ground port services and operations; • Diffusion of innovation, data and AI for smart mobility.
	SO 1.1	Pillar 4	31,19	• Enhancing transport safety and security.
	SO 4.6	Pillar 2	29,85	• Enhancing transport safety and security.
	ISO 1 - 6.2	All	3,65	• Greening ground port services and operations; • Diffusion of innovation, data and AI for smart mobility
	SO 1.1	Pillar 4	31,19	• Enhancing transport safety and security.
	SO 4.6	Pillar 2	29,85	• Enhancing transport safety and security.
	ISO 1 - 6.2	All	3,65	• Greening ground port services and operations; • Diffusion of innovation, data and AI for smart mobility.
	SO 1.1	Pillar 4	31,19	• Enhancing transport safety and security.

ITALY				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
Central Europe	SO 2.1	Pillar 1, 2 and 4	20,79	• Improvement of the energy efficiency and reduction of emissions of vessels.
	SO 2.4	Pillar 3	20,79	• Enhancing transport safety and security.
	SO 2.6	Pillar 2	15,59	• Greening ground port services and operations; • Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 2.8	Pillar 2	20,79	• Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Greening ground port services and operations; • Development of efficient capacity allocation and traffic management systems.
	SO 3.2	Pillar 2	20,79	• Creation of a comprehensive network of recharging and refuelling infrastructure; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Enhancing transport safety and security • Development of efficient capacity allocation and traffic management systems; • Diffusion of innovation, data and AI for smart mobility; • Diffusion of innovation, data and AI for smart mobility.
	ISO 1 - 6.6	All	20,79	• Diffusion of innovation, data and AI for smart mobility.
EURO MED	SO 2.4	Pillar 3 and 4	58,80	• Enhancing transport safety and security.
	SO 2.6SO 2.6	Pillar 2	48,1	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 1.1	Pillar 1	4,64	• Creation of a comprehensive network of recharging and refuelling infrastructure.
Greece - Italy	SO 2.6	Pillar 2	12,75	• Promotion of ports as testbeds for waste reuse and the circular economy.

ITALY				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
	SO 4.5	None	5,18	• Enhancing transport safety and security.
IPA CBC South Adriatic (ItalyAlbania-Montenegro	SO 2.1	Pillar 1, 2 and 4	3,93	• Improvement of the energy efficiency and reduction of emissions of vessels.
	SO 3.2	Pillar 2	12,11	• Greening ground port services and operations; • Enhancing transport safety and security; • Development of efficient capacity allocation and traffic management systems; • Diffusion of innovation, data and AI for smart mobility.
	SO 4.6	Pillar 2	6,12	• Enhancing transport safety and security.
IPA Adriatic Ionian	SO 1.1	Pillar 1	28,82	• Creation of a comprehensive network of recharging and refuelling infrastructure.
	SO 2.4	Pillar 3 and 4	24,15	• Creation of a comprehensive network of recharging and refuelling infrastructure; • Enhancing transport safety and security.
	SO 2.6	Pillar 1, 2, 3 and 4	10,06	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 3.2	Pillar 2	11,18	• Improvement of the energy efficiency and reduction of emissions of vessels; • Creation of a comprehensive network of recharging and refuelling infrastructure; • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels • Greening ground port services and operations; • Diffusion of innovation, data and AI for smart mobility.

SLOVENIA				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
	SO 2.4	Pillar 3	9,34	• Enhancing transport safety and security.

SLOVENIA				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
Italy-Slovenia	SO 2.6	Pillar 2	5,29	• Improvement of the energy efficiency and reduction of emissions of vessels; • Greening ground port services and operations; • Diffusion of innovation, data and AI for smart mobility,
	SO 4.6	Pillar 2	29,85	• Enhancing transport safety and security.
	ISO 1 - 6.2	All	3,65	• Greening ground port services and operations; • Diffusion of innovation, data and AI for smart mobility.
	SO 4.6	Pillar 2	29,85	• Enhancing transport safety and security
	ISO 1 - 6.2	All	3,65	• Greening ground port services and operations; • Diffusion of innovation, data and AI for smart mobility.
Central Europe	SO 1.1	Pillar 4	31,19	• Enhancing transport safety and security.
	SO 2.1	Pillar 4	20,79	• Improvement of the energy efficiency and reduction of emissions of vessels; • Enhancing transport safety and security.
	SO 2.6	Pillar 2	15,59	• Promotion of ports as testbeds for waste reuse and the circular economy; • Greening ground port services and operations.
	SO 2.8	Pillar 2	20,79	• Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Greening ground port services and operations; • Development of efficient capacity allocation and traffic management systems; • Creation of a comprehensive network of recharging and refuelling infrastructure; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels • Enhancing transport safety and security; • Development of efficient capacity allocation and traffic management systems; • Diffusion of innovation, data and AI for smart mobility
EURO MED	SO 2.4	Pillar 3 and 4	58,8	• Enhancing transport safety and security
	SO 2.6	Pillar 2	48,1	• Promotion of ports as testbeds for waste reuse and the circular economy.

CROATIA				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
Italy-Croatia	SO 1.4	Pillar 1	7,08	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 2.4	Pillar 3	37,63	• Enhancing transport safety and security.
	SO 2.7	Pillar 2 and 4	25,23	• Greening ground port services and operations.
	SO 3.2	Pillar 2	33,56	• Development of efficient capacity allocation and traffic management systems; • Promotion of ports as testbeds for waste reuse and the circular economy; • Greening ground port services and operations; • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power.
	SO 4.6	Pillar 2	31,1	• Promotion of ports as testbeds for waste reuse and the circular economy.
	ISO 1 - 6.6	Iso	10,5	• Enhancing transport safety and security.
Central Europe	SO 1.1	Pillar 4	31,19	• Enhancing transport safety and security.
	SO 2.1	Pillar 1, 2 and 4	20,79	• Improvement of the energy efficiency and reduction of emissions of vessels; • Enhancing transport safety and security.
	SO 2.6	Pillar 2	15,59	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 2.8	Pillar 2	20,79	• Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Promotion of ports as testbeds for waste reuse and the circular economy; • Development of efficient capacity allocation and traffic management systems.
	SO 3.2	Pillar 2	20,79	• Creation of a comprehensive network of recharging and refuelling infrastructure; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Enhancing transport safety and security; • Development of efficient capacity allocation and traffic management systems; • Diffusion of innovation, data and AI for smart mobility.

CROATIA				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
	ISO 1 - 6.6	All	20,79	• Diffusion of innovation, data and AI for smart mobility.
EURO MED	SO 2.4	Pillar 3 and 4	58,8	• Enhancing transport safety and security.
	SO 2.6	Pillar 2	48,1	• Promotion of ports as testbeds for waste reuse and the circular economy.
IPA Adriatic Ionian	SO 1.1	Pillar 1	28,82	• Creation of a comprehensive network of recharging and refuelling infrastructure.
	SO 2.4	Pillar 3 and 4	24,15	• Creation of a comprehensive network of recharging and refuelling infrastructure; • Enhancing transport safety and security.
	SO 2.6	Pillar 4	10,06	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 3.2	Pillar 2	11,18	• Improvement of the energy efficiency and reduction of emissions of vessels; • Creation of a comprehensive network of recharging and refuelling infrastructure. • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power; • Promotion of ports as testbeds for waste reuse and the circular economy; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Diffusion of innovation, data and AI for smart mobility.
Slovenia - Croatia	SO 2.4	Pillar 3 and 4	9,8	• Enhancing transport safety and security.
	SO 2.7	Pillar 3 and 4	9,8	• Enhancing transport safety and security.
Slovenia - Croatia	SO 4.6	Pillar 2	16,32	• Enhancing transport safety and security.
	ISO 1 - 6.2	All	4	• Diffusion of innovation, data and AI for smart mobility.
IPA Croatia - Bosnia and	SO 1.1	Pillar 1 and 4	13,54	• Improvement of the energy efficiency and reduction of emissions of vessels; • Diffusion of innovation, data and AI for smart mobility.

CROATIA				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
Herzegovina - Montenegro	SO 1.3	Pillar 4	10	• Diffusion of innovation, data and AI for smart mobility.
	SO 2.1	Pillar 2	11,5	• Creation of a comprehensive network of recharging and refuelling infrastructure; • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Development of efficient capacity allocation and traffic management systems.
	SO 2.4	Pillar 3 and 4	23	• Promotion of ports as testbeds for waste reuse and the circular economy; • Enhancing transport safety and security.
	SO 2.6	Pillar 1 and 2	11,5	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 4.5	None	19,25	• Enhancing transport safety and security; Diffusion of innovation, data and AI for smart mobility.
	SO 4.6	Pillar 4	18,18	• Improvement of the energy efficiency and reduction of emissions of vessels; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Promotion of ports as testbeds for waste reuse and the circular economy.

GREECE				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
EURO MED	SO 2.4	Pillar 3 and 4	58,8	• Enhancing transport safety and security.
	SO 2.6	Pillar 2	48,1	• Promotion of ports as testbeds for waste reuse and the circular economy.
Greece - Italy	SO 1.1	Pillar 1	4,64	• Creation of a comprehensive network of recharging and refuelling infrastructure.
	SO 2.6	Pillar 2	12,75	• Promotion of ports as testbeds for waste reuse and the circular economy.

GREECE				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
	SO 4.5	None	5,18	• Enhancing transport safety and security.
IPA Adriatic Ionian	SO 1.1	Pillar 1	28,82	• Creation of a comprehensive network of recharging and refuelling infrastructure.
	SO 2.4	Pillar3 and 4	24,15	• Creation of a comprehensive network of recharging and refuelling infrastructure; • Enhancing transport safety and security.
	SO 2.6	Pillar 1, 2, 3 and 4	10,06	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 3.2	Pillar 2	11,18	• Improvement of the energy efficiency and reduction of emissions of vessels; • Creation of a comprehensive network of recharging and refuelling infrastructure; • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Promotion of ports as testbeds for waste reuse and the circular economy; • Diffusion of innovation, data and AI for smart mobility.
IPA Greece Albania	SO 2.4	Pillar 3 and 4	2,39	• Creation of a comprehensive network of recharging and refuelling infrastructure; • Enhancing transport safety and security.
	SO 2.6	Pillar 2	3,48	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 3.2	Pillar 2	2,7	• Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Enhancing transport safety and security.
Greece-North Macedonia	SO 2.7	Pillar 3 and 4	4,54	• Diffusion of innovation, data and AI for smart mobility; • Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 3.2	Pillar 2	3,26	• Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power.
	SO 4.5	None	3,27	• Enhancing transport safety and security.

GREECE				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
	ISO 1 - 6.6	All	2,40	• Enhancing transport safety and security.

MONTENEGRO				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
EURO MED	SO 2.1	Pillar 3 and 4	3,93	• Improvement of the energy efficiency and reduction of emissions of vessels.
IPA CBC South Adriatic (ItalyAlbania-Montenegro	SO 3.2	Pillar 2	12,11	• Promotion of ports as testbeds for waste reuse and the circular economy; • Promotion of ports as testbeds for waste reuse and the circular economy; • Enhancing transport safety and security; • Development of efficient capacity allocation and traffic management systems; • Diffusion of innovation, data and AI for smart mobility.
	SO 4.6	Pillar 2	6,12	• Enhancing transport safety and security.
IPA Adriatic Ionian	SO 1.1	Pillar 1	28,82	• Creation of a comprehensive network of recharging and refuelling infrastructure.
	SO 2.4	Pillar 3 and 4	24,15	• Creation of a comprehensive network of recharging and refuelling infrastructure; • Enhancing transport safety and security.
	SO 2.6	Pillar 1, 2, 3 and 4	10,06	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 3.2	Pillar 2	11,18	• Improvement of the energy efficiency and reduction of emissions of vessels; • Creation of a comprehensive network of recharging and refuelling infrastructure; • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Promotion of ports as testbeds for waste reuse and the circular economy; • Diffusion of innovation, data and AI for smart mobility.

BOSNIA HERZEGOVINA				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**ERDF IN MIO €**	**'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT**
IPA Adriatic Ionian	SO 1.1	Pillar 1	28,82	• Creation of a comprehensive network of recharging and refuelling infrastructure.
	SO 2.4	Pillar 3 and 4	24,15	• Creation of a comprehensive network of recharging and refuelling infrastructure; • Enhancing transport safety and security.
	SO 2.6	Pillar 1, 2, 3 and 4	10,06	• Promotion of ports as testbeds for waste reuse and the circular economy.
	SO 3.2	Pillar 2	11,18	• Improvement of the energy efficiency and reduction of emissions of vessels; • Creation of a comprehensive network of recharging and refuelling infrastructure; • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Promotion of ports as testbeds for waste reuse and the circular economy; • Diffusion of innovation, data and AI for smart mobility.
IPA Croatia - Bosnia and Herzegovina - Montenegro	SO 1.1	Pillar 1 and 4	13,54	• Improvement of the energy efficiency and reduction of emissions of vessels; • Diffusion of innovation, data and AI for smart mobility.
	SO 2.1	Pillar 2	11,5	• Creation of a comprehensive network of recharging and refuelling infrastructure.
	SO 2.1	Pillar 2	11,5	• Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Development of efficient capacity allocation and traffic management systems.
	SO 1.3	Pillar 4	10	• Diffusion of innovation, data and AI for smart mobility
	SO 2.4	Pillar 3 and 4	23	• Promotion of ports as testbeds for waste reuse and the circular economy: • Enhancing transport safety and security.
	SO 2.6	Pillar 1 and 2	11,5	• Promotion of ports as testbeds for waste reuse and the circular economy.

BOSNIA HERZEGOVINA				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	ERDF IN MIO €	'THEMES' INCLUDED IN THE "GREEN/SMART PORT" CONCEPT
	SO 4.5	None	19,25	• Enhancing transport safety and security; • Diffusion of innovation, data and AI for smart mobility.
	SO 4.6	Pillar 2 and 4	18,18	• Improvement of the energy efficiency and reduction of emissions of vessels; • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels; • Promotion of ports as testbeds for waste reuse and the circular economy.

3.2.2 Scope analysis

The work carried out here starts with the subdivision of the 'Scope' of "green/smart port" concept, grouping all the themes into 4 'scopes':

- Improving sustainability in maritime vessels operations,
- Ports as green hubs,
- Safety in ports,
- Digitalisation in ports

Then the data are grouped according to European Territorial Cooperation programme, and broken down by specific objectives; in addition for each specific objective details are provided relating to the Indicative and main action of Specific Objective and the 9 'Themes' included in the "green/smart port" concept.

'SCOPE' : IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	'THEME'
Italy-Croatia	SO 3.2	Pillar 2	• Fostering the use of alternative fuels and the diffusion of new ecological transport modes.	Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power

'SCOPE' : IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	'THEME'
Italy-Slovenia	SO 2.6	Pillar 2	• Developing and testing innovative technologies following the concepts of industrial symbiosis and facilitating waste reuse, as well as carbon capture, utilization or storage	Improvement of the energy efficiency and reduction of emissions of vessels
Central Europe	SO 2.1	Pillar 1, 2 and 4	• Promoting the production and use of advanced biofuels, notably the second (produced from non-food crops, such as cellulosic biofuels and waste biomass) and third generation biofuels (algal biomass); • Promoting the production and use of advanced biofuels, notably the second (produced from non-food crops, such as cellulosic biofuels and waste biomass) and third generation biofuels (algal biomass); • Supporting policies and strategies to overcome barriers for deploying carbon capture, utilisation and storage solutions in order to reduce GHG emissions.	Improvement of the energy efficiency and reduction of emissions of vessels

'SCOPE' : IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**'THEME'**
	SO 3.2	Pillar 2	• Designing and testing integrated, demand-responsive and sustainable transport solutions to better connect rural and peripheral areas to major transport nodes; • Improving transport management and navigation (including e.g. multi-modal logistics to better use existing waterway and rail transport infrastructure).	Creation of a comprehensive network of recharging and refuelling infrastructure
Greece - Italy	SO 1.1	Pillar 1	• Fostering quadruple helix ties in the fields of marine technologies and blue biotechnologies for advancing innovation, business development and business adaptation in blue bio-economy whereby there is a great potential as well as in and around ports.	Creation of a comprehensive network of recharging and refuelling infrastructure

'SCOPE' : IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**'THEME'**
IPA CBC South Adriatic (ItalyAlbania-Montenegro)	SO 2.1	Pillar 2	• Awareness-raising on CO2 emissions such as through solutions to decarbonize maritime mobility (e.g. fishing fleets) e.g. though innovative /sustainable electricity supply for vessels, energy efficiency measures targeting specific sectors (e.g. culture/tourism, construction, public facilities, etc.), but also efficiency & security of cross-border energy networks & pipelines, digital tools / processes for energy efficiency, integrated energy efficiency plans within RES strategies / actions, as well as adoption of EU rules on energy.	Improvement of the energy efficiency and reduction of emissions of vessels
IPA Adriatic Ionian	SO 1.1	Pillar 1	• Promote and encourage the development of transnationally designed innovations (technical and non-technical innovation, including services) through pilot and joint actions contributing to face societal and environmental challenges like demographic change, energy efficiency or climate change.	Creation of a comprehensive network of recharging and refuelling infrastructure

'SCOPE' : IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**'THEME'**
	SO 2.4	Pillar 3 e 4	• In the framework of Maritime Spatial Planning activities, develop transnational joint plans and pilot actions to boost resilience to climate change in marine ecosystems.	Creation of a comprehensive network of recharging and refuelling infrastructure
	SO 3.2	Pillar 2	• Support environmental performance and energy efficiency for low carbon port systems and related infrastructures – such as noise reduction, air quality, decrease of CO2 emissions - through the adoption of pilot actions testing innovative technologies, energy sustainability and harmonised regulatory standards for maritime/river transport. • Enhance the development of the Motorways of the Seas (Mos) concept as an alternative to overstretched land transport through targeted strategies and action plans, aimed at making full use of maritime transport resources as well as inland waterways in the logistics chain.	Improvement of the energy efficiency and reduction of emissions of vessels

'SCOPE' : IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	'THEME'
	SO 3.2	Pillar 2	• Set in place transnational cooperation actions to develop and/or improve sustainable smart mobility systems to strengthen urban-rural linkages and implement innovative sustainable transport solutions, including forms of participatory governance to improve multimodal and low carbon mobility for passengers, tourists, and commuters of the Adriatic-Ionian region; • Map infrastructural, technological, legislative gaps and barriers to freight circulation including the legal and administrative variances hampering the efficiency of smooth transnational transport, in order to create a common transnational transport policy framework.	Creation of a comprehensive network of recharging and refuelling infrastructure
	SO 3.2	Pillar 2	• Develop and test innovative planning tools/solutions forecasting future demand for public transport in view of the impact caused by current socio-demographic changes and present pandemic situation on intermodal national, regional and local mobility.	Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power

'SCOPE' : IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**'THEME'**
IPA Greece Albania	SO 2.4	Pillar 2 and 3	• Upgrade of green and blue infrastructure for adaptation to climate change	Creation of a comprehensive network of recharging and refuelling infrastructure
IPA Croatia - Bosnia and Herzegovina - Montenegro	SO 1.1	Pillar 1 and 4	• Accelerating innovation and technology transfer including commercialisation of the final product or solution These technologies should belong on the low carbon technology list and will include applications to minimize resource consumption in other sectors	Improvement of the energy efficiency and reduction of emissions of vessels
	SO 2.1	Pillar 2	• Developing and implementing joint pilot and demonstration actions on innovative technologies, measures and solutions in the field of energy management (collection of integrated data and the interoperability of data through digital technologies, use of innovative technology for energy saving and necessary reinforcement or extension of the grid) and reducing greenhouse gas emissions (e.g., monitoring of air quality and other parameters in public buildings on a larger scale) and use of RES (e.g., demo centres/plants),	Creation of a comprehensive network of recharging and refuelling infrastructure

'SCOPE' : IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**'THEME'**
	SO 2.1	Pillar 2	• Joint incentives and pilot projects to encourage and ensure a strategic approach to energy efficiency (e.g., developing SECAP, including both mitigation and adaptation, establishing energy hierarchy, such as reduction of energy demand, ensuring efficient use of energy, generating energy needs from renewable sources, etc.)	Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
	SO 4.6	Pillar 2 and 4	• Capacity building for innovation in tourism and cultural heritage, focusing on recovery and resilience, and sustainable development of new or upgrading of existing cross-border tourism products, product diversification to adapt to new trends and needs, including sustainable mobility measures such as use of public transportation, alternative mobility modes, low-emission transport	Improvement of the energy efficiency and reduction of emissions of vessels

'SCOPE' : IMPROVING SUSTAINABILITY IN MARITIME VESSELS OPERATIONS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**'THEME'**
Greece-North Macedonia	SO 3.2		• Strategic actions and projects related to the BC "Markova Noga/Laimos" between North Macedonia and Greece in the Prespa region; • The border crossing project's exact scope and Terms of Reference will be specified in a targeted Call for Proposals.	Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
Italy-Croatia	SO 1.4	Pillar 1	• Enhancing entrepreneurial capacities to foster innovation in products and processes, also through the promotion of collaboration with cultural/creative industries and the development of new sustainable technologies/circular economy approach; Building or reinforcing transformation and digitalisation skills of SMEs and their networks, in order to boost innovation mainly in blue economy sectors and adopting circular economy practices.	Promotion of ports as testbeds for waste reuse and the circular economy

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
	SO 2.7	Pillar 3 and 4	• Promoting information campaigns for responsible tourism activities aiming at safeguarding ecosystem and reducing pollution; • Designing integrated policies aimed at limiting the anthropogenic pressure on coastal and inner regions including green ports, by adopting innovative technologies/procedures/processes by the use of ICT tools (including pollution monitoring, handling meteorological data, etc) and sustainable fisheries and aquaculture models	Greening ground port services and operations

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
	SO 3.2	Pillar 2	• Sharing expertise, developing common strategies and organizing training courses for traffic management in the coastal and inner areas; • Exploiting ICT technologies to pilot sustainable, seamless passenger and freight transport solutions and to develop new joint models of multi-modal approach; • Sharing expertise, developing common strategies and organizing training courses for traffic management in the coastal and inner areas; • Designing cycle routes of macro-regional relevance and testing new services to encourage intermodality (bike and train/ ferry/ tram/ bus/ plane) also considering tourism needs	Greening ground port services and operations
	SO 3.2	Pillar 2	• Promoting innovative solutions for implementing the circular economy approach in the management of the ports; Promoting innovative solutions for implementing the circular economy approach in the management of the ports;	Promotion of ports as testbeds for waste reuse and the circular economy

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
	SO 4.6	Pillar 2	• Promote sustainable tourism in peripheral areas through the enhancement of experiential tourism, the diffusion of slow mobility, the creation of new routes linked to local specificities and new services provided by cultural and creative industries, also applying circular economy approaches.	Promotion of ports as testbeds for waste reuse and the circular economy
Italy-Slovenia	SO 2.6	Pillar 2	• Innovative and sustainable solutions for the conversion of production activities from a linear model towards a circular economy model, also capitalising past experiences/good practice; • Supporting the creation of experimental supply chains in the context of the circular economy and sustainable food production, using digital technologies and artificial intelligence.	Promotion of ports as testbeds for waste reuse and the circular economy
	ISO 1 - 6.2	All	• Exchange of experience and data, training programmes to enhance the capacity of public authorities to design and implement integrated cross-border initiatives on specific issues for the • Programme area (e.g., inner and maritime mobility, health services, etc.)	Greening ground port services and operations

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
Central Europe	SO 2.6	Pillar 2	• Increasing awareness of policy makers and stakeholders about environmental and economic opportunities of a circular economy and improving their capacity for the practical implementation of circular economy approaches; • Supporting policy frameworks for deploying and scaling up circular economy approaches, e.g. through developing and implementing integrated circular economy strategies and action plans at the local and regional levels, including related regional innovation schemes.	Promotion of ports as testbeds for waste reuse and the circular economy

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
	SO 2.6	Pillar 2	• Developing and testing approaches that lead to behavioural changes and higher acceptance of more sustainable products (e.g. through the promotion and uptake of schemes such as EMAS, EU Ecolabel or Green Public Procurement) and resource-efficient consumption and production patterns (e.g. integrated approaches for reducing food waste) · • Developing and testing approaches that enhance market demand for recycled materials and products (e.g. sustainable public procurement)	Greening ground port services and operations

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
	SO 2.8	Pillar 2	• Fostering and implementing integrated urban mobility concepts including e.g. zero-emission transport including cycling and monitoring strategies that contribute to improved air quality management for reducing exposure of the population to transport-related emissions (air and noise pollution) based on the applicable WHO guidelines and EU Directives; • Sharing experiences and approaches for sustainable fleet management (e.g. hydrogen and electric buses) as well as use of end-of-life batteries in urban electro-mobility systems; • Testing and deploying green urban logistic solutions and testing new approaches for multimodal transport of goods at the level of FUAs (e.g. multi-modal hubs)	Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
	SO 2.8	Pillar 2	• Designing and deploying strategies to green the "last mile" of urban deliveries and logistics, including preparation and implementation of Sustainable Urban Logistics Plans (SULP); • Triggering behavioural changes towards more sustainable urban mobility through innovative approaches (e.g. "pop-up" measures accompanied by digital campaigning).	Greening ground port services and operations
EURO MED	SO 2.6	Pillar 2	• Supporting sustainable practices for waste reduction and prevention, tackling waste generation and over-packaging – with a focus on plastic. • Supporting public authorities in the development and adoption of strategies for the transition to circular economy.	Promotion of ports as testbeds for waste reuse and the circular economy

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
Greece - Italy	SO 2.6	Pillar 2	• Knowledge building in awareness-raising of policy makers and stakeholders regarding environmental and economic opportunities of circular economy. Best strategies and action plans at local/regional level for developing and implementing integrated circular economy. • Best practices and demonstration for improving waste management policies and competences of the public and private sector, including the prevention, processing and recycling of waste tackling specific types of waste (maritime, micro-plastics, textiles, waste related to pandemic equipment, construction, etc.)	Promotion of ports as testbeds for waste reuse and the circular economy
IPA CBC South Adriatic (ItalyAlbania-Montenegro)	SO 3.2	Pillar 2	• Maritime, air, rail and road transports, also targeted to tourism, such as with improved public transport links to cultural / natural heritage sites, through soft measures	Greening ground port services and operations

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
IPA Adriatic Ionian	SO 2.6	Pillar 1, 2, 3 and 4	• Enhance cooperation between the public and the private sector and establish networks to prevent, process and recycle waste, and test them through pilot initiatives. Develop and implement transnational frameworks and test pilot actions to drive public waste policies towards circularity (e.g.: through integrated and systemic approaches in waste management systems).	Promotion of ports as testbeds for waste reuse and the circular economy
	SO 3.2	Pillar 2	Support the increase of Short Sea Shipping (SSS) in the Adriatic-Ionian Sea basin as sustainable transport mode through joint developed actions, including the promotion of the use of alternative fuels/modes and last / first mile environmentally friendly solutions	Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
	SO 3.2	Pillar 2	Implement transnational integrated action plans supporting the development of rail-sea transportation intended as intermodal and multimodal transport mode.	Greening ground port services and operations

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
IPA Greece Albania	SO 2.6	Pillar 2	Joint knowledge development and planning of circular economy solutions. Building cross-border cooepration networks aimed at waste re-use. Investment in the development and testing of solutions for the separate sorting, storage and treatment of hazardous waste and bio-waste	Promotion of ports as testbeds for waste reuse and the circular economy
	SO 3.2	Pillar 2	• Investments for the modernization of the road network in the cross-border area, with an emphasis on reduction of black spots. Actions for realignment of urban and rural roads in the cross-border area, with the aim to improve accessibility in remoted or mountainous areas; • Investments in the implementation of climate proofed standards in road reconstruction in order to increase the resilience of cross-border road transport infrastructure.	Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
IPA Croatia - Bosnia and Herzegovina - Montenegro	SO 2.1	Pillar 2	• Investments in measures and actions that increase energy efficiency and improve the integration of sustainable energy sources in different sectors with consideration of use of clean mobility and transport, including small-scale infrastructure preferring nature-based solutions.	Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
	SO 2.4	Pillar 3 and 4	• Establishment of joint emergency centres, including small-scale infrastructure preferring nature-based solutions.	Greening ground port services and operations
	SO 2.6	Pillar 1 and 2	• Developing and implementing approaches and solutions for limiting landfilling of all types of waste and retaining their value (as future resources) in the economic cycle. Improving waste management policies and competences of the public sector, including the prevention, processing and recycling of communal waste.	Promotion of ports as testbeds for waste reuse and the circular economy

SCOPE: PORTS AS GREEN HUBS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
	SO 4.6	Pillar 2 and 4	• Developing and implementing innovative solutions and creating smart destinations (e.g. through digitalisation and creative industries), and new services and products for specific targeted market segments such as seniors, young people or people with disabilities including small scale infrastructure preferring nature-based solution	Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
	SO 4.6	Pillar 2 and 4	• Developing and implementing joint (pilot) actions to support diversification and sustainability of the tourism by investing in lesser-known destinations (e.g. less developed parts of the programme area, hinterland and continental parts of the programme area) and diverse forms of tourism (cultural, rural, agro, active, health tourism, etc.) including small-scale infrastructure preferring nature-based solutions	Greening ground port services and operations
Greece-North Macedonia	SO 2.6	Pillar 1, 2, 3 and 4	• Support joint product design for durability, reparability, upgradability and recycling. • Circular economy collaboration for resilient value chains	Promotion of ports as testbeds for waste reuse and the circular economy

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
Italy-Croatia	SO 2.4	Pillar 3	• Studying and testing integrated climate-adaptation solutions for different domains/target groups of population and enhancing the definition of common datasets on atmospheric parameters for climate analysis and impact assessment or improving the usability of existing ones; exchanging good practices to monitor, manage, mitigate and support the adaptation to climate change effects on the most relevant economic sectors. Improving digital competencies, fostering the use of new monitoring technologies and tools and reinforcing the exchange of data to increase safety and risk forecasting capacities; exchange of good practices to increase post disaster management capacities of relevant actors	Enhancing transport safety and security

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
	ISO 1 - 6.6	All	• Raising awareness of the persistence and impact of legal and administrative cross-border obstacles related to maritime cooperation in the Programme area; investigating and recognising legal and administrative cross-border obstacles hindering cooperation, especially in the fields of risk management, fisheries and aquaculture, Maritime Spatial Planning; • Supporting joint actions to investigate, adapt and test digital CB services for better administrative cooperation in crucial fields of maritime cooperation (surveillance, emergency response, accessibility.	Enhancing transport safety and security

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
Italy-Slovenia	SO 2.4	Pillar 3	• Application of joint tools to counteract the effects of climate change and extreme events and to improve quality of life in the cross-border space; • Strengthening cross-border cooperation among local authorities to build up integrated risk management systems and joint action plan Promoting investments for the development / strengthening / modelling of joint early warning and risk monitoring systems as well as small infrastructures for risk prevention and management, also with bio-engineering technique.	Enhancing transport safety and security
	SO 4.6	Pillar 2	• Digitalising the tourism sector to help product diversification and recovery after the pandemic. Digitalising the tourism sector to help product diversification and recovery after the pandemic.	Enhancing transport safety and security

Central Europe	SO 2.4	Pillar 4	• Developing integrated strategies and solutions to improve central European capacities for preparing and adapting to climate change and its negative impacts on society, economy and the environment (e.g. by addressing different aspects of resilient eco-systems). • Exchanging knowledge and good practices on eco-system based climate change adaptation measures and implementing pilot actions for restoration towards resilient eco-systems, e.g. rivers and wetlands, transnational connectivity of habitats, agro-forestry, biodiversity, landscapes, climate proofing, modelling and forecasting . • Developing and implementing integrated strategies and climate action plans that improve the risk awareness and resilience of central European cities and regions (e.g. regarding urban heat islands, flash floods, wildfires, greening) . • Increasing climate resilience of critical infrastructures and cultural/natural heritage sites through improved risk preparedness and risk management plans. Developing integrated strategies and solutions for strengthening eco-system services for human health and wellbeing in order to support social resilience	Enhancing transport safety and security

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
			and counteracting socio-economic impacts of climate change.	
	SO 3.2	Pillar 2	• Exchanging good practices and developing standards and sustainable solutions to improve regional mobility services in the public interest and to increase their resilience in times of crisis	Enhancing transport safety and security
EURO MED	SO 2.4	Pillar 3 and 4	• Prevention and mitigation of natural and environmental risks: o tackling coastal erosion and sea level rise fostering better integration of coastal zone management with other management approaches of natural resources. Prevention and mitigation of risks linked to human activities: Help reduce water use by encouraging water efficiency	Enhancing transport safety and security

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
Greece - Italy	SO 4.5	None	• Support the development of joint platforms or other type of digital infrastructure for ehealth. Networking and exchange of information and good practices at cross-border level that will allow to prepare and adopt in case of pandemics and other types of health crisis; • Reinforcement of the quality of and the access to health sector and services in the Programme area. Cross-border cooperation in healthcare can guarantee quality and equality in the supply of joint public health services, as this type of cooperation decreases fixed costs, increases the number of patients that can receive treatments and improves efficiency. Public and private cross-border operators can take part in crossborder projects.	Enhancing transport safety and security
IPA CBC South Adriatic (ItalyAlbania-Montenegro)	SO 3.2	Pillar 2	• Security procedures at border-crossing & customs, aimed at efficient connectivity are also included.	Enhancing transport safety and security
IPA Adriatic Ionian	SO 2.4		• Implement pilot actions for a shared and coordinated use of big data for modelling, early forecasting and warning systems to reduce climate change risks.	Enhancing transport safety and security

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
Slovenia – Croatia	SO 2.4	Pillar 3 And 4	• Development and enhancement of cooperation of disaster response units and organisations, including rescue plans, protocols, and co-ordination mechanisms of civil protection to prepare and respond to climate change-related hazards and other risks in the cross-border area. Increasing the resilience to climate-change effects in the programme area: Preparing and coordinating cross-sectoral, integrated, cross-border climate adaptation action plans for neighbouring municipalities/cities/regions/territorial units (aligned with the national climate plans) and their implementation on the regional level (e.g., SECAP - Sustainable Energy and Climate Action Plan) for anticipating the adverse effects of climate change on key sectors and taking appropriate activities to prevent/minimise damage they can cause, or taking advantage of opportunities that may arise	Enhancing transport safety and security

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	SPECIFIC OBJECTIVE	PILLAR	INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE	THEME
	SO 2.7	Pillar 3 and 4	• Joint cross-border upskilling and equipping of disaster response units and organisations for different types of hazard scenarios define for the expected area covered (e.g., fires, frost, floods, droughts, storms, earthquakes, and other extreme events); sharing knowledge and good practices on climate adaptation for resilience of society and infrastructure; • Increasing the resilience to climate-change effects in the programme area: Preparing and coordinating cross-sectoral, integrated, cross-border climate adaptation action plans for neighbouring municipalities/cities/regions/territorial units.	Enhancing transport safety and security
	SO 4.6	Pillar 2	• Enhancing resilience and recovery of tourism and culture by development and upgrade of joint CB tourism products and services	Enhancing transport safety and security

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
IPA Greece Albania	SO 2.4	Pillar 3 and 4	• Joint actions and development of strategies for supporting adaptation to climate change and preventing natural risks. Increasing institutional and operational capacity of local communities for supporting the prevention and management of climate change related risks.	Enhancing transport safety and security
	SO 3.2	Pillar 2	• Measures to manage safety risks created in the cross-border road network due to weather conditions and the special geomorphological characteristics of the cross-border area	
	SO 4.5	None	• Support of the digitalization in healthcare, including the supply of new and improved equipment for supporting telemedicine services, with a focus on H224 and sparsely populated communities of the cross-border area.	

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
IPA Croatia - Bosnia and Herzegovina - Montenegro	SO 2.4	Pillar 3 and 4	• Development and introduction of joint climate change adaptation, cross-border disaster prevention strategies and first response plans, as well as solutions and systems for monitoring, prevention and management of potential risks (e.g., floods, wildfires, landslides, droughts, sea pollution, earthquakes, invasive alien species, etc.), including education of public and regulation of behaviour. Encouraging intersectoral/interstate cooperation in risk prevention and rapid response management through development and implementation of joint protocols, procedures, approaches and measures, small-scale infrastructure preferring nature-based solutions, response vehicles, equipment, shelters, etc.	Enhancing transport safety and security

SCOPE: SAFETY IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
	SO 4.5	None	• Improving access to health care services for vulnerable and marginalised groups, such as elderly, children (e.g., children deprived of parental care) and persons with disabilities through investments in equipment, transport means, etc. • Developing and implementing joint activities/solutions to promote healthy lifestyles and active and healthy aging, disease prevention.	
Greece-North Macedonia	SO 4.5	None	• Actions aimed at preventing the occurrence and effects of unpredictable adverse events such as crisis situations, e.g. epidemics, nosocomial infections.	Enhancing transport safety and security

SCOPE: DIGITALISATION IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
Italy-Croatia	SO 3.2	Pillar 2	• Setting up common analysis and data exchanges on existing connections in order to define new sustainable solutions for the access to ports and the integration of transport networks in port towns; establishing action plans and common standards to manage physical and cybersecurity of freight and passengers' transports also in real time through the use of ICT and web-based tools. Promoting joint monitoring and data analysis helping defining cross border policies on greener maritime routes and sea pollution reduction;	Development of efficient capacity allocation and traffic management systems
Italy-Slovenia	SO 2.6	Pillar 2	• Developing cross-border services based on ICT solutions in order to increase the efficiency and sustainability of economic activities (logistic, delivery, mobility services, etc.)	Diffusion of innovation, data and AI for smart mobility
	ISO 1 - 6.2	All	• Joint investments to improve quality and accessibility of public services for the benefit of the most isolated and remote areas (i.e., through telemedicine, e-services for disadvantaged groups etc.) exploiting ICT technologies to share and process data and developing a bilingual offer	

SCOPE: DIGITALISATION IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
Central Europe	SO 2.8	Pillar 2	• Exchanging knowledge, experiences and good practices on smart traffic management to improve aspects such as parking, congestion, GHG and other transport-related emissions, considering among others Urban vehicle access regulations (UVAR); • Testing and rolling out Mobility-as-a-Service (MaaS) solutions and other digital business models for sustainable urban mobility and smart logistic solutions ·	Development of efficient capacity allocation and traffic management systems
	SO 3.2	Pillar 2	• Improving the coordination between regional transport operators across borders (including e.g. the harmonisation and integration of ticketing information and services and the setting up of interregional partnerships of transport operators). Developing and testing smart concepts for regional mobility (including e.g. digital solutions and traffic management systems).	Development of efficient capacity allocation and traffic management systems

SCOPE: DIGITALISATION IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
	SO 3.2	Pillar 2	• Testing the optimisation of logistic chains in rural and peripheral areas through pilot actions based on innovative technological solutions (e.g. digitalisation) · Developing and implementing green solutions for an efficient "last mile" transport of goods in peripheral, rural and sparsely populated areas	Diffusion of innovation, data and AI for smart mobility
	ISO 1 - 6.6	All	• Developing smart city and smart region strategies and supporting their integration into local and regional policies and governance systems · Further strengthening digital governance solutions to create efficient public services that facilitate interaction between administrations and citizens and businesses (e.g. e-governance solutions, digital public services, e-participation); • Testing, adapting and deploying smart digital services for better cooperation and coordination beyond administrative borders (e.g. in the health sector)	Development of efficient capacity allocation and traffic management systems
IPA CBC South Adriatic (ItalyAlbania-Montenegro)	SO 3.2	Pillar 2	• These actions may also support adopting EU rules on transports, and include digitalisation management / monitoring of transport	Development of efficient capacity allocation and traffic management systems

SCOPE: DIGITALISATION IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
	SO 3.2	Pillar 2	• Joint actions for soft mobility, multimodal transport links, ports security & green ports (such as while testing new technology, digital tools, ICT solutions in ports e.g. to enhance interoperability among ports, to support the supply chain, or to enhance connectivity to islands, incl. green solutions for short sea shipping, etc.)	Diffusion of innovation, data and AI for smart mobility
IPA Adriatic Ionian	SO 3.2	Pillar 2	• Strengthen the role of the Adriatic-Ionian transport sector within the upcoming TEN-T policy through pilot actions and the implementation of shared solutions aimed at boosting the role of ICT, in particular with regard to the dematerialization of transport procedures, especially in maritime port areas.	Development of efficient capacity allocation and traffic management systems

SCOPE: DIGITALISATION IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
Slovenia - Croatia	ISO 1 - 6.2	All	• Development of innovative cross-border solutions and pilot actions in the field of energy efficiency (jointly developed tools and solution for improving energy efficiency at different levels, models of self-sufficient energy communities, monitoring systems, proposals for reducing legal, administrative and other obstacles hampering implementation of such tools and solutions);	Diffusion of innovation, data and AI for smart mobility
IPA Greece Albania	SO 4.6	Pillar 2	• Enhancement and promotion of cultural and creative industry (capacity building, training, promotion of cultural services, support of cultural and creative industry clusters, support of upskilling and reskilling for digital transformation of CCI).	Diffusion of innovation, data and AI for smart mobility

SCOPE: DIGITALISATION IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
IPA Croatia - Bosnia and Herzegovina - Montenegro	SO 1.1	Pillar 1 and 4	• Supporting cross-border innovation and technology based on smart specialisation approach and improving cooperation between research institutions, SMEs, public sector, and business support organisations. Strengthening and modernising business support services (including small-scale infrastructure preferring nature-based solutions) that could help with: trainings, marketing, developing and or implementing new services/products, using ICT and new technologies, implementing innovative solutions in business organisation and processes (blockchain, big data, cloud computing, Internet of Things, advanced manufacturing, robotics, artificial intelligence, cybersecurity, etc.)	Diffusion of innovation, data and AI for smart mobility
	SO 1.3	Pillar 4	• Developing and supporting existing business clusters and/or networks of SMEs in applying ICT, innovation and new technologies to develop and promote common products for local cross-border and international market	Diffusion of innovation, data and AI for smart mobility

SCOPE: DIGITALISATION IN PORTS				
ETC PROGRAMME	**SPECIFIC OBJECTIVE**	**PILLAR**	**INDICATIVE AND MAIN ACTION OF SPECIFIC OBJECTIVE**	**THEME**
	SO 2.1	Pillar 2	• Implementing pilot actions to test innovative and climate-neutral solutions through, e.g., taking up and exploiting R&D results for the energy efficient renovation and heating and cooling of buildings (including cultural heritage building	Development of efficient capacity allocation and traffic management systems
	SO 4.5	None	• Development and implementation of ICT solutions and (pilot) actions to support digitalization in health care	Diffusion of innovation, data and AI for smart mobility
Greece-North Macedonia	SO 2.7	Pillar 3 and 4	• Actions related to the protection of the environment and especially in the management and monitoring of Axios/Vardar river water quality and the establishment of early warning mechanisms (using ICT). • Actions for capacity building and knowledge exchange for the management of water ecosystems (e.g. by applying innovative water treatment technologies)	Diffusion of innovation, data and AI for smart mobility

3.3 Summary by country

Each row represents the assessment of each individual EUSAIR country under consideration.

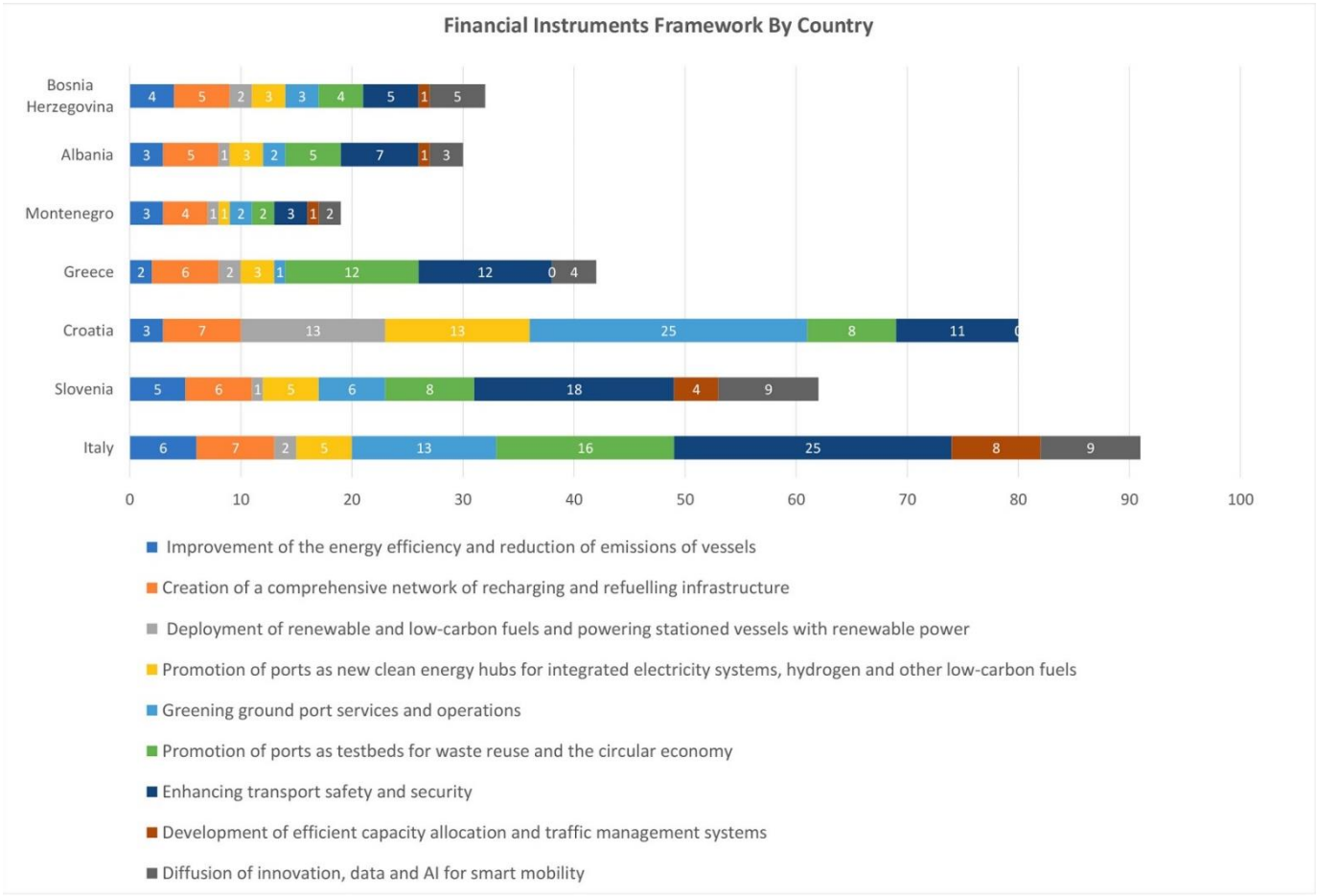
On the abscissa axis we find instead two main evaluation blocks:

- the 9 ‘themes’ included in the "green/smart port" concept: these were weighted according to the indicative and main action of Specific Objective contained in the various ETC programmes 21-27 as a qualitative/quantitative indicator. It ranges from a minimum of 0 - white color - up to 25 -dark green- witk color by graduating every 5 correlated indicative and main action.
- 11 ETC Programme: In this case, for each country, programmes 21-27 have been marked to which that country has access

Outcomes of the evaluation:

- EU countries have a higher amount of indicative and main action themes included in the “green/smart port” concept than non-EU countries
- Non-EU countries, despite the small number of indicative and main action with respect to the themes included in the "green/smart port" concept, nonetheless present a good variety and coverage of the themes.
- At the level of EU countries, the greatest satisfaction from the actions with respect to the themes belongs to Italy and Croatia with regard to the quantity, while Italy and Slovenia with regard to the variety
- As far as non-EU countries are concerned, Albania and Bosnia Herzegovina are the countries with the highest number of indicative and main actions with respect to the themes considered
- The most satisfied theme is "Safety in ports-Enhancing transport safety and security", while at the level of 'Scope' "Ports as green hubs"

EUSAIR Countries	TOPICS included in the "green/smart port" concept									ETC Programme										
	Improving sustainability in maritime vessels operations			Ports as green hubs			Safety in ports	Digitalisation in ports												
	Improvement of the energy efficiency and **reduction of emissions** of vessels	Creation of a comprehensive network of **recharging and refuelling** infrastructure	Deployment of renewable and low-carbon fuels and powering stationed vessels with **renewable power**	Promotion of ports as new **clean energy hubs** for integrated electricity systems, hydrogen and other low-carbon fuels	Greening ground **port services** and operations	Promotion of ports as testbeds for waste reuse and the **circular economy**	Enhancing transport **safety and security**	Development of efficient capacity allocation and **traffic management** systems	Diffusion of innovation, data and AI **for smart mobility**	Italy-Croatia	Italy-Slovenia	Central Europe	EURO MED	Greece - Italy	South Adriatic (ItalyAlbania+Montenegro)	IPA Adriatic Ionian	Slovenia - Croatia	IPA Greece Albania	IPA Croatia - Bosnia and Herzegovina -	Greece-North Macedonia
Italy	6	7	2	5	13	16	25	8	9	X	X	X	X	X	X	X				
Slovenia	5	6	1	5	6	8	18	4	9		X	X	X			X	X			
Croatia	3	7	13	13	25	8	11	0	0	X		X	X			X	X		X	
Greece	2	6	2	3	1	12	12	0	4				X	X		X		X		X
Montenegro	3	4	1	1	2	2	3	1	2						X	X				
Albania	3	5	1	3	2	5	7	1	3						X	X		X		
Bosnia Herzegovina	4	5	2	3	3	4	5	1	5							X			X	


Financial Instruments Framework By Country
Bosnia Herzegovina
Albania
Montenegro
Greece
Croatia
Slovenia
Italy
0
10
20
30
40
50
60
70
80
90
100
Improvement of the energy efficiency and reduction of emissions of vessels
Creation of a comprehensive network of recharging and refuelling infrastructure
Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
Greening ground port services and operations
Promotion of ports as testbeds for waste reuse and the circular economy
Enhancing transport safety and security
Development of efficient capacity allocation and traffic management systems
Diffusion of innovation, data and AI for smart mobility

3.4 Summary by ETC Programme

In the following tables, each line represents the assessment of each single EUSAIR country considered.

On the abscissa axis we find instead two main evaluation blocks:

- the 9 'themes' included in the concept of “green/smart port”: these have been weighted according to the indicative and main action of the Specific Objective contained in the various ETC programmes 21-27 as a qualitative/quantitative indicator. It goes from a minimum of 0 - white - up to 8 - dark green - white, graduating every 2 correlated indicative and main actions.
- 7 Countries: The beneficiary countries are indicated for each ETC programme

Outcomes of the evaluation:

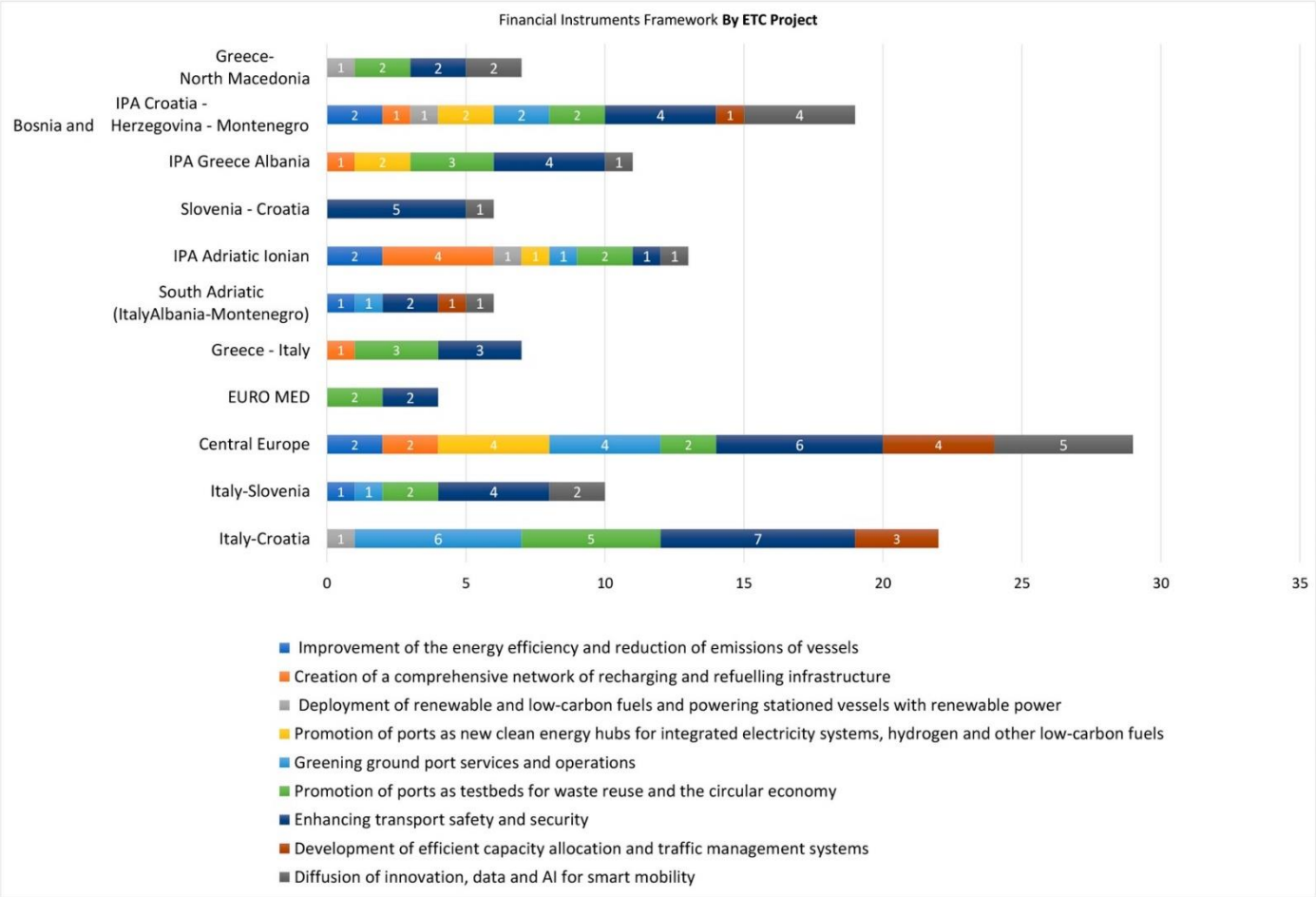
- The most homogeneous programmes in terms of satisfying the 9 'themes' included in the concept of "green/smart port" are:
    - Central Europe
    - Adriatic Ionian IPA
    - Croatian IPA
    - Bosnia and Herzegovina - Montenegro
- The programmes most oriented towards the satisfaction of only some of the 9 'themes' included in the concept of "green/smart port", with the particular concentration on the themes Ports as green hubs and Safety in ports are:
    - Italy-Croatia
    - Euromed
    - Slovenia - Croatia (mainly Safety in ports)
    - Greece and Italy

ETC Programme	Pillar	Specific Objective	ERDF in Mio €	TOPICS included in the "green/smart port" concept									EUSAIR Countries						
				Improving sustainability in maritime vessels operations			Ports as green hubs			Safety in ports	Digitalisation in ports								
				Improvement of the energy efficiency and **reduction of emissions** of vessels	Creation of a comprehensive network of **recharging and refuelling** infrastructure	Deployment of renewable and low-carbon fuels and powering stationed vessels with **renewable power**	Promotion of ports as new **clean energy hubs** for integrated electricity systems, hydrogen and other low-carbon fuels	Greening ground **port services** and operations	Promotion of ports as testbeds for waste reuse and the **circular economy**	Enhancing transport **safety and security**	Development of efficient capacity allocation and **traffic management** systems	Diffusion of innovation, data and AI **for smart mobility**	Italy	Slovenia	Croatia	Grecia	Montenegro	Albania	Bosnia
Italy-Croatia	Pillar 2 (5) Pillar 3 (2) Pillar 4 (2) Pillar 1 (1)	SO 1.4- SO 2.4 SO 2.4- SO 2.7 SO 3.2- SO	145,10	0	0	1	0	6	5	7	3	0	x		x				
Italy-Slovenia	Pillar 2 (2) Pillar 3 (1)	SO 2.4 - SO 2.6 SO 4.6 ISO 1 - 6.2	48,13	1	0	0	0	1	2	4	0	2	x	x					
Central Europe	Pillar 2 (7) Pillar 4 (3) Pillar 3 (1) Pillar 1 (1)	SO 1.1 - SO 2.1 SO 2.4 - SO 2.6 SO 2.8	150,73	2	2	0	4	4	2	6	4	5	x	x	x				
EURO MED	Pillar 3 (1) Pillar 2 (1) Pillar 4 (1)	SO 2.4 SO 2.8	106,90	0	0	0	0	0	2	2	0	0	x	x	x	x			
Greece - Italy	Pillar 2 (1) Pillar 1 (1)	SO 1.1 - SO 2.6 SO 4.5	22,57	0	1	0	0	0	3	3	0	0	x			x			
South Adriatic (ItalyAlbania-Montenegro)	Pillar 2 (7) Pillar 4 (2) Pillar 1 (1)	SO 2.1 - SO 3.2 SO 4.8	22,16	1	0	0	0	1	0	2	1	1	X				x	x	
IPA Adriatic Ionian	Pillar 2 (6) Pillar 3 (6) Pillar 4 (3) Pillar 1 (2)	SO 1.1 - SO 2.4 SO 2.6 - SO 2.7 SO 2.8 - SO	107,08	2	4	1	1	1	2	1	0	1	x	x	x	x	x	x	x
Slovenia - Croatia	Pillar 2 (1) Pillar 3 (5) Pillar 4 (2)	SO 2.4 - SO 2.7 SO 4.6 ISO 1 - 6.2	39,92	0	0	0	0	0	0	5	0	1		x	x				
IPA Greece Albania	Pillar 2 (6) Pillar 3 (1) Pillar 4 (1)	SO 2.4 - SO 2.6 SO 3.2 - SO 4.6 SO 4.5	17,96	0	1	0	2	0	3	4	0	1				x		x	
IPA Croatia - Bosnia and Herzegovina - Montenegro	Pillar 2 (4) Pillar 3 (1) Pillar 1 (2) Pillar 4 (9)	SO 1.1 - SO 1.3 SO 2.1 - SO 2.4 SO 2.6 - SO	106,97	2	1	1	2	2	2	4	1	4			x				x
Greece-North Macedonia	Pillar 2 (5) Pillar 1 (1) Pillar 3 (2) Pillar 4 (2)	SO 2.7 - SO 2.6 SO 3.2 - SO 4.5 ISO 1 - 6.6	18,01	0	0	1	0	0	2	2	0	2				x			

4. Inventory of Green and Smart port projects

4.1 Introduction

Developing a green and smart port is a significant progress in the specific application of energy



conservation and emission reduction as well as intelligent technologies in global ports and maritime shipping sectors.

A green port is a port that invests and encourages in environmentally friendly and sustainable operations in all formats of the ports and maritime industry.

This chapter aims to provide a detailed inventory of existing projects with reference to the framework of scopes and themes related to the concept of green and smart ports previously identified and illustrated in the inception report of this project.

The first part provides a specific benchmarking exercise of best practices and of European and International case studies to include the key topics of the Flagship projects, among technological innovation and sustainability and resilience.

It is followed by the state of the art of macro-region's port sector in terms of sustainable and smart initiatives by describing the ongoing projects and initiatives regarding the themes mentioned in the first part of the report.

4.2 Scope and themes of green and smart ports concept

The following chapter provide details of the themes related to the following four main scopes of green and smart points, providing detailed explanations of their relevant themes.

- Improving sustainability in maritime vessels operations
- Ports as green hubs
- Safety in ports
- Digitalization in ports

4.2.1 Improving sustainability in maritime vessels operations

Improvement of the energy efficiency and reduction of emissions of vessels

Deployment of Liquid Natural Gas (LNG) fueled vessels

The improvement of the energy efficiency and reduction of emissions of vessels can go through several steps, including the deployment of Liquid Natural Gas (LNG) fueled vessels and the test and deployment of full electric vessels and tugs.

A liquid natural gas (LNG) fueled vessel is a ship that runs on LNG as its primary fuel source. Natural gas is cooled to minus 162 degrees Celsius which turns it into a liquid. Liquefaction reduces the volume to 1/600 of that of gas and enables it to be transported in large quantities by sea. It is also relatively safe because its specific gravity is lighter than that of air and it is easy to diffuse, so there is less risk of explosion. [3] LNG is a cleaner burning fuel than traditional marine fuels, such as heavy fuel oil or diesel, and its use in shipping can help reduce emissions and comply with stricter environmental regulations. LNG-powered vessels include cargo ships, ferries, and cruise ships.

The volume of LNG trade, which plays a leading role in international gas trading, is expected to increase by 21% in 2025 compared to 2019. Globally, the number of LNG-fueled vessels has increased from 18 completed vessels in 2010 to 175 currently in service, with more than 200 on order in 2020. Most of the vessels in service are operated in Europe and it is expected that the shift from heavy oil to LNG or other alternative fuels will be further accelerated as a result of the strengthening of Sulfur Oxides (SOx) regulations in January 2020. [4]

The SOx emission regulations by International Maritime Organization (IMO) is limiting the sulfur content of bunker fuel to reduce vessel exhaust emissions of SOx and prevent air pollution. The current limit of 3.5% sulfur content in bunker fuel is being reduced to 0.5% as of January 2020. Main measures include installation of onboard scrubbers, use of complied fuel, and transition to LNG as fuel.

LNG fuel has a low environmental impact, but there are the following three general disadvantages to using it as a ships fuel.

- Installation of engines that can use LNG fuel
- Capital investment is also required in equipment other than engines, such as fuel tanks 2 to 3 times larger than conventional ones and re-liquefaction equipment.
- Cost at the time of new construction is 15 ~ 30% higher compared to conventional fueled vessels

[3] https://www.mol-service.com/blog/lng-as-ships-fuel
[4] https://www.mol-service.com/blog/lng-as-ships-fuel

Figure 1"Gas Agility", the world's largest LNG-bunkering vessel, LNG bunkering to the world's largest LNG-fueled container ship

Europe is leading the way in the field of LNG-fueled vessels, with most of these vessels operating in Europe. This is due to the fact that companies there took the lead in accepting strict sulfur content regulations in the Emission Control Areas (ECA) of the North Sea and the Baltic Sea.

The development of LNG bunkering infrastructure is also essential for the widespread use of LNG-fueled ships, and Europe is also leading the way. The Port of Rotterdam (the Netherlands), the Port of Amsterdam (the Netherlands), the Port of Zeebrugge (Belgium), the Port of Barcelona (Spain), and other major ports can LNG bunkering.

A significant example of it can be found in the Valencia port in Spain. The Port of Valencia is a major seaport located in the city of Valencia, on the east coast of Spain. It is the largest port on the Mediterranean Sea and is considered one of the most important ports in Europe. The port handles a wide range of cargo, including containerized cargo, bulk goods, and general cargo.

Valencia port is at the forefront in Spain in the supply of LNG (Liquefied Natural Gas) by the shipping company Baleària. Specifically, in 2020, the Dénia-based company carried out a total of 291 natural gas supply operations, reaching 26,777 m3, in the Port of Valencia.[5]

The Port Authority of Valencia (PAV) and Baleària have been collaborating for years in the introduction of LNG and the improvement of supply services to ships with this fuel with the implementation of the Multi Truck to Ship System (MTTS). Thus, 95% of all Baleària's supplies were carried out using this method, where several tankers simultaneously supply liquefied natural gas to the ship, making bunkering faster and more efficient. The ships that received this cleaner fuel were the five ferries that last year connected the port of Valencia with the Balearic Islands: Hypatia of Alexandria, Abel Matutes, Sicilia, Nápoles and Bahama Mama.

Test and deployment of full electric vessels and tugs

Another way to improve the energy efficiency and reduce the emissions is the employment of fully electric vessels. A full electric vessel, also known as an electric boat or electric ship, is powered by electric motors that run on stored electricity from batteries. The batteries can be charged by shore power or by on-board

[5] https://www.valenciaport.com/en/valenciaport-leads-spain-in-natural-gas-supply-operations/

generators, such as solar panels or fuel cells. Because electric motors are more efficient than internal combustion engines, electric boats are quieter, produce less pollution and have a lower total cost of ownership.

An example of this type of green vessel is the Yara Birkenland[6]. This is the world's first autonomous and zero-emission container vessel. With this vessel, the company will remove 40,000 diesel-powered truck journeys every year, and reduce NOx (Nitrogen oxide) and CO2 emissions, improve road safety, reduce road dust formation and traffic noise. The zero-emission vessel will transport mineral fertilizer from Yara's production plant in Porsgrunn, Norway to the regional export port in Brevik.

On the technical side, KONGSBERG is responsible for the development and delivery of all essential technologies at Yara Birkeland. This applies to the sensors and integration required for remote and autonomous operations, as well as electrical propulsion, battery and control systems.

Yara Birkeland was put into commercial operation in Porsgrunn in the spring of 2022. During the first to years of operation, the vessel will go through a gradual transition towards full autonomous sailing.

Figure 2 Yara Birkeland, the world's first autonomous and zero-emission container vessel

Creation of a comprehensive network of recharging and refueling infrastructure

Construction of LNG depots and facilities

This new generation of vessels (the LNG powered vessels and the fully electric powered vessels) need a new type of infrastructure so that they operate optimally.

In particular is necessary the construction of LNG depots and facilities and the deployment of LNG bunkering vessels. A liquefied natural gas (LNG) depot and facility is a location where LNG is stored and distributed. LNG is liquified, so it takes up 600 times less space than natural gas in its gaseous state, making it more practical for transport.

An LNG depot typically includes one or more large storage tanks that can hold millions of gallons of LNG. These tanks are insulated to maintain the low temperature of the LNG. The depot also includes facilities for

[6] https://www.yara.com/news-and-media/media-library/press-kits/yara-birkeland-press-kit/

loading and unloading LNG onto ships or trucks for transport, as well as systems for vaporizing the LNG back into its gaseous form for distribution to customers.

An efficient example of LNG facilities is the Adriatic LNG Terminal, which is the first offshore Gravity Based Structure (GBS) for unloading, storing and regasifying Liquefied Natural Gas (LNG), in full respect of the environment.

The Adriatic LNG terminal is a liquid natural gas offshore terminal, formally known as Terminale GNL Adriatico Srl. Located in the northern Adriatic 9 miles (14 km) offshore of Porto Levante, Porto Viro, near Rovigo, Italy, it is the world's first offshore gravity-based structure LNG regasification terminal.[7]

With a regasification capacity of 8 billion cubic meters of LNG per year (equal to half the national LNG import capacity), the terminal supplies over 10% of national consumption of natural gas.

Figure 3 Adriatic LNG terminal

Guaranteeing supply to Italy LNG shipped mainly from Qatar, but also from Egypt, Trinidad and Tobago, Equatorial Guinea and Norway, the Adriatic LNG terminal marked the start of a new phase in the national energy supply system.

The offshore terminal includes:

- A reinforced concrete structure (Gravity Based Structure - GBS) which hosts two LNG tanks;
- A regasification plant;
- Mooring and LNG unloading facilities;
- Utility systems
- Living quarters and heliport.

[7] https://en.wikipedia.org/wiki/Adriatic_LNG_terminal

Figure 4 Adriatic LNG offshore terminal

To acknowledge its technological and strategic excellence within the national energy system, in 2010 the terminal was awarded “Best Infrastructure Project” at the 12th edition of the Platts Global Energy Awards.[8]

Deployment of LNG bunkering vessels

LNG bunkering vessels are also available to feed LNG vessels. These vessels are ships that are specifically designed and built to transfer liquefied natural gas (LNG) from a storage facility or another ship to a vessel that uses LNG as fuel. This process is called "bunkering" and it is similar to refueling a traditional ship with oil. LNG bunkering vessels are equipped with specialized tanks, pumps, and other equipment that allow for the safe and efficient transfer of LNG. They are used to supply LNG to ships that have been converted to run on LNG as fuel as an alternative to oil-based fuels, helping to reduce emissions and increase energy efficiency.

[8] https://www.adriaticlng.it/en/the-terminal/

Figure 5 LNG bunkering vessel Coral Energy

LNG bunkering vessels are used for ship to ship bunkering operations, supporting the increasing use of LNG as a marine fuel. The typical capacity of these vessels is up to 10,000 cubic meters.

An example of LNG bunker vessel would be the "Hai Yag Shi You"[9], described as the world's largest LNG bunker vessel, which has been officially put into operation by China State Shipbuilding Corporation's subsidiary Guangzhou Shipbuilding International (GSI) following a conversion project.

The vessel is China's first LNG bunkering vessel and it was converted from an LNG carrier for China National Offshore Oil Corporation (CNOOC). It was built by Jiangnan Shipbuilding and delivered in May 2015. The conversion project was launched back in August 2022 at GSI's Wenchong yard. The bunker vessel, spanning a total length of 184.7 meters and a molded width of 28.1 meters, can carry 30,000 cubic meters of liquefied natural gas. During the conversion process, the vessel will be fitted with key equipment such as cryogenic units, gas combustion devices, ship-to-ship refueling systems, and reliquefication systems to enable the refueling function.

The vessel has a fueling capacity of 1,650 cbm of LNG per hour, sufficient to fuel large container ships, duel fuel ore carriers, crude tankers and RORO ships.

[9] https://www.offshore-energy.biz/worlds-largest-lng-bunker-vessel-is-here/

Figure 6 World's largest LNG bunker vessel - Hai Yang Shi You 301

Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power

Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels

Use of renewable energy sources to feed the power system of ports and terminals

There are several clean energy sources that can be used to feed the power system of a port, including:

- Solar power: Solar panels can be installed on the roofs of port buildings and on dedicated structures in the port area. These panels convert sunlight into electricity that can be used to power the port's operations.
- Wind power: Wind turbines can be installed in the port area to generate electricity from wind energy. This is particularly effective in coastal areas where winds are strong.
- Hydroelectric power: In ports located near a river or waterfall, hydroelectric power can be generated by harnessing the energy of flowing water.
- Biomass: Organic material such as wood chips, agricultural waste, and sewage can be converted into energy through the process of combustion or anaerobic digestion.
- Geothermal: Ports located in areas with geothermal activity can harness the heat from the earth's crust to generate electricity.
- Tidal and wave energy: Ports located in coastal areas can harness the energy from ocean tides and waves to generate electricity.

Figure 7 Sustainable Ports as Energy Hubs[10]

As an energy hub, a port's demand for electricity, as being facilitated by the grid, will vary over time. Electrification of the transport sector increase the need for demand side management, cluster control and energy storage to offer peak load shaving and flexibility. Furthermore, it is large potential to save energy and increase the amount of local produced renewable energy.[11]

The choice of energy source to feed the power system of a port will depend on the location and availability of the resources, as well as the specific energy demands of the port. There are several examples for each source. The first one related with solar power can be found in the Hualien Port, Taiwan. Considering the increase in environmental protection awareness and the rise in prevalence of adopting renewable energy, Hualien Port began installing solar panels on the rooftops of its buildings in 2018. This led to an increase in the port's income and reduction in its CO2 emissions. At the end of 2020, a total of 2,407 kilowatts of capacitors will be completed. According to statistics, a total of 1,283,841 kWh of electricity will be produced in 2020, reducing carbon dioxide emissions by approximately 684 metric tons.[12]

For what concern the wind power there can be two alternatives: either the energy is produced on site, in the harbor area by installing wind turbines in the immediate vicinity of the wharves, or the energy is produced in offshore wind farms, more or less distant from the harbor, and then transported to the harbor area. As a first case, one can consider the port of Tanjin where the , three wind turbines intended for clean power generation were connected to the port's power grid marking the completion of phase II of the 15 Megawatt wind power project as part of the Green Intelligent Energy Demonstration Program Section C at the Port of Tianjin.[13]

Port of Tyne (UK) is an example of an infrastructure which use an off-shore wind farm. The Port of Tyne has launched a new green energy park that will serve as a strategic base for the UK North East's renewable energy sector. The Tyne Clean Energy Park is planning to provide infrastructure for all renewable energy generation needs. A total of 200 hectares of land will be available within its boundaries.

Located on 4 sites, the Port of Tyne is one of only two deep sea ports in the north east region. Offering sites and berths to accommodate deep drafted vessels with no beam restriction, Port and Tyne Clean Energy

[10] https://maritime-executive.com/editorials/sustainable-ports-as-energy-hubs
[11] https://maritime-executive.com/editorials/sustainable-ports-as-energy-hubs
[12] https://hl.twport.com.tw/en/CP.aspx
[13] https://www.offshore-energy.biz/port-of-tianjin-making-headway-on-clean-power-supply/

Park users will benefit from unrestricted, lock free access to berths with 13.0m of depth alongside. The Port is a safe haven for offshore wind operators and other renewables specialists that is open 24/7, 365 days a year, during all tide states.

Figure 8 Port of Tyne

Port of Tyne is already rapidly transforming its own commercial operations to become a low-carbon industrial hub and made a clear commitment to decarbonization in its Tyne 2050 strategy. This outlines the Port's strategic vision to become an Enabler and Operator of clean energy powered maritime supply chain services, including being 'Carbon Neutral by 2030' and 'All Electric by 2040'.[14]

Deployment of new, more efficient port lighting systems

Another improvement in order to transform the port into a green hub is the deployment of new, more efficient port lightening system. A more efficient port lighting system would be one that is designed to minimize energy consumption while providing the necessary lighting for port operations. There are several ways to achieve this:

- LED lighting: LED lights are more energy-efficient than traditional incandescent or fluorescent lights. They consume less power and last longer, reducing the need for frequent replacements.
- Smart lighting control: Smart lighting control systems can be used to automatically adjust the brightness of lights based on the level of ambient light or the presence of people. This can help to reduce energy consumption when lighting is not needed.
- Daylight harvesting: This technique uses sensors to detect the amount of natural light available and adjust the intensity of artificial lights accordingly. This can help to reduce energy consumption during daylight hours.
- Solar-powered lighting: Solar-powered lights do not require a connection to the electrical grid, and can be installed in areas where a power source is not readily available. This can be especially useful for remote areas of the port.

[14] https://www.portoftyne.co.uk/news-and-media/news/port-of-tyne-launches-tyne-clean-energy-park-to-boost-north-easts-renewables-infrastructure

In particular the replacement of the old lightning system with the new LED lighting can also significantly contribute to achieving an efficient port lighting system. Several ports have already started with this process: Port Klang (Malesia), Tan Cang (Vietnam) and the Port of Rotterdam (Netherland).[15]

Creation of green hydrogen sites for production and distribution of hydrogen power

Another fundamental elements in order to mitigate the emissions for a port is the creation of green hydrogen sites for production and distribution of hydrogen power. Hydrogen fuel cells can be used to power ships and cranes, and hydrogen can also be used to generate electricity for lighting and other needs. Additionally, hydrogen can be used to store energy generated from renewable sources, such as solar and wind power, which can then be used to power the port during times of low renewable energy production. This can help to reduce the port's dependence on fossil fuels and lower its carbon emissions. There are several examples of how Hydrogen is deployed in a port's infrastructure, but the most interesting is in the port of Quingdao, in the port of Valencia and in the port of Rotterdam.

Qingdao Port has claimed that it is the world's first 'hydrogen + 5G' smart ecological terminal, pioneering hydrogen-powered crane technology and systems by developing a hydrogen energy-driven solution for the fueling of equipment needed for the operation of a large port.

The system reduces carbon emissions by some 3.5 kilograms and sulfur dioxide emissions by 0.11 kilograms per TEU.[16]

In the Valencia Port the tank and compressor of the hydrogen generator which will supply hydrogen to the prototypes of port machinery have already been placed on the north quay.

The European project which will enable Valencia and its port to work and move port machinery with hydrogen is called "H2PORTS – Implementing Fuel Cells and Hydrogen Technologies in Ports". It is an initiative coordinated by the Valencia port Foundation in close collaboration with the Port Authority, and is financed by the Clean Hydrogen JU programme of the European Union. Its main objective is to test and validate hydrogen technologies on port machinery that will provide applicable and real solutions without affecting the performance and safety of port operations and producing zero local emissions.

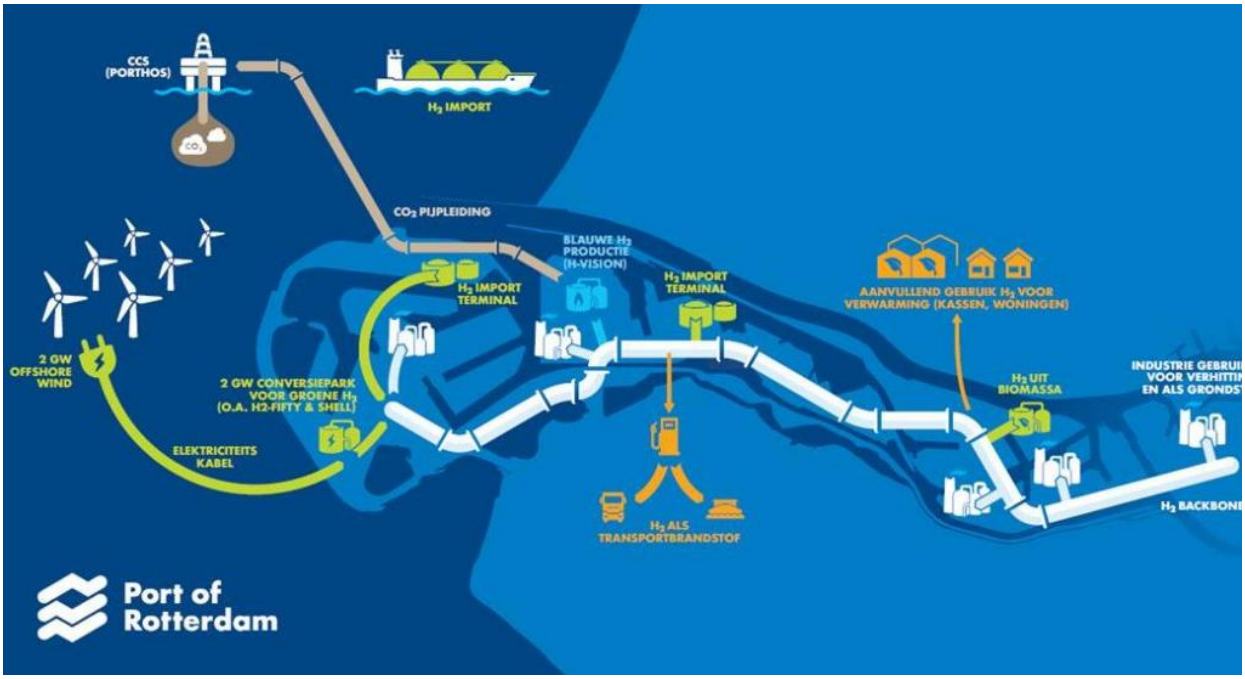
Valencia port is committed to the fight against climate change and decarbonization through different actions. Green hydrogen is one of the lines of work being carried out by the PAV, which has been recognized by the Spanish Government as a benchmark within the framework of the 'Hydrogen Roadmap'. Thus, the PAV is one of the institutions, together with the Valencia City Council, the Generalitat Valenciana and the Universitat Politécnica de València, of the 'Valencia Hydrogen Valley' strategy to coordinate, create synergies and promote research into green hydrogen in the transport and logistics sector in Valencia and its metropolitan area.[17]

Finally The Port of Rotterdam Authority has set up a special site for this new industry on Maasvlakte 2. The electrolysers that produce green hydrogen using green power (offshore wind) will be located there. These are plants of Shell (Holland Hydrogen 1), bp and HyCC (H2-Fifty), and of Air Liquide (CurtHYL). The plants each have a capacity of 200 to 250 MW. By comparison, the largest currently operational plant in Europe is 20 MW. The central government has announced that a total of seven green hydrogen production projects

[15] https://www.ledsuniverse.com/led-sea-port-lighting-high-mast-lighting-for-port-hangar/
[16] https://www.porttechnology.org/news/qingdao-port-becomes-the-worlds-first-hydrogen-powered-and-5g-intelligent-port/
[17] https://www.valenciaport.com/en/the-port-of-valencia-now-has-its-hydrogen-plant/

in the Netherlands will receive subsidies. Three of these are in Rotterdam. The other four are in Zeeland, Amsterdam/North Sea Canal and Groningen.[18]

Figure 9 Port of Rotterdam



Creation of central power management systems to regulate the energy network of the port

Another facility which is extremely useful in order to obtain a sustainable port is the central power management system. This can be used to regulate the energy network of a port by controlling the distribution and use of energy within the port. It would allow for real-time monitoring and management of energy consumption and production, including the integration of renewable energy sources such as solar and wind power.

The system would include sensors and other monitoring equipment to gather data on energy usage, and use this data to optimize energy usage and reduce energy waste. It would also include control systems to manage the distribution of energy throughout the port, including the ability to switch between different energy sources, such as hydrogen fuel cells and traditional power sources, as needed.

The central power management system could also be connected to the grid, allowing for the export of excess energy to the grid and the import of energy from the grid as required. This would enable the port to take advantage of fluctuations in energy prices and reduce its dependence on traditional power sources, further reducing its carbon emissions.

An example of a port that has implemented a central power management system is the Port of Rotterdam in the Netherlands. The port, one of the busiest in the world, has been working to reduce its carbon emissions and increase its use of renewable energy. To achieve this, the port has implemented a central power management system to control and optimize the use of energy throughout the port.[19]

[18] https://www.portofrotterdam.com/en/building-port/sustainable-port
https://www.offshorewind.biz/2021/02/15/rotterdam-port-and-uniper-plan-green-hydrogen-project/
[19] https://sustainableworldports.org/wp-content/uploads/Port-of-Rotterdam-Authority-Alternative-Maritime-Power-in-the-Port-of-Rotterdam.pdf

Deployment of public charging points for electric vehicles

Finally in order to obtain a no emission port Is fundamental the deployment of public charging points for electric vehicles. In this way it enables the use of electric vehicles for transportation within the port. This includes electric vehicles for cargo handling, such as electric forklifts, as well as electric buses and other vehicles used for transportation of people and goods.

Figure 10 Electric vehicles for port

Electric vehicles produce zero emissions at the point of use and can significantly reduce the carbon emissions of the port. By providing charging infrastructure, it makes it more likely that companies and individuals will choose electric vehicles over traditional, fossil-fuel-powered vehicles, which will further reduce the port's carbon emissions.

Additionally, by having public charging points, it allows for the use of electric vehicles for transportation outside the port, such as for the delivery of goods and for the transportation of port workers. This would further reduce the carbon emissions associated with transportation to and from the port.

Having a comprehensive charging infrastructure for electric vehicles is a necessary step for ports to transition to a more sustainable future, and to reduce their carbon footprint.

An example of a port that has implemented public charging points for electric vehicles is the Port of San Diego in California, United States. The port has installed a network of charging stations for electric vehicles, including both Level 2 and DC fast charging stations. These charging stations are available for use by the public and are intended to support the use of electric vehicles for transportation within the port and the surrounding area.[20]

Electrification of quays and deployment of onshore power supply systems (cold ironing)

Powering stationed vessels with renewable power involves using energy from renewable sources like solar and wind to generate electricity to power the vessel while it is at port. This can be done through the use of solar panels, wind turbines, and other renewable energy technology.

The goal of using renewable and low-carbon fuels and powering vessels with renewable power is to reduce the environmental impact of shipping. Traditional fossil fuels are a major source of greenhouse gas emissions, which contribute to climate change. Renewable and low-carbon fuels, as well as the use of renewable power, can help reduce the carbon footprint of shipping and make it more sustainable.

[20] https://www.portofsandiego.org/environment/energy-sustainability/transportation

An example of a policy aimed to incentivize the use of Low carbon fuels can be found in Long Beach Port in Los Angeles[21], where The Green Ship Program is adopted. Under the program, ships can get thousands of dollars in incentives per call if they are powered by cleaner engines, reducing emissions such as diesel particulate matter and nitrogen oxides. In addition, more than 95% of vessels earn incentives by complying with the Green Flag Program by slowing down ships to 12 knots or less within 20 nautical miles of Point Fermin. A slower approach to the port saves fuel and therefore less pollution once landed.

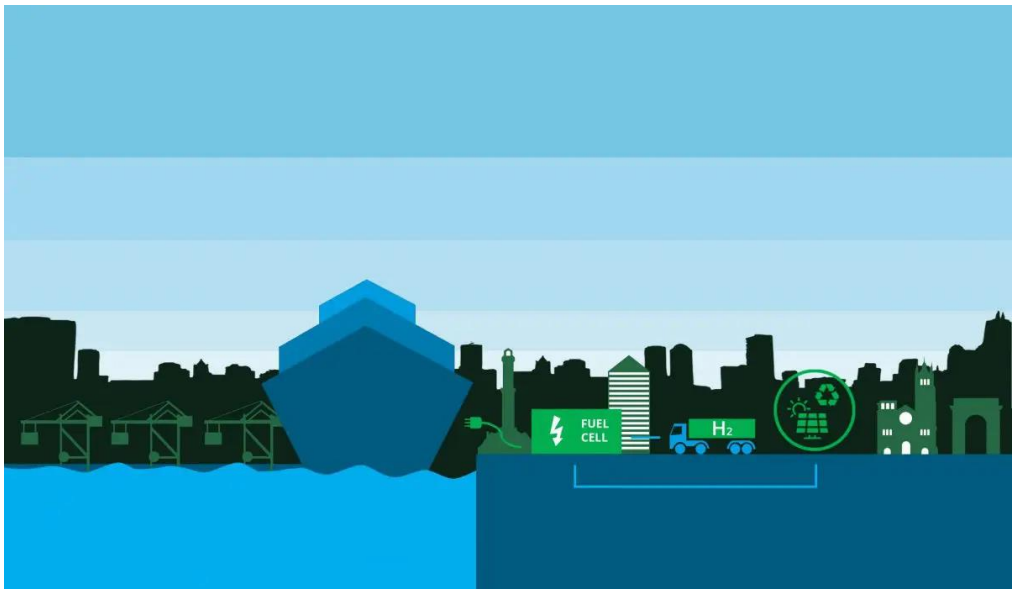
Figure 11 Shore power at the Port of Los Angeles

It is fundamental the electrification of quays and deployment of onshore power supply systems (cold ironing). Cold ironing, or shore connection, shore-to-ship power (SSP) or alternative maritime power (AMP), is the process of providing shoreside electrical power to a ship at berth while its main and auxiliary engines are turned off.[22] Cold ironing permits emergency equipment, refrigeration, cooling, heating, lighting and other equipment to receive continuous electrical power while the ship loads or unloads its cargo. Shore power saves consumption of fuel that would otherwise be used to power vessels while in port, and eliminates the air pollution associated with consumption of that fuel. Use of shore power facilitates maintenance of the ship's engines and generators, and reduces noise.

[21] https://polb.com/

[22] https://safety4sea.com/cm-do-you-know-what-cold-ironing-is/

Figure 12 Cold Ironing[23]



The CO2 emissions generated by a cruise ship parked for 10 hours are equivalent to the amount of emissions of 25 cars in one year. From various studies on emissions related to port activities, it emerges that ships parked and maneuvering are by far the most polluting , with a carbon footprint sometimes equal to 80% of the total emissions in the port.

The cold ironing solution guarantees continuity in the provision of services on board, with the reduction of polluting emissions, or even zeroing them if the system is totally powered by renewable sources. In addition to the reduced polluting emissions, the beneficial effects of Cold Ironing include: the reduction of noise pollution , the improvement of comfort on board while in port, the improved positioning of the shipowner in the eyes of the customer through a "green" cruise product ”.[24]

In case of the Hualien Port, in Taiwan.[25] the power supply equipment on the shore to provide the power required for the maintenance or routine maintenance, replacing the diesel used by the internal combustion engine of the ship, thereby greatly reducing air pollution. In addition to the full use of ultra-low-sulfur low-pollution fuel super diesel as fuel for ships, shore power facilities have been set up for all port handling vessels at several piers cooperate with sea patrols.

For the ports of Bari and Brindisi a planned cold ironing project envisages the realization of a network of systems for the supply of electricity from the shore to the ships during the mooring phase, so as to minimize the use of the auxiliary engines on board for the self-production of the necessary electricity, significantly limiting emissions of CO2, nitrogen oxides and fine dust, as well as noise impact.[26] In addition, the construction of photovoltaic power plants is planned to partially cover the energy needs arising from the activation of cold ironing systems.

[23] https://www.rinnovabili.it/mobilita/navigazione-sostenibile/cold-ironing-porti-riduzione-emissioni-marittime/
[24] https://www.rinnovabili.it/mobilita/navigazione-sostenibile/cold-ironing-porti-riduzione-emissioni-marittime/
[25] https://hl.twport.com.tw/en/CP.aspx
[26] https://www.adspmam.it/porti-di-bari-e-di-brindisi-riduzione-di-co2-e-maggiore-eco-sostenibilita-firmato-il-contratto-per-la-progettazione-definitiva-per-gli-interventi-di-cold-ironing-la-durata-del-servizio-e-di-massimo/

4.2.2 Ports as green hubs

Greening ground port services and operations

Deployment of low emission cranes, front-loaders and other service vehicles

Deployment of low emission cranes, front-loaders, and other service vehicles refers to using construction equipment that has been specifically designed to emit fewer pollutants and greenhouse gases into the environment. This can include using electric or hybrid vehicles, as well as vehicles that use alternative fuels like propane or natural gas. The goal is to reduce the environmental impact of construction operations while maintaining or improving performance and efficiency.

Low emission cranes work by using alternative power sources or advanced engine technology to reduce emissions of pollutants and greenhouse gases. One example is an electric crane, which uses an electric motor to power its movements instead of a traditional internal combustion engine. This eliminates the emissions associated with burning fossil fuels and can also provide a quieter and smoother operation.

Another example is a hybrid crane, which uses a combination of an internal combustion engine and an electric motor. The electric motor can be used during low power operations such as slow moving or idle times, reducing the use of the internal combustion engine and its associated emissions.

One example of a low emission crane that is used in ports is the Kalmar E-One2 electric straddle carrier. This is a battery-powered straddle carrier that is used for moving shipping containers within a port. The electric drivetrain eliminates the need for fossil fuels, reducing emissions of pollutants and greenhouse gases. The E-One2 also features a regenerative braking system, which captures energy from braking and uses it to recharge the batteries. Additionally, the E-One2 has a low noise level, which makes it ideal for use in port environments where noise pollution is a concern.

One of the port where this technology is implemented in the most effective way is the Long Beach Port in Los Angele, where the state-of-the-art terminal will be nearly all-electric, with automated stacking cranes and guided vehicles to handle cargo. Orient Overseas Container Line signs a 40-year, $4.6 billion lease to be the primary tenant.[27]

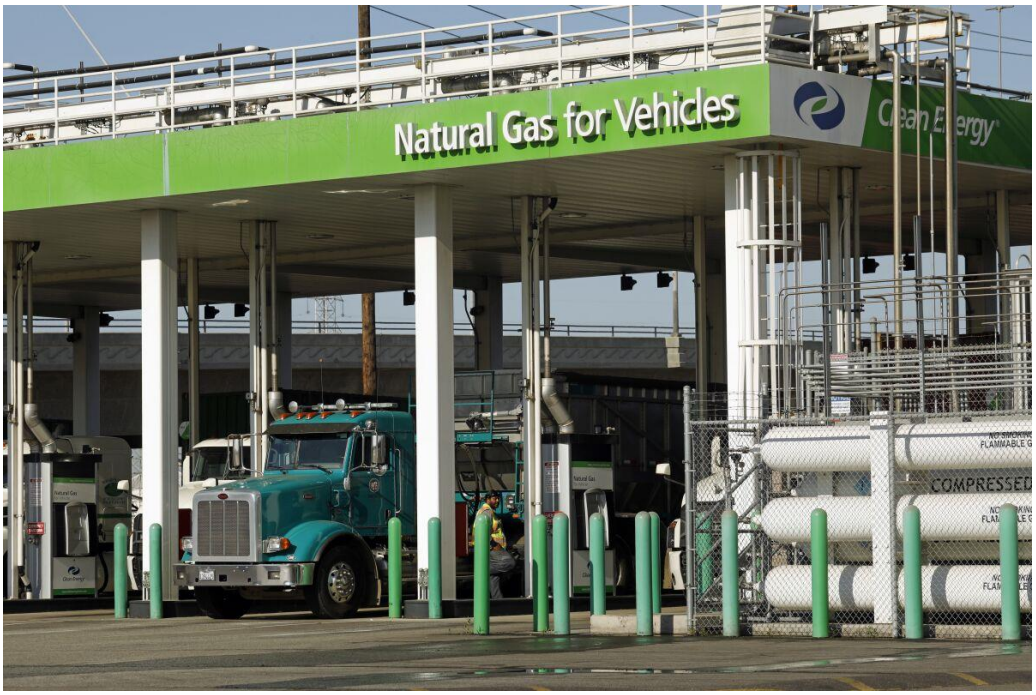
Deployment of Mobile LCNG Stations serving the purposes of refueling CNG fueled port heavy duty vehicles and buses

The deployment of mobile liquefied natural gas (LCNG) stations serves the purpose of refueling compressed natural gas (CNG) fueled heavy-duty vehicles and buses at ports. These mobile stations are equipped with the necessary equipment to convert liquefied natural gas (LNG) into CNG, which can then be used to fuel vehicles. They are designed to be easily transported and set up at different locations within the port, making them a flexible solution for providing CNG fuel for heavy-duty vehicles and buses.

The use of mobile LCNG stations at ports can help to reduce emissions from heavy-duty vehicles and buses, as CNG is a cleaner-burning alternative to diesel fuel. It can also help to reduce dependence on fossil fuels, as natural gas is a domestic and abundant resource. Additionally, the mobile station can be moved to different location as needed, which means they can be used to fuel vehicles at multiple sites within the port as well as be used in different ports.

[27] https://polb.com/port-info/green-port/

Figure 13 A natural gas fueling station operated by Clean Energy Fuels Corp. is situated in L.A.'s Wilmington neighborhood, near the ports of Los Angeles and Long Beach



The world's largest natural gas truck fueling station can be found in the Long Beach Port, Los Angeles[28]. The new public access station, configured to fuel trucks on a 24/7 basis, features two 25,000-gallon liquefied natural gas (LNG) storage tanks, six LNG dispensers, and two compressed natural gas (CNG) dispensers. The Clean Energy station is located on property leased from the Port of Long Beach at Anaheim and I streets. It is specifically designed to support the goals of the San Pedro Bay Ports' Clean Air Action Plan (CAAP) and Clean Truck programmes. The Ports' CAAP and Clean Truck programmes call for the retirement or conversion of old diesel trucks entering the ports in favor of new diesel and alternative fuel (natural gas) trucks. Natural gas vehicle fuel provides lower emissions than gasoline and diesel, including up to a 23% reduction in greenhouse gases in medium- and heavy-duty applications and up to 30% reductions for light-duty vehicles.

Greening port spaces

Greening the port space is important for a variety of reasons, including:

- Environmental protection: Greening ports can help to reduce the environmental impact of port operations. This includes reducing emissions from ships, cargo handling equipment, and other vehicles, as well as reducing the amount of waste and pollution generated by the port.
- Community engagement: Greening ports can also help to improve the relationship between the port and the local community. By reducing emissions and pollution, and increasing the use of clean technologies, ports can become better neighbors and contribute to the overall well-being of the community.
- Economic benefits: Greening ports can also provide economic benefits. For example, ports that are able to reduce their environmental impact are often more attractive to shipping companies and other businesses that are looking for sustainable logistics solutions. Additionally, the use of clean technologies can also help to reduce costs and improve the overall efficiency of the port.

[28] https://investors.cleanenergyfuels.com/news-releases/news-release-details/clean-energy-opens-worlds-largest-lngcng-truck-fueling-station

Examples in environmental protection can be found in a lot of ports around the world, especially where there are newly built ports. One of them is the Hamad Port in Qatar[29].

Hamad Port, a Greenfield mega port located south of Doha city was developed as the new logistics hub for the State of Qatar. The scope of the first phase was to develop a port complex in an area of 28 square km including a 10 km long channel with a width of 300 m. Construction of the port began in 2010; it became operational in December 2016. It was officially opened in September 2017, and is expected to become fully operational by 2020.

The guiding principle for the port management was to ensure that the project is sustainable and environmentally does not adversely affect the communities in the vicinity. With guidance from the Qatar's Environment ministry, a separate project was set for independently monitoring the development activities with respect to their effects on environment. In particular the impact of the construction activities on air quality, coastal morphology, groundwater quality, marine ecology, sediment, noise, fauna and flora were closely monitored and follow up actions were taken where needed.

For example, a separate project was initiated to relocate the 'at risk' marine life to alternate 'recipient' sites. A total of 4,257 square meters of sea-grass, 139,117 mangroves, 11,595 directly threatened hard coral colonies and 121 m^3 of existing reefs were relocated to provide habitat for resident fish and preserve its ecosystem functionality.

Another example of efficient environmental protection of the port area is the Port Klang[30], near Kuala Lumpur. Here several green initiatives are adopted, including adopting marine sanctuary area, collaborating with Malaysian Nature Society, beach cleaning, mangrove planting and environmental monitoring and waste management.

Finally a significant example for the "urban point of view "is the Hualien Port, Taiwan[31]. Here, after the outer ring road along the northern coast was built, vehicles change their route to the underground road, thus reducing the air and noise pollution suffered by communities along the northern coast, ensuring the safety of people and vehicles, and quality of life of the community. In addition, access roads to the Port of Hualien have been built to separate port traffic from the commuting routes of nearby residents. A green belt, railings, bicycle pathway, promenade, and jogging trail have been built upon the box culvert road. In addition to its extensive, ongoing environmental monitoring and management work, the Port is also deeply invested in the surrounding community. To mitigate the impact of the commercial and industrial activity it generates, the Port has constructed an 11 acre green belt between it and the neighboring residential community. This green belt serves as a noise barrier and, more importantly, as a green buffer zone between the Port and the city.

[29] https://sustainableworldports.org/project/hamad-port-ensuring-sustainable-mega-port-development/
[30] https://www.westportsholdings.com/2021/02/10/port-klang-awarded-apsn-green-port-2020/
[31] https://hl.twport.com.tw/en/CP.aspx

Figure 14 Port of Hualien

Optimization of port operations to reduce ground vehicle mobility

Optimization of port operations to reduce ground vehicle mobility typically involves implementing strategies and technologies that can reduce the number of vehicles needed to move cargo and people within the port. This can include:

- Intermodal transportation: Utilizing intermodal transportation, such as using cargo trains and ships to move cargo instead of trucks, can reduce the number of ground vehicles needed to transport cargo to and from the port.
- Shared mobility: Encouraging shared mobility solutions, such as carpooling and ride-sharing, can help to reduce the number of vehicles needed to move people within the port.
- Route optimization: Optimizing routes for vehicles, such as using GPS technology to plan the most efficient routes, can help to reduce the distance that ground vehicles need to travel.
- Consolidation: Consolidating cargo loads in order to make a single trip rather than multiple trips can reduce the number of ground vehicles needed to move cargo.

For what concern the intermodality, a significant example is the port is the Montreal Port[32]. With over 100 km of rail lines and four locomotives, the Port of Montreal is a unique model in North America in that the port authority operates its own railway and offers on-dock shunting services to its Class1 railway partners. Since over 60% of greenhouse gas emissions generated by port authority activities are generated by its rail activities, the Montreal Port Authority (MPA) began replacing its fleet of locomotives with next generation low-emission GenSet locomotives since 2010. To fully optimize the environmental benefits from these engines, the MPA is introducing and testing in 2021 an on-board dashboard that will make real-time recommendations to the conductor with the aim to optimize driving behavior and further save on fuel consumption. Locomotives are being equipped with sensors that capture a full range of data on train specifications and parameters, feeding the AI optimization algorithm. Recommendations on speed, acceleration, tractive power output and distribution will assist drivers in lowering fuel consumption. The project could reduce MPA's greenhouse gas emissions by 7 % and fuel consumption by 11 % annually.

[32] https://www.port-montreal.com/en/the-port-of-montreal/social-responsibility/sustainable-development#espaces

Deployment of innovative handling systems to reduce the impact of port operations on air pollution

In the recent years ports are becoming more receptive to disruptive solutions from industry in a bid to slake the prevalent challenges facing container handling in operations, systems integration, and reducing emissions.

Artificial Intelligence (AI), intelligence demonstrated by machines, is making waves in Smart Port and terminal operations. Artificial Intelligence is a key technology for Smart Ports and the reason for port automation. In fact, without AI Smart Ports could not exist. AI has already impacted global logistics companies and will continue to impact the development of the maritime and shipping industry. Digital Smart Ports using AI can handle an increase in cargo and traffic, optimize employee working hours, cut human error, and make the supply chain more productive. AI improves overall efficiency. For ports and shipping companies, AI and automation projects are known as retrofitting. This is when existing facilities, like ports, employ AI technologies into a traditional system to create a safer and more organized environment. AI enables companies, to create software-based platforms and modules that maritime actors can use for improved business practices. Essentially, with the help of AI, ports could process their data to help them to make accurate decisions, plan for shipping arrival and departure times and optimum storage solutions, and quickly load and unload containers and cargos from ships. [33]

Promotion of ports as testbeds for waste reuse and the circular economy

Use of secondary materials in production and construction

The use of secondary materials in production and construction in a port is important for a variety of reasons, including:

- Environmental sustainability: Reusing secondary materials, such as recycled steel and concrete, can help to conserve natural resources and reduce the environmental impact of port operations.
- Energy efficiency: Using secondary materials can help to reduce the energy needed to produce new materials, which can help to reduce the overall energy consumption of the port.
- Cost savings: Using secondary materials can be more cost-effective than using new materials, which can help to reduce the overall costs of port operations.
- Job creation: The use of secondary materials can also generate jobs in the recycling and repurposing industries
- Waste reduction: The use of secondary materials can help to reduce the amount of waste generated by the port, by repurposing materials that would otherwise be discarded.
- Compliance: Using secondary materials can also help ports to comply with regulations and standards related to waste reduction and environmental sustainability.

Several examples can be found in the use of secondary materials in production and construction. One of them is in the Hamad's Port. Here an environmental concern from the project was turbidity from dredging and groundwater disposal. To overcome this, huge dredged water settling ponds were constructed. Sand and gravel recovered from the dredging activities were processed and then beneficially used for reclamation and port construction activities. An estimated 44.4 million cubic meter of dredged material and 64.7 million cubic meter of excavated material were used for this purpose, resulting in significant savings for the project and partly offsetting relocation costs.[34]

Deployment of waste-to-energy facilities

A waste-to-energy (WTE) facility in a port facility is a type of facility that converts waste into energy. This can be done through a variety of methods, such as incineration, gasification, or pyrolysis. The waste that is

[33] https://sinay.ai/en/what-is-artificial-intelligence-in-smart-port-operations/

[34] https://sustainableworldports.org/project/hamad-port-ensuring-sustainable-mega-port-development/

processed in WTE facilities can include a wide range of materials, such as municipal solid waste, industrial waste, and even biomass.

The main goal of WTE facilities in a port facility is to convert waste materials into electricity, heat, or fuel. This can help to reduce the amount of waste that needs to be disposed of in landfills and can also help to generate clean energy. Additionally, WTE facilities can also reduce greenhouse gas emissions and decrease the dependence on fossil fuels. WTE facilities in a port facility are integrated into the port's logistics operations, and they can be used to power the port's infrastructure, vehicles and equipment. Also, they can be used to provide energy to surrounding communities or industries.

An example of a waste-to-energy facility in a port facility is the Copenhagen's waste-to-energy (WTE) facility, also known as Amager Bakke. This WTE facility is located at the Port of Copenhagen, and it is designed to convert waste into energy. The facility is capable of processing up to 600,000 tons of waste per year, and it generates electricity and heat for the city of Copenhagen.[35]

Another example is the Port of Rotterdam in the Netherlands, which has a WTE facility that converts waste into energy and heat. The facility is capable of processing up to 3,000 tons of waste per day, and it generates enough energy to power around 40,000 households. The heat generated by the facility is used to heat buildings in the nearby town of Maasvlakte.[36] The bio plant and incinerator on their site, in which the production's waste is treated and transformed into steam. The steam is used as an energy source in the existing on-site production plant, thus making it a circular process.[37]

Reconversion of industrial and port areas into eco-districts is the process of transforming these areas into sustainable, low-carbon communities. This typically involves the repurposing of existing industrial and port infrastructure, such as buildings and land, to create new residential, commercial, and recreational spaces. The goal is to create mixed-use, walkable communities that promote sustainable transportation options, energy efficiency, and environmental stewardship.

[35] https://www.power-technology.com/projects/amager-bakke-waste-energy-plant/
[36] https://www.portofrotterdam.com/en/building-port/sustainable-port
[37] https://chemicalparks.eu/news/lyondellbasell-covestro-water-based-waste-energy-rotterdam-netherlands

Figure 15 Bio plant and incinerator converting water-based waste to energy in Rotterdam

Reconversion of industrial and port areas into eco-districts, exploring possibilities to set up ship decommissioning operations

One possibility for the reconversion of industrial and port areas into eco-districts is to set up ship decommissioning operations. This involves the process of dismantling and recycling end-of-life ships in an environmentally responsible manner. Ship decommissioning operations can be integrated into the eco-districts, providing a source of employment and economic development. Additionally, this can also help to reduce the environmental impact of shipping and promote sustainable transportation.

Figure 16 P Zorrozaurre eco-district project

The ship recycling process is regulated by the International Maritime Organization (IMO), and the shipowners are responsible for ensuring that ships are recycled in safe and environmentally sound manner. Additionally, there are also standards such as the Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships.

An example is the redevelopment of the former shipyard in Bilbao, Spain, which has been transformed into a sustainable mixed-use community, known as the Zorrozaurre eco-district. The project includes the

construction of new residential and commercial buildings, as well as the creation of new public spaces and parks. The development also includes a focus on sustainable transportation, with the construction of bike lanes and pedestrian walkways, as well as the promotion of electric vehicles.[38]

4.2.3 Safety in ports

Enhancing transport safety and security

Improvement of infrastructure resilience and deployment of measures to contain the impact of extreme weather events

In order to enhance transport safety and security in ports it is fundamental to improve the infrastructure resilience and deployment of measures to contain the impact of extreme weather events. In fact these events can cause significant damage to port infrastructure and disrupt port operations. This can include damage to berths and wharfs, flooding of port facilities, and erosion of coastal areas. These disruptions can result in significant economic losses, as well as potential safety hazards for port workers and the public.

By improving the infrastructure resilience and deploying measures to contain the impact of extreme weather events, ports can minimize the potential damage and disruption caused by these events. This can include measures such as reinforcing berths and wharfs, elevating or relocating port facilities to higher ground, and implementing coastal protection measures. Additionally, ports can also implement early warning systems and emergency response plans to minimize the potential damage caused by extreme weather events.

Furthermore, climate change is resulting in an increase in the frequency and severity of extreme weather events, making it more important than ever to improve the resilience of port infrastructure and to deploy measures to contain their impact.

In the case of Hualien Port, in accordance with the Environmental Protection Agency's "Port Area Pollution Prevention and Reduction Measures Plan", Hualien Port Branch has built the Outer Harbor Wharf's runoff wastewater interception and treatment system year by year to control and reduce the pollution of stormwater runoff wastewater. In 2015, the Outer Harbor Pier 25 runoff wastewater collection system was completed, with a water treatment capacity of 500CMD, reducing the discharge of suspended solids by 90%.

Moreover Taiwan has scarce water resources. The Hualien Branch of TIPC adjacent to the Meilun Mountain is favorable for collecting and filtering surface runoff because it is low lying and has gravel at the surface layer and mudstone at the bottom layer. According to the concept of water resource banks, the Branch built 12 water storage facilities in the port to provide nondomestic water in replacement of tap water for flushing toilets in the administrative building, greening, containing dust at the sand and gravel storage site, and washing vehicles. In 2018 Hualien Port salvaged approximately 4000 cubic meter of concrete blocks after disasters and screened for concrete blocks that were viable for use in the creation of concrete breakwater foot protection blocks. Though this process, Hualien Port reduced processing costs of soil and stone resource processing and protected the port from ocean wave erosion.[39]

Another case study is the Port of Rotterdam[40]. Rotterdam's port area is situated several meters above New Amsterdam Water Level (NAP) and it is protected effectively from flooding. Global climate change is leading to sea-level rise. The Port of Rotterdam has implemented several measures to counteract the risk of flooding, including:

[38] https://www.zorrotzaurre.com/en/the-zorrotzaurre-urban-regeneration-project/
[39] https://hl.twport.com.tw/en/CP.aspx
[40] https://www.portofrotterdam.com/en/building-port/sustainable-port

- Dikes and dams: The Port of Rotterdam has a network of dikes and dams that protect the port from flooding. These structures are designed to withstand extreme weather events and are regularly inspected and maintained to ensure their integrity.
- Flood gates: The port also has flood gates, which can be closed to prevent flooding in low-lying areas. These gates are operated by the Port of Rotterdam Authority and can be closed in the event of a flood warning.
- Storm surge barriers: The Port of Rotterdam also has storm surge barriers that are designed to protect the port from storm surges. The most notable of this is the Maeslantkering, one of the largest moving structures in the world, that protects the port from high water.
- Early warning systems: The Port of Rotterdam also has an early warning system that can detect and predict potential flooding. This system uses sensors and weather models to provide real-time information on water levels and weather conditions, allowing the port to take appropriate actions to minimize the impact of a flood.
- Climate adaptation plan: The port of Rotterdam also has a climate adaptation plan to ensure the resilience of the port infrastructure and the continuity of the operations. This plan includes measures such as the elevation of infrastructure, the implementation of green solutions and the integration of flood defense systems.
- Research and development: The Port of Rotterdam also conducts research and development to improve the understanding of the risk of flooding

Planning and implementation of measures to reduce the impact of pandemics and other sanitary emergencies

Planning and implementing measures to reduce the impact of pandemics and other sanitary emergencies in a port context is important for several reasons.

Firstly, ports are key entry points for goods and people, making them vulnerable to the spread of disease. Having measures in place to reduce the risk of disease transmission can help to protect the health of workers and the community.

Secondly, ports play a critical role in the global economy, and disruptions can have significant impacts on trade and supply chains. Having a plan in place to minimize the disruption of port operations can help to minimize the economic impacts of a pandemic or other sanitary emergency.

Thirdly, ports often have a large number of people in a confined space, which can make it difficult to implement social distancing measures. Planning and implementation of measures can help to reduce the risk of disease transmission in these environments, such as providing personal protective equipment, implementing temperature screening, and promoting hygiene practices.

Lastly, ports act as transportation hubs, and a pandemic or other sanitary emergency can disrupt the movement of people and goods. Planning and implementing measures to minimize these disruptions can help to minimize the economic and social impacts of an emergency.

The Port of Singapore Authority (PSA) implemented a range of measures to reduce the risk of disease transmission and minimize the disruption of port operations[41]. These measures include:

- Temperature screening and health declarations for all workers and visitors entering the port
- Implementing social distancing measures such as staggered working hours and reducing the number of workers on-site
- Providing personal protective equipment such as masks and gloves to workers
- Enhancing cleaning and sanitization measures in common areas

[41] https://www.mpa.gov.sg/maritime-singapore/what-maritime-singapore-offers/covid-19-info

- Implementing contact tracing measures to quickly identify and isolate any infected individuals

These measures helped to minimize the spread of COVID-19 among port workers and helped to ensure that port operations could continue as normally as possible during the pandemic, minimizing the economic and social impacts of the emergency.

4.2.4 Digitalization in ports

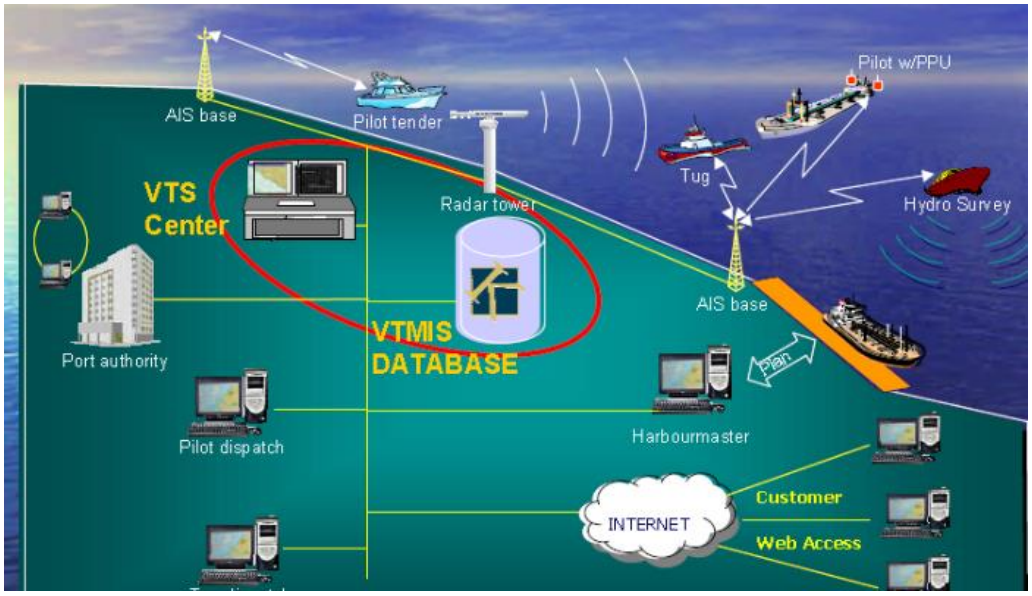
Development of efficient capacity allocation and traffic management systems

Further deployment of Vessel Traffic Monitoring and Information Systems (VTMIS)

The development of efficient capacity allocation and traffic management systems is a fundamental step in order to obtain a green port and this goes through the process of digitizing some functions of port business. A fundamental element for the an efficient administration of the vessels in a port is the vessel traffic monitoring and information system.

A vessel traffic monitoring and information system (VTMIS) is a system used to monitor and manage the movement of ships in a specific area, such as a port or coastal region. The VTMIS typically consists of a combination of hardware and software that allows for the tracking, identification, and communication with ships in the area, as well as the management of vessel traffic.

Figure 17The operation of the VTMIS[42]



The VTMIS uses radar, Automatic Information System (AIS) and other technologies to track the movement of ships and provide real-time information on their location, course, speed, and other relevant data. This information is then used to manage vessel traffic and ensure safe navigation in the area, such as by providing real-time information to ships, and giving instructions to ships to avoid collision or congestion.

VTMIS also provides information for the coastal and port authorities to monitor and manage the operations, for example, it can be used to monitor compliance with safety regulations, to ensure that ships are following designated shipping lanes, and to manage the movement of ships in and out of a port. VTMIS is also used for security, search and rescue, and environmental protection purposes.

[42] https://sheltermar.com/vts/vtmis/

The further deployment of Vessel Traffic Monitoring and Information Systems (VTMIS) can provide a number of benefits, including:

- Improving safety: VTMIS can improve the safety of navigation by providing real-time information on the location, course, speed, and other relevant data of ships in the area, which can help to avoid collisions and other accidents.
- Enhancing efficiency: VTMIS can also improve the efficiency of vessel traffic management by providing real-time information on the movement of ships, which can help to minimize congestion and optimize the use of resources.
- Supporting compliance: VTMIS can also support compliance with safety regulations and other maritime laws by providing real-time information on the movement of ships, which can help to ensure that ships are following designated shipping lanes and other rules.
- Improving security: VTMIS can also enhance security by providing real-time information on the movement of ships in the area, which can help to detect and respond to potential threats.
- Supporting environmental protection: VTMIS can support environmental protection by providing real-time information on the movement of ships, which can help to detect and respond to potential oil spills or other environmental hazards.
- Improving decision making: the data collected by VTMIS can be used by the coastal and port authorities to make better decisions, such as identifying areas of high traffic or potential congestion and re-routing ships to avoid them.

In summary, further deployment of VTMIS can help to improve safety, efficiency, compliance, security, and environmental protection, and provide more accurate data for decision making in the maritime sector[43].

An example of a port that has recently implemented a Vessel Traffic Monitoring and Information System (VTMIS) is the Port of Rotterdam in the Netherlands. In 2019, the Port of Rotterdam Authority (PRA) announced that it was implementing a new VTMIS system to improve the safety and efficiency of vessel traffic in the port.

The new VTMIS system uses Automatic Identification System (AIS) technology to track and monitor the movement of ships in real-time, providing information on the location, course, speed, and other relevant data of ships in the port. The system also provides real-time information to ships and other vessels in the port, such as information on weather conditions, water levels, and traffic congestion.

The VTMIS system also includes an advanced decision support system, which allows the PRA to optimize vessel traffic in the port, such as by re-routing ships to avoid congestion or identifying areas of high traffic. The VTMIS also has the ability to provide real-time information to the authorities in case of emergency.

The new VTMIS system is expected to improve the safety and efficiency of vessel traffic in the Port of Rotterdam, while also minimizing the environmental impact of shipping. The system is also expected to help the PRA to make better decisions, such as identifying areas of high traffic or potential congestion and re-routing ships to avoid them, which will increase the capacity of the port and reduce the waiting time for ships.[44]

Moreover there is an European project, called Vessel Traffic Management and Information System NETwork (VTMIS NET) which provides the information interchange network for already existing VTS, VTMIS, navigational, emergency, monitoring of the marine environment and other transport related information services and vessels. A major objective is to encourage the providers and users of VTMIS-related

[43] https://sheltermar.com/vts/vtmis/
[44] https://www.portofrotterdam.com/en/to-do-port/futureland/the-digital-port

information to proceed to use the network after the conclusion of the project. It is therefore essential that the network is being established according to real cases.

By establishing the network use will be made of existing installations, services and communication networks and links. Development work is required to provide interface software, common protocols and message formats, human-computer interfaces, interconnection of communication networks and geographical information systems (GIS) functionalities.[45]

Deployment of solutions for enabling multimodal travel planning

Deployment of solutions for enabling multimodal travel planning in ports refers to the implementation of systems and technologies that allow for the integration of different modes of transportation in the port area, such as ships, trains, buses, and cars. These solutions are designed to help passengers and cargo move seamlessly between different modes of transportation and to facilitate the smooth flow of goods and people in and out of the port.

Examples of solutions that enable multimodal travel planning in ports include:

- Integrated transport information systems: This type of system provides real-time information on the availability of different modes of transportation, such as train, bus, and ferry schedules, as well as information on parking availability and traffic conditions.
- GPS-enabled transportation: This technology allows for the real-time tracking of buses, trains, and other modes of transportation, which can help to optimize transportation schedules and reduce delays.
- Autonomous transportation: This technology allows for the deployment of self-driving vehicles in the port area, which can help to improve the efficiency and safety of transportation in the port.

In the case of Tan Cang Port (Vietnam)[46] barging is used to transport cargo from the port to nearby destinations. The Tan Cang Port, also known as the Cai Mep International Terminal, is a deep-water port located in the southern province of Ba Ria-Vung Tau in Vietnam. It is a major port for containerized and bulk cargo in the region, and it has been expanding its capacity in recent years to handle larger vessels.

Barging is an efficient and cost-effective way to transport cargo from the port to nearby destinations (especially Ho Chi Minh City which is quite close), particularly for bulk cargo such as coal, grain, and other dry bulk cargo. Barges are able to navigate in shallow waters and can reach destinations that are not accessible to larger ships. Additionally, barging can also reduce congestion on the roads and highways, as it can transport large quantities of cargo without the need for additional trucking or rail transportation.

Barging operations at the Tan Cang Port are typically operated by third-party companies that have agreements with the port to provide barge transportation services. These companies typically own and operate their own fleet of barges and employ experienced personnel to handle the loading, unloading, and transportation of cargo.

Overall, barging is an important component of the logistics and transportation network at the Tan Cang Port, providing an efficient and cost-effective way to transport cargo to nearby destinations, and reducing the impact on the road and highway network.

Another example can be Found in the Port of Montreal, where an IT solution was designed for predicting truck turnaround times for improved route optimization[47]. The platform was introduced in 2016 as an open

[45] https://cordis.europa.eu/project/id/WA-97-SC.2135/it
[46] https://vlr.vn/tan-cang-cai-mep-international-terminal-tcit-awarded-green-port-2020-7373.html

desktop and mobile app to obtain real-time truck turn times at the 4 container terminals. The app also uses an algorithm that translates processing times into greenhouse gas emissions and reports on real-time truck-borne carbon emissions at the port. The app has been used by truckers and dispatchers to optimize their routings and dispatches by making optimal use of uncongested time windows and night gates so as to maximize the number of truck turns in a single day. In 2019, an AI layer was added to create truck turn time predictions up to 24 hours out. The predictions provide further visibility to inform planning of port visits and dispatches for the 2,500 trucks that visit the port daily. Combined with the introduction of a night gate program, the app has allowed increased fluidity of trucks at the gate. Since its introduction, the port has been able to decrease truck processing times by 5% despite a 30% increase of truck volumes. This efficiency gain translates into better environmental performance per transaction.

Safe deployment of automated and autonomous maritime operations

The safe deployment of automated and autonomous maritime operations refers to the use of technology such as automation and robotics to perform various tasks in the maritime industry, without human intervention. This can include the use of autonomous ships, drones, and other unmanned systems to perform tasks such as navigation, cargo handling, and surveillance.

There are several benefits of deploying automated and autonomous maritime operations, such as increased efficiency, safety, and cost-effectiveness.

One the most advanced fully automated port in the world is the Qingdao Port[48]. It is now one of the world's leading automated container terminals equipped with state-of-the-art technologies, a high degree of automation and high loading and offloading efficiency. The port has achieved productivity of 36.2 containers per ship per hour on average, peaking at 52.76 containers per hour, a production efficiency that is 50 per cent higher than other ports with similar automated terminals. On 30 June, 2021, the world's first intelligent overhead container delivery system (in a pilot phase) was put into operation at the automated terminal. The system was co-developed by a team of Qingdao Port engineers working under Zhang and the R&D team at CRRC Yangtze, with the goal of integrating the leading suspension transport technologies into the port's operations to resolve that most difficult 'last mile'. The aim is to maximize efficiencies when it comes to delivering containers between the terminal, ships, transfer stations and stockyards, and meet the requirements for low cost, short loading and unloading cycles, greater efficiency, full automation, higher safety and zero emissions.

[48] https://www.porttechnology.org/news/qingdao-port-becomes-the-worlds-first-hydrogen-powered-and-5g-intelligent-port/

Figure 18 Unmanned trucks load containers at Qingdao Port, Shandong province, China

Diffusion of innovation, data and AI for smart mobility

Diffusion and integration of Port Community Systems at the port, port cluster, and national levels

Port Community Systems (PCS) are software platforms that enable different stakeholders in the port ecosystem, such as shipping companies, freight forwarders, customs authorities, and terminal operators, to share information and collaborate more effectively. Diffusion and integration of PCS at the port, port cluster, and national levels refers to the widespread adoption and use of these systems across different ports and port clusters, as well as the integration of these systems with other systems and platforms at the national level.

The diffusion and integration of PCS can bring several benefits, such as:

- Improved efficiency: PCS can help to streamline and automate various processes in the port ecosystem, such as cargo handling, customs clearance, and vessel scheduling, which can reduce delays and improve the overall efficiency of the port.
- Better communication and collaboration: PCS can help to improve communication and collaboration between different stakeholders in the port ecosystem, such as shipping companies, freight forwarders, and customs authorities, which can reduce errors and improve the overall flow of goods and people in and out of the port.
- Increased transparency: PCS can provide real-time information on the status of various processes in the port ecosystem, such as cargo handling, customs clearance, and vessel scheduling, which can increase transparency and improve the overall flow of goods and people in and out of the port.
- Better decision making: PCS can provide real-time data, which can be used by port authorities, shipping companies and other stakeholders to make better decisions, such as identifying areas of high traffic or potential congestion and re-routing ships to avoid them.

An example of the diffusion and integration of Port Community Systems at the port, port cluster, and national levels is the Port of Singapore[49]. The Port of Singapore is one of the busiest ports in the world and handles a large volume of cargo and passengers. To improve the efficiency and coordination of operations in the port, the port authority has implemented the Singapore Port Community System (PCS), which is a centralized platform for sharing information and coordinating activities between different stakeholders in the port ecosystem, such as shipping companies, freight forwarders, customs authorities, and terminal operators.

The Singapore PCS provides a range of services, including:

- Electronic submission of shipping documents: The system allows for the electronic submission of shipping documents, such as bills of lading and manifest, which can reduce the need for paper documents and improve the overall efficiency of cargo handling.
- Real-time tracking of cargo: The system provides real-time information on the location and status of cargo, which can improve the overall visibility of cargo movements in the port.
- Automated customs clearance: The system automates the customs clearance process, which can reduce the need for manual intervention and improve the overall efficiency of customs clearance.
- Integrated transportation management: The system integrates data from various sources to provide a comprehensive view of transportation in the port, which enables the port authorities, shipping companies and other stakeholders to make better decisions.
- Compliance: The system ensures compliance with various regulations, such as customs and security laws, by providing a centralized platform for sharing information and coordinating activities between different stakeholders.

The Singapore PCS is integrated with other systems and platforms at the national level, which enables the Port of Singapore to share information with other ports and logistics hubs in the region, creating a seamless flow of goods and people in the region.

Another important example is the Portbase[50]. Portbase was founded in 2009 by Port of Rotterdam and Port of Amsterdam and has the broad support of the port business community. Our ambition is to make the logistics chains of the Dutch ports as attractive as possible through a one-stop shop. Portbase connects all parties in the logistics chains of the Dutch ports to this end. Via the Port Community System, Portbase facilitates data sharing between companies and information exchange with governments in order to work faster, more efficiently and at lower costs. Together with our growing community, Portbase is making data sharing increasingly valuable. With the aim of making the Dutch port community and thus the ports, the smartest in Europe.

Finally also in the Qatar's ports can be found a PCS. The Port Community System (PCS) "Mwanina" is an electronic platform that allows smart and secure exchange of information between stakeholders and various port-related authorities, which contributes to making the import and export operations more efficient and effective in terms of time and cost. This system will support green initiatives by reducing reliance on paper, eliminating manual intervention, delays and errors that result from it, which contributes to raising performance and productivity indicators and supports the national economy and commercial movement along with the development of logistics services in the State of Qatar.

[49] https://www.mpa.gov.sg/home
[50] https://www.portbase.com/en/about-us/

Diffusion of Maritime Single Window solutions and deployment of automated and paperless procedures and solutions to speed up processes

The diffusion of Maritime Single Window (MSW) solutions and deployment of automated and paperless procedures and solutions aim to speed up processes and improve the overall efficiency of the maritime industry.

A Maritime Single Window (MSW) is an electronic platform that allows different stakeholders in the maritime industry, such as shipping companies, freight forwarders, customs authorities, and terminal operators, to submit and share information electronically, rather than through paper-based processes. By automating and digitizing these processes, MSW solutions can help to reduce delays, improve the overall efficiency of the maritime industry, and increase transparency.

An example of the diffusion of Maritime Single Window solutions is the Indian Customs Electronic Commerce/Electronic Data Interchange (EC/EDI) Gateway.[51]

The EC/EDI Gateway is an electronic platform that allows different stakeholders in the maritime industry, such as shipping companies, freight forwarders, customs authorities, and terminal operators, to submit and share information electronically, rather than through paper-based processes.

The EC/EDI Gateway allows for the electronic submission of various documents, such as bills of lading and manifests, which can reduce the need for paper documents and improve the overall efficiency of cargo handling. The system also provides real-time information on the status of cargo, which can improve the overall visibility of cargo movements in the port. Additionally, the EC/EDI Gateway automates the customs clearance process, which can reduce the need for manual intervention and improve the overall efficiency of customs clearance.

The EC/EDI Gateway is integrated with other systems and platforms at the national level, which enables the Indian Customs to share information with other ports and logistics hubs in the region, creating a seamless flow of goods and people in the region. This integration with other systems and platforms is particularly beneficial as it improves the overall efficiency and compliance of the customs clearance process.

Deployment of IT solutions for planning and management of rail traffic within the port

Deployment of IT solutions for planning and management of rail traffic within the port refers to the use of technology to optimize the scheduling, routing, and movement of rail traffic within the port area. This can include the use of data analytics, real-time monitoring, and automated decision-making systems to improve the efficiency, safety, and cost-effectiveness of rail traffic within the port.

Deployment of IT solutions for planning and management of rail traffic within the port can bring several benefits, such as:

- Improved efficiency: By optimizing the scheduling, routing, and movement of rail traffic within the port, IT solutions can help to reduce delays and improve the overall efficiency of rail traffic within the port.
- Increased safety: By providing real-time monitoring and automated decision-making, IT solutions can help to detect and prevent bottlenecks and other disruptions, which can improve the overall safety of rail traffic within the port.
- Better decision-making: IT solutions can provide real-time data, which can be used by port authorities and other stakeholders to make better decisions, such as identifying areas of high traffic or potential congestion and re-routing rail traffic to avoid them.

[51] https://www.port-montreal.com/en/the-port-of-montreal/social-responsibility/sustainable-development#espaces

- Predictive maintenance: IT solutions can predict when maintenance is needed on rail equipment, which can help to reduce downtime and improve the overall efficiency of rail traffic within the port.
- Connectivity: IT solutions enable connectivity between different rail systems and stakeholders, such as the Port Authority, Terminal operator, and rail company, this enables the sharing of information and coordination of activities, which can improve the overall flow of goods and people in and out of the port.

An example of a port that has implemented IT solutions for planning and management of rail traffic is the Port of Rotterdam in the Netherlands[52]. The port has developed a digital twin, a digital replica of the port, which allows for the simulation of different scenarios and provides real-time data on rail traffic and other activities in the port. This enables the port authorities to optimize the scheduling, routing, and movement of rail traffic within the port, which helps to improve the overall efficiency and safety of rail traffic within the port.

Diffusion of solutions involving virtualization (digital twin), Internet of Things, Artificial Intelligence, automated/unmanned terminal operations and blockchain

The diffusion of solutions involving virtualization (digital twin), Internet of Things (IoT), Artificial Intelligence (AI), automated/unmanned terminal operations and blockchain in a port can bring several benefits to the ports and logistics industry. These technologies can help to improve the efficiency, safety, and transparency of various processes in the port ecosystem, such as cargo handling, vessel scheduling, and customs clearance.

A digital twin is a digital replica of a physical system, such as a port, that can be used to simulate and analyze different scenarios. This technology can help to improve the overall efficiency and safety of operations in the port by providing real-time data on various activities in the port, such as vessel movements and cargo handling.

Internet of Things technology can be used to provide real-time monitoring and tracking of various assets in the port, such as cargo containers and vehicles. This can help to improve the overall visibility of cargo movements in the port and reduce the risk of errors and delays.

Artificial Intelligence can be used to automate various processes in the port, such as cargo handling and vessel scheduling. This can help to improve the overall efficiency of operations in the port and reduce the need for manual intervention.

Automated/unmanned terminal operations: Automated and unmanned terminal operations can help to improve the overall efficiency and safety of operations in the port by reducing the need for human intervention.

Blockchain: Blockchain technology can be used to provide a secure and transparent platform for sharing information and coordinating activities between different stakeholders in the port ecosystem, such as shipping companies, freight forwarders, customs authorities, and terminal operators. This can help to improve the overall flow of goods and people in and out of the port, and increase transparency and security in the port operations.

The Port of Rotterdam[53] uses IoT technology to monitor and track cargo containers and vehicles in real-time, which improves the overall visibility of cargo movements in the port and reduces the risk of errors and delays. Additionally, the port has implemented AI systems to automate various processes such as cargo

[52] https://www.portofrotterdam.com/en/port-future/digitisation/control-management
[53] https://www.portofrotterdam.com/en/port-future/digitisation/control-management

handling and vessel scheduling, which improves the overall efficiency of operations in the port and reduces the need for manual intervention.

The port is also working on implementing automated and unmanned terminal operations, which will help to improve the overall efficiency and safety of operations in the port by reducing the need for human intervention. Furthermore, the port is looking into using blockchain technology to provide a secure and transparent platform for sharing information and coordinating activities between different stakeholders in the port ecosystem, such as shipping companies, freight forwarders, customs authorities, and terminal operators.

Another project is COREALIS[54], which it proposes a strategic, innovative framework, supported by disruptive technologies, including Internet of Things (IoT), data analytics, next generation traffic management and emerging 5G networks, for cargo ports to handle upcoming and future capacity, traffic, efficiency and environmental challenges. The proposed beyond state of the art innovations, target to increase efficiency and optimize land use, while being financially viable, respecting circular economy principles and being of service to the urban environment.

The innovations will be implemented and tested in real operating conditions in 5 Living Labs, namely Piraeus port, Valencia port, Antwerp port, Livorno port and Haminakotka port.

Deployment of IT solutions for the improving the effectiveness of port operations, including infrastructure maintenance and waste management

Deployment of IT solutions for improving the effectiveness of port operations can include using technology to optimize the maintenance and management of port infrastructure, as well as the disposal of waste.

- Infrastructure maintenance: IT solutions can be used to manage and track the maintenance of port infrastructure, such as quays and warehouses. This can include the use of sensors and other technologies to monitor the condition of infrastructure, as well as predictive maintenance algorithms to schedule repairs and replacements.
- Waste management: IT solutions can be used to manage and track the disposal of waste generated by port operations. This can include the use of sensors and other technologies to monitor the amount and type of waste generated, as well as the implementation of recycling and other waste reduction programmes.
- Automated decision-making: IT solutions can be used to make automated decisions, such as rerouting cargo, to optimize the use of infrastructure and reduce the impact of waste on the environment.
- Data analytics: IT solutions can be used to analyze data from various sources to identify patterns and trends in port operations, which can help to identify areas for improvement and optimize the maintenance and management of port infrastructure and waste disposal.
- Connectivity: IT solutions enable connectivity between different systems and stakeholders, such as the Port Authority, Terminal operator, and maintenance companies, this enables the sharing of information and coordination of activities, which can improve the overall effectiveness of port operations.

An example of a port that has implemented IT solutions for improving the effectiveness of port operations is the Port of Rotterdam[55] in the Netherlands. The port uses sensors and other technologies to monitor the condition of infrastructure, such as quays and warehouses, and schedules repairs and replacements based

[54] https://www.corealis.eu/
[55] https://www.portofrotterdam.com/en/port-future/digitisation/control-management

on the data collected. Additionally, the port has implemented a recycling program to manage and reduce the amount of waste generated by port operations.

4.3 Inventory of the best practice European and international case studies

The following chapter provides an overview of best practices of European and International case studies aimed at mapping the state of the art of port reality considering a wide and well-calibrated spectrum of survey dimensions, to include the key topics of the Flagship projects, among technological innovation and sustainability and resilience.

4.3.1 Hamad Port in Qatar

Location	2JF5+7MQ, New Port Road, Qatar, (City of Mesaieed)
Annual passenger traffic	no passengers
Annual cargo traffic	1,596,826 tons (2022)
Type connection to the rest of the city	Doha Express Hwy (40 km to the center of the city)
Nearest airport and connection to the airport	Hamad International Airport (35 km)
Railway connection	No railway connection
Green and Smart Port Themes	Electricity-powered ; Digitalization; Green initiatives

Hamad Port, a Greenfield mega port located south of Doha city was developed as the new logistics hub for the State of Qatar. The scope of the first phase was to develop a port complex in an area of 28 square km including a 10 km long channel with a width of 300 m. Construction of the port began in 2010; it became operational in December 2016. It was officially opened in September 2017, and is expected to become fully operational by 2020.

The guiding principle for the port management was to ensure that the project is sustainable and environmentally does not adversely affect the communities in the vicinity. With guidance from the Qatar's Environment ministry, a separate project was set for independently monitoring the development activities with respect to their effects on environment. In particular the impact of the construction activities on air quality, coastal morphology, groundwater quality, marine ecology, sediment, noise, fauna and flora were closely monitored and follow up actions were taken where needed.

For example, a separate project was initiated to **relocate the 'at risk' marine life** to alternate 'recipient' sites. A total of 4,257 square meters of sea-grass, 139,117 mangroves, 11,595 directly threatened hard coral colonies and 121 cubic meter of existing reefs were relocated to provide habitat for resident fish and preserve its ecosystem functionality.

Another environmental concern from the project was turbidity from dredging and groundwater disposal. To overcome this, huge dredged water settling ponds were constructed. Sand and gravel recovered from the dredging activities were processed and then beneficially used for reclamation and port construction activities. An estimated 44.4 million cubic meter of dredged material and 64.7 million cubic meter of excavated material were used for this purpose, resulting in significant savings for the project and partly offsetting relocation costs.[56]

[56] https://sustainableworldports.org/project/hamad-port-ensuring-sustainable-mega-port-development/

Figure 19 Hamad Port in Qatar

Digitalization: The Port Community System (PCS) "Mwanina" is an electronic platform that allows smart and secure exchange of information between stakeholders and various port-related authorities, which contributes to making the import and export operations more efficient and effective in terms of time and cost.

This system will support green initiatives by reducing reliance on paper, eliminating manual intervention, delays and errors that result from it, which contributes to raising performance and productivity indicators and supports the national economy and commercial movement along with the development of logistics services in the State of Qatar.[57]

Siemens has won a QAR45.2 million (US$12.4 million) contract to help power Qatar's new Hamad Port, a megaproject, with a sizeable energy management package. The contract is the first for Siemens within the project and includes the supply of fully-integrated E-House substations that will significantly reduce on-site civil works and installation.[58]

4.3.2 Port of Singapore in Singapore

Location	33 Harbour Dr, Singapore 117606
Annual passenger traffic	65.900 passengers in 2020
Annual cargo traffic	36,870,900.000 TEUs in 2020
Type connection to the rest of the city	Public transport, train, ferry
Nearest airport and connection to the airport	Singapore Changi Airport (28 km)
Railway connection	Pasir Panjang (1km)
Green and Smart Port Themes	Electricity-powered, low and zero-emission fuels, digitalization

[57] https://www.qna.org.qa/en/News-Area/News/2022-11/10/0044-minister-of-transport-hamad-port-visitor-center-introduces-qatar's-marine-environment
[58] https://press.siemens.com/middleeast/en/pressrelease/siemens-helps-power-qatars-new-hamad-port

The Port of Singapore[59] is a deepwater port located in the southern part of the island nation of Singapore. It is one of the busiest ports in the world, handling over 36 million TEUs annually, and is also the second busiest port in terms of total tonnage. It serves as a key hub for shipping and logistics in Southeast Asia, connecting the region to major markets around the globe.

Figure 20 Port of Singapore Aerial View

The port is made up of a number of different terminals that handle different types of cargo, including container cargo, bulk cargo, and general cargo. These terminals are equipped with state-of-the-art facilities and technology to handle large vessels and handle cargo efficiently.

The Port of Singapore is also home to a number of other industries, including ship repairing and shipbuilding, as well as oil refining and petrochemical production. There is also a large community of maritime and logistics-related companies located in the area.

[59] https://www.mpa.gov.sg/home

Figure 21 Port of Singapore Cargo

The Maritime Singapore Green Initiative seeks to reduce the environmental impact of shipping and related activities and to promote clean and green shipping in Singapore. In 2011, the Maritime and Port Authority of Singapore (MPA) pledged to invest up to S$100 million over 5 years in the Maritime Singapore Green Initiative.

In 2019, the Initiative was further extended till 31 December 2024 and enhanced to promote decarbonization of shipping. It is a comprehensive initiative comprising four programmes:

- Green Ship Programme
- Green Port Programme
- Green Energy and Technology Programme
- Green Awareness Programme

These are voluntary programmes designed to recognize and provide incentives to companies that adopt clean and green shipping practices over and above the minimum required by International Maritime Organization (IMO) Conventions. The initiative underscores Singapore's commitment as a responsible flag and port state to clean and green shipping.

The Maritime and Port Authority of Singapore (MPA) has also worked with volunteers from environmental interest groups to relocate coral colonies to St John’s and Sisters’ Islands, to protect them from the impact of Tuas Port development. Globally, Singapore supports the International Maritime Organization (IMO)’s regulations to control pollution from ships. It has ratified every major IMO Convention relating to the prevention of pollution from ships.

To tackle climate change, Singapore also supports the IMO’s targets to reduce the carbon intensity of international shipping by at least 40% by 2030 and reduce the total annual greenhouse gas emissions from international shipping by at least 50% by 2050. Both targets are based on 2008 figures.

In 2011, MPA launched a S$100 million Maritime Singapore Green Initiative (MSGI). This programme was enhanced in 2019 to focus on the decarbonization of ports and shipping. In 2021, we established the Global Centre for Maritime Decarbonization with key industry players. It brings together industry partners round the world to develop and drive maritime decarbonization solutions, including low- and zero-carbon fuels.

The Maritime Singapore Decarbonization Blueprint was launched at COS 2022, charting out our strategies and concrete targets to drive the decarbonization of our domestic maritime sector, and plans for collaborations with researchers, industry and international partners to catalyze green shipping. MPA will

commit additional funds of at least $300 million to support initiatives outlined in the Blueprint, and will update the Blueprint progressively in line with our climate change commitments.[6061]

4.3.3 Long Beach Port in Los Angeles, USA

Location	Los Angeles, CA, USA
Annual passenger traffic	151.971 in 2021
Annual cargo traffic	10.700,000.000 TEUs in 2021
Type connection to the rest of the city	Public transport (BRT)
Nearest airport and connection to the airport	Los Angeles International Airport, (34 km)
Railway connection	yes, but no railway station.
Green and Smart Port Themes	Electricity-powered, low and zero-emission fuels, intermodal, Green initiatives, automated port

The Port of Long Beach[62] is a major seaport located in Long Beach, California, in the United States. It is one of the busiest ports in the country, and the second busiest port in the state of California, handling over $180 billion in trade annually. The Port is located in the heart of the Los Angeles metropolitan area, in the south coast of California.

The Port of Long Beach comprises of several terminals, including the Long Beach Container Terminal, the Middle Harbor Terminal, and the Pier T Terminal among others. These terminals are equipped with state-of-the-art equipment and technology to handle large vessels and handle cargo efficiently. The port handles a wide variety of cargo, including containerized cargo, automobiles, and perishable goods.

Five main objectives of Green Port polices in Los Angeles: 1. Protect the community from harmful environmental impacts of Port operations. 2. Distinguish the Port as a leader in environmental stewardship and compliance. 3. Promote sustainability. 4. Employ best available technology to avoid or reduce environmental impacts. 5. Engage and educate the community.

[60] https://www.mot.gov.sg/what-we-do/green-transport/maritime-environment-responsibility
[61] https://www.mpa.gov.sg/media-centre/details/cos-2022---media-factsheet---maritime-singapore-decarbonisation-blueprint-working-towards-2050
[62] https://polb.com/

Figure 22 Port of Long Beach Aerial View

Long Beach Harbor Commissioners adopt the Green Flag Vessel Speed Reduction Program. The program offers tiered financial incentives for ships that slow down to 12 knots or less within 20 and 40 nautical miles of Point Fermin. The program helps to cut air pollution such as smog-forming nitrogen oxides, diesel particulate matter and greenhouse gases.

The Harbor Commission agrees to contribute $11.4 million to restore the Bolsa Chica Wetlands, an ecologically important saltwater marsh in Huntington Beach. Along with a previous expenditure in 1997, the Port provided more than $50 million for the successful habitat restoration project. The Port receives mitigation credits toward future development.

The Port's Clean Trucks Program implements a ban on older, heavy polluting diesel drayage trucks, eventually reducing emissions from the vehicles by 90%.

First shore power hookup for container ships is installed at Pier G.

According to the Port's annual emissions inventory, diesel particulate matter has been reduced by 75%, exceeding the 2014 goal three years early.

Crane lifting cargo: construction begins on Long Beach Container Terminal. The state-of-the-art terminal will be nearly all-electric, with automated stacking cranes and guided vehicles to handle cargo. Orient Overseas Container Line signs a 40-year, $4.6 billion lease to be the primary tenant.

The Green Ship Program is adopted. Under the program, ships can get thousands of dollars in incentives per call if they are powered by cleaner engines, reducing emissions such as diesel particulate matter and nitrogen oxides.

Sediment from a federal dredging project at Marina del Rey and Newport Harbor is marked for reuse as fill material for the terminal under construction at Long Beach Container Terminal (LBCT). The sediment eliminates the need to dredge up new material for the project, and the need to dispose of those other harbors' sediment at sea.

Water quality conditions have also improved, with oxygen and phytoplankton measurements higher than ever before. Fish are abundant, and giant kelp beds have expanded to cover as much as 132 acres of Outer Harbor waters. Maximum kelp coverage reached only 27 acres in 2000 and 80 acres in 2008.

The new Port of Long Beach Maintenance Building is certified LEED Gold. When it opens, it has a solar array that is the third-largest in Long Beach, at 323 kilowatts.

Ten years after the Green Port Policy was adopted, the Port has seen an 85% reduction in diesel particulates, a 97% reduction in sulfur oxides, a 50% reduction in nitrogen oxides and a 21% reduction in greenhouse gases.

The world's greenest container terminal, Long Beach Container Terminal, opens. At full buildout in 2021, the terminal will have the world's largest on-dock rail yard for any terminal and by itself be a top five U.S. seaport by container volume.

Harbor commissioners start the nation’s largest seaport pollution mitigation effort, the Community Grants Program. At least $46.4 million is set aside for the program to help those in the community who are most vulnerable to pollution. Combined with a previous effort, almost $65 million has been committed.

More than 95% of vessels earn incentives by complying with the Green Flag Program by slowing down ships to 12 knots or less within 20 nautical miles of Point Fermin.

New state regulations take effect mandating at least half of all container ships run on shore-side electricity at berth. The Port has already completed more than $185 million worth of dockside power hookups and other infrastructure to facilitate shore power, reducing emissions.

2018 - The Port of Long Beach is named “Best Green Seaport” by industry peers.

The Port is awarded over $70 million in total grant funding to move ahead with multiyear projects to support the development and use of electric power for operations. Among other projects: electric rubber-tire gantry cranes and yard tractors, and a microgrid at the Joint Command and Control Center.

Due to continued improvements in water and habitat quality, the 2018 San Pedro Bay Biological Survey recorded the highest species diversity recorded since harbor-wide surveys began in 2000. More intensive surveys of the 100+ acres of kelp forest habitat within the harbor documented several new species, including garibaldi, horn sharks, and three species of abalone, which are usually associated with pristine marine habitats.

Future: After 15 years of the Green Port, diesel soot is down 88%. Marine life in the harbor is thriving, with the most recent survey showing a twofold increase in the number of plants and animals living on the rocks and pilings in the San Pedro Bay Harbor.

Looking ahead, the Port has turned its focus to reducing greenhouse gases in an attempt to stave off climate change, with targets of 40% reductions below 1990 levels by 2030 and 80% reduction below 1990 levels by 2050.

Capital improvements over the next decade include an extensive rail support facility to expand the Port’s on-dock rail capacity, moving cargo more efficiently and reducing truck trips. New technologies being tested on and near the docks will make the Port's cargo handling zero emissions by 2030 and the drayage truck fleet zero emissions by 2035 – when Long Beach will celebrate 30 years as The Green Port.[63]

[63] https://polb.com/port-info/green-port/

4.3.4 Port of Rotterdam in Netherlands

Location	Europaweg 875, 3199 LD Maasvlakte Rotterdam, Netherlands
Annual passenger traffic	NA
Annual cargo traffic	15.300.000,00 in 2021
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Rotterdam The Hague Airport (50km)
Railway connection	yes
Green and Smart Port Themes	Electricity-powered; low and zero-emission fuels, intermodal, Green initiatives

The Port of Rotterdam is a major seaport located in Rotterdam, the Netherlands. It is the largest port in Europe and one of the busiest in the world, handling over 500 million tons of cargo annually. The port is situated on the Nieuwe Waterweg, a shipping channel that connects the port to the North Sea. It handles a wide range of cargo, including containerized cargo, bulk goods, and general cargo. It serves as a key hub for shipping and logistics in the region, connecting the Netherlands, Germany, and other countries in Western Europe to major markets around the world.

The Port of Rotterdam Authority has set up a special site for this new industry on Maasvlakte 2**.** The electrolysers that produce green hydrogen using green power (offshore wind) will be located here. These are plants of Shell (Holland Hydrogen 1), bp and HyCC (H2-Fifty), and of Air Liquide (CurtHYL). The plants each have a capacity of 200 to 250 MW. By comparison, the largest currently operational plant in Europe is 20 MW.

The central government has announced that a total of seven green hydrogen production projects in the Netherlands will receive subsidies. Three of these are in Rotterdam. The other four are in Zeeland, Amsterdam/North Sea Canal and Groningen.

Rotterdam's port area is situated several meters above New Amsterdam Water Level (NAP) and it is protected effectively from flooding. Global climate change is leading to sea-level rise. We are engaged in ongoing studies of the associated risks, impact and possible solutions. There appears to be no significant increase in the flood risk.

There is a pilot study in progress with floating solar panels at the Slufter, the silt depot for Maasvlakte 2, and the lights on the bollards that line Caland Canal are powered by the sun. What's more: Rotterdam's port area is providing the room needed for wind power: generating capacity was 200 megawatts (MW) in 2016 and planned capacity for 2020 is 300 megawatts.

late 2016, trade unions, container companies and the Port Authority signed a joint sector agreement on employment conditions. The Port Authority played an intermediary and facilitating role in this process. An important feature of the agreement was job security until July 2020 for all port personnel with permanent contracts.

Figure 23 Port of Rotterdam Aerial View

Throughout the port area, the Port Authority has realized five dedicated stops for visiting trucks. The largest truck stop – Maasvlakte Plaza – has over 350 parking spaces. All the stops have a variety of facilities, including security surveillance, Wi-Fi, toilets and showers and a relaxation area.

The port's industrial sector generates a lot of residual heat that is currently lost to surface water or the air. With the construction of an underground network of pipelines, the port can supply this heat to industry and greenhouses and, potentially, to 500,000 homes.

RDM Rotterdam (Research, Design and Manufacturing) at the Heijplaat location is a unique area where companies, students and researchers are working together on the development of a new manufacturing industry for the port and the city that can create new jobs for the employees of the future.

Sea-going vessels that comply with standards above the statutory requirement (as recorded in the Environmental Ship Index) qualify for a discount of up to 20% on port dues. Inland vessels receive a discount when they are cleaner than the current standards or when they have a Green Award Certificate.

The most effective way to reduce carbon emissions quickly is to capture and store CO2. The Port Authority has teamed up with a number of other parties to study the construction of a CO2 pipeline through the port area that will allow companies to capture their CO2 for storage in empty gas fields under the North Sea.

The Rotterdam Port Welfare Committee supports projects and initiatives undertaken by a variety of organizations for the benefit of seafarers in Rotterdam, such as the seamen's institutes that are open to international seafarers for counselling and support.

Rotterdam's port area is surprisingly rich in animal and plant life. The 'Green Gateway' near the Rozenburg Peninsula is home to 20 hectares of riverbank nature. The dunes on the Maasvlakte also contain a wealth of nature, such as the Bird Valley: a nature area covering 21 hectares that was developed by the Port Authority.

The Port Authority will be replacing all public lighting in the port area with LED lights. This has already been completed on the Maasvlakte, and the other port areas will follow before 2020. LED lights last longer and consume 50% less electricity than conventional lights.

Future Land is the Port Authority's premier information center at Maasvlakte 2. Every year, some 110,000 people visit the center and enjoy its programme of boat tours, exhibitions and guided coach tours. And EIC Main port Rotterdam introduces some 20,000 young people annually to a range of port related training programmes and professions.

Figure 24 Port of Rotterdam

E-NOSES To track down noxious or hazardous emissions in time, hundreds of electronic sensors (known as e-noses) have been installed throughout the port area to prevent problems like odour nuisance. Two of the Port Authority's patrol vessels have also been fitted out with an e-nose.

The Port Authority not only encourages companies in the port to reduce their carbon emissions, it is also taking action itself. By commissioning hybrid patrol vessels, or by using hydrogen and electric vehicles and green wind power.

Through the Startbaan project The Port Authority gives young people without basic qualifications for the employment market an opportunity to obtain a diploma and therefore to improve their job prospects. Many of the young people go on to find jobs or start training.[64]

4.3.5 Port of Tyne in UK

Location	Maritime House, South Shields NE34 9PT, United Kingdom
Annual passenger traffic	748.000 passengers in 2021
Annual cargo traffic	66,000.000 TEUs in 2021
Type connection to the rest of the city	Public transport

[64] https://www.portofrotterdam.com/en/building-port/sustainable-port
https://www.offshorewind.biz/2021/02/15/rotterdam-port-and-uniper-plan-green-hydrogen-project/

Nearest airport and connection to the airport	Newcastle International Airport (33 km)
Railway connection	yes
Green and Smart Port Themes	Electricity-powered, Digitalization, Green initiatives

The Port of Tyne[65] is a major seaport located in Tyne and Wear, on the northeast coast of England, in the United Kingdom. It is situated on the River Tyne, and it handles a wide range of cargo, including containerized cargo, bulk goods, and general cargo. It serves as a key hub for shipping and logistics in the region, connecting the northeast of England and Scotland to major markets around the world.

Clean Energy: Port of Tyne is using the Offshore Wind North East conference as the forum to launch its latest commercial venture, a new green energy park for the north east region. Tyne Clean Energy Park has already welcomed its first tenant and will create a convenient, versatile strategic base for the region's rapidly growing renewable energy sector. Port of Tyne's new clean energy park will play an important role in supporting the government's goal to power every UK home with offshore wind electricity.[66]

Earlier in 2020, the Port was selected as Equinor's flagship operations and maintenance base, for what will become the world's largest offshore wind farm at Dogger Bank. This success provided the catalyst for further land clearance to free up additional space for renewable energy tenants. The new Tyne Clean Energy Park will provide an infrastructure catering for all renewable energy production needs, with a total of 200 acres of land soon to become available within the park's perimeters. Attracting tenants to Tyneside is expected to create thousands of jobs.

Figure 25 Port of Tyne Aerial View

Port of Tyne is already rapidly transforming its own commercial operations to become a low-carbon industrial hub and made a clear commitment to decarbonization in its Tyne 2050 strategy. This outlines the

[65] https://www.piraeus.org/

[66]https://www.portoftyne.co.uk/news-and-media/news/port-of-tyne-launches-tyne-clean-energy-park-to-boost-north-easts-renewables-infrastructure

Port's strategic vision to become an Enabler and Operator of clean energy powered maritime supply chain services, including being 'Carbon Neutral by 2030' and 'All Electric by 2040'.

Demonstrating a long term commitment to innovation, the Port of Tyne is leading the UK's first 2050 Maritime Innovation Hub, a collaboration of organizations from maritime logistics, technology and academia. Launched in response to the government's call for greater innovation in maritime, this has focused on a range of projects, including investigating the potential of renewables within Port of Tyne plus maritime relevant solutions using autonomous systems and AI.

BY 2023 the port will create a strategy to automate the assessment and management of environmental impacts to ensure that every activity considers the impact on the Port and region by 2023.

Port authority is committed to clean energy for the Port and the communities and will put in place a programme that ensures our Port is nationally recognized as a test bed for clean energy trials by 2025. [67]

Port of Tyne has discharged its largest ever wood pellet shipment carrying 62,522.49 metric tons of sustainable biomass pellets for Drax Power Station in North Yorkshire.

4.3.6 Qingdao Port in China

Location	11 Ganghua Rd, Huangdao, Qingdao, Shandong, China, 266599
Annual passenger traffic	NA
Annual cargo traffic	23,700,000.000 TEUs in 2021
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Qingdao International Airport (24 km)
Railway connection	NA
Green and Smart Port Themes	Automation, Green Initiatives,

Qingdao Port[68] is a major seaport located in the city of Qingdao, in the Shandong province of China. It is one of the busiest ports in China and is considered as an important hub for trade and transportation in the region.

The port has a natural deep-water harbor which makes it an ideal location for handling large vessels, and it has been developed into a modern port with a range of facilities for handling different types of cargo, including container cargo, bulk cargo, and general cargo. Qingdao port also comprises of several terminals such as the Qingdao New Container Terminal, the Qingdao Qianwan Container Terminal and the Qingdao Dongjiakou Container Terminal, among others.

The Port also contributes to various other sectors such as marine engineering, shipbuilding and many other manufacturing industries.

Shandong Provincial People's Government has shared insights into its automated container terminal at Qingdao Port as part of the 2022 Qingdao Multinationals Summit.

[67] https://www.portoftyne.co.uk/news-and-media/publications/tyne-2050
[68] https://www.porttechnology.org/news/qingdao-port-becomes-the-worlds-first-hydrogen-powered-and-5g-intelligent-port/

As the traffic volume continues to increase, the port's carrying capacity limitations has become a bottleneck that limits further development.

It quickly became evident that deploying a 3D intelligent, green and low-carbon transportation system is the way of the future, the Information Office of the People's Government of Shandong Province wrote in its statement.

Shandong Port Group Senior Expert Zhang Liangang and Qingdao New Qianwan Container Terminal General Manager Li Yongcui explained that Qingdao Port is now one of the world's leading automated container terminals equipped with state-of-the-art technologies, a high degree of automation and high loading and offloading efficiency. It is also the first fully automated container terminal in Asia.

The port has achieved productivity of 36.2 containers per ship per hour on average, peaking at 52.76 containers per hour, a production efficiency that is 50 per cent higher than other ports with similar automated terminals.

Figure 26 Qingdao Port

On 30 June, 2021, the world's first intelligent overhead container delivery system (in a pilot phase) was put into operation at the automated terminal.

The system was co-developed by a team of Qingdao Port engineers working under Zhang and the R&D team at CRRC Yangtze, with the goal of integrating the leading suspension transport technologies into the port's operations to resolve that most difficult 'last mile'.

The aim is to maximize efficiencies when it comes to delivering containers between the terminal, ships, transfer stations and stockyards, and meet the requirements for low cost, short loading and unloading cycles, greater efficiency, full automation, higher safety and zero emissions.

Qingdao Port has claimed that it is the world's first 'hydrogen + 5G' smart ecological terminal, pioneering hydrogen-powered crane technology and systems by developing a hydrogen energy-driven solution for the fueling of equipment needed for the operation of a large port.

The system reduces carbon emissions by some 3.5 kilograms and sulfur dioxide emissions by 0.11 kilograms per TEU.

Calculated on the basis of an annual capacity of 3 million TEU, 21,000 tons of carbon dioxide and 640 tons of sulfur dioxide emissions are estimated to be cut annually.

4.3.7 Tianjin Port in China

Location	XQXF+8VM, Linhai Rd, Binhai, Tianjin, China, 300456
Annual passenger traffic	NA
Annual cargo traffic	20,300,000.000 TEUs in 2021
Type connection to the rest of the city	No public transport
Nearest airport and connection to the airport	Tianjin Binhai International Airport (53 km)
Railway connection	Yes but no railway station
Green and Smart Port Themes	Electricity-powered, Green initiatives

The Tianjin Port Alliance International Container Terminal[69] a large seaport located in the city of Tianjin, which is a municipality in northeastern China. It is one of the busiest ports in China and one of the largest ports in the world, handling over 1 billion tons of cargo annually.

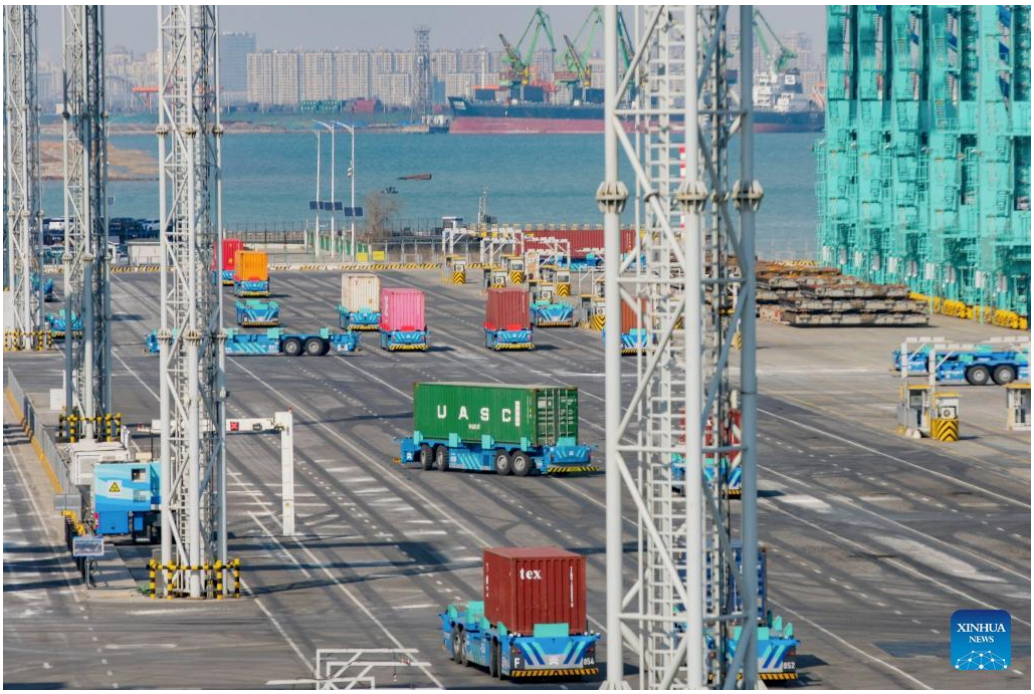
Figure 27 Tianjin Port in China

Tianjin Port has a natural deep-water harbor, which makes it an ideal location for handling large vessels, and it has been developed into a modern port with a range of facilities for handling different types of cargo, including container cargo, bulk cargo, and general cargo. The port consists of several terminals, including the Tianjin Binhai New Area Container Terminal, which is one of the largest container terminals in the world, the Tianjin Port Container Terminal and the Tianjin Port Bulk Terminal among others.

As the "maritime gateway" to the Beijing-Tianjin-Hebei region, Tianjin Port has been ceaselessly advancing the construction of a smart port, boosting the coordinated development of the region with fresh impetus. A full Internet of Things container terminal started operations in January 2023 in Tianjin Port, which connects six IoT elements, including people, vehicles, containers, ships, aircraft, and sites. Equipped with more than 100 thousand types of sensors, the terminal is upgraded from a smart container terminal with zero carbon emissions.[70]

[69] https://www.apmterminals.com/en/tianjin/about/our-terminal
[70] http://en.ce.cn/main/latest/202302/23/t20230223_38408925.shtml

Figure 28 Smart delivery robots work at the full IoT container terminal of Tianjin Port in north China's Tianjin, Feb. 2023



The utilization of clean energy is the trend of port development in the future. By improving the technology of "oil to gas" and "oil to electricity" in port RTG and port vehicles, we can use electric energy and natural gas instead of all kinds of fuel to effectively reduce fossil fuel use. At the same time, the manager of the port must vigorously promote the wind power and solar energy application in the port area, and actively support the geothermal energy, ocean energy and other new energy development and utilization in the port, including the local conditions in promoting wind and solar complementary lighting technology solar bathing and use natural gas as the building heating energy refrigeration system. Through a variety of measures, we can further optimize the structure of the port energy consumption, and improve the use of clean energy and renewable energy.

“Compared with other automated container terminals, the intelligent container terminal in section C is still building wind turbines and photovoltaics on site, allowing the terminal to use electricity for its own use, and truly achieve ‘zero carbon’ emissions,” Chen Yanping, deputy general manager of Tianjin Port Group Kexin Facilities Department said.[71]

The improvement of port loading and unloading technology is the most direct way to reduce the energy consumption of the port. We should vigorously carry out outdoor and yard lighting, intelligent control technology, application of power grid harmonic pollution control technology and grid reactive power compensation technology, equipped with shore based ships and shore power facilities. Besides, for container terminals, crane should mainly use potential energy recovery, energy storage technology or DC drive technology, shore side loading and unloading process.

Environmental protection in port area and surrounding area is one of the most important tasks in green port construction. It mainly includes three aspects: pollution control, comprehensive utilization of resources and ecological protection: In the field of pollution control, using the water saving equipment recommended by the state is selected. High efficiency green irrigation technology should be used, such as sprinkler irrigation and micro irrigation. Collect and separate the toxic and harmful residue separately; put the hazardous waste to the relevant qualified enterprises. Setting up an emergency management plan for

[71] https://www.offshore-energy.biz/tianjin-port-to-build-worlds-first-zero-emission-terminal/

environmental pollution. In the comprehensive utilization of resources, non-traditional water sources should be used for toilet flushing, green irrigation, road spraying, car washing and cooling. Measures for reuse of solid waste resources, such as dredged soil and sludge comprehensive utilization, are adopted. In terms of ecological protection, the terminal frontiers should be equipped with the receiving facilities of ship pollutants and ensure their normal use. Meanwhile, port operators should actively plant all kinds of vegetation, ensure the greening of the port area and participate in the surrounding ecological environment protection activities.[7273]

4.3.8 Zhangjiagang Port in China

Location	XC77+WJJ, Lin'gang Rd, Zhangjiagang, Suzhou, Jiangsu, China, 215633
Annual passenger traffic	NA
Annual cargo traffic	810,000.000 TEUs in 2021
Type connection to the rest of the city	No public transport
Nearest airport and connection to the airport	Sunan Shuofang International Airport, (75 km)
Railway connection	No
Green and Smart Port Themes	Green initiatives

Zhangjiagang Port[74], also known as the Zhangjiagang Free Trade Port Zone, is a seaport located in the city of Zhangjiagang, in the Jiangsu province of China. It is situated at the confluence of the Yangtze River and the Beijing-Hangzhou Grand Canal, which makes it a strategically important location for trade and transportation in the region.

Zhangjiagang Port is a modern port, with a range of facilities for handling different types of cargo, including container cargo, bulk cargo, and general cargo. The port has several terminals such as the Zhangjiagang International Container Terminal, the Zhangjiagang Yangtze River Container Terminal and the Zhangjiagang Yangtze River Bulk Terminal among others, that are equipped with state-of-the-art equipment and technology to handle large vessels and handle cargo efficiently.

The port operates under the Zhangjiagang Free Trade Port Zone, which is the first approved free-trade port zone in China, it provides tax and custom benefits, as well as streamlined clearance processes and efficient logistics services to companies operating within it.

Gangsheng Bulk Terminal of Zhangjiagang Port Group became one of the winners of the GPAS (Green Port Award System) program in 2020, a green evaluation system for ports in the APEC region developed by APEC Port Services Network (APSN).

The terminal has been committed to green practices in its operations, making great strides in dust control, energy-saving transformation, and environmental protection.

[72] https://www.matec-conferences.org/articles/matecconf/abs/2018/34/matecconf_ifcae-iot2018_04012/matecconf_ifcae-iot2018_04012.html
[73] https://www.offshore-energy.biz/worlds-1st-zero-carbon-terminal-gets-carbon-neutrality-certificate/
[74] https://shipnext.com/port/zhangjiagang-cnzjg-chn

After the use of environment-friendly solutions and equipment, such as the solar-powered lighting and exhaust purifier, the terminal has achieved "zero sewage discharge, no oil pollution, and effective waste sorting," becoming a role model in creating a sustainable future for society.[75]

4.3.9 Valencia Port in Spain

Location	de, València, Valencia, Spain
Annual passenger traffic	635,689 in 2021
Annual cargo traffic	5,604,478 TEUs in 2021
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Valencia Airport (19 km)
Railway connection	yes, but no train station
Green and Smart Port Themes	Electricity-powered, Low and zero-emission fuels, Digitalization

The Port of Valencia[76] is a major seaport located in the city of Valencia, on the east coast of Spain. It is the largest port on the Mediterranean Sea and is considered one of the most important ports in Europe. The port handles a wide range of cargo, including containerized cargo, bulk goods, and general cargo.

The Port of Valencia has several terminals, including the Container Terminal Valencia, the Valencia Terminal Euro-Med, and the Terminal Químico-Muelles Norte, among others. These terminals are equipped with state-of-the-art equipment and technology to handle large vessels and handle cargo efficiently.

The Port of Valencia plays a vital role in the Spanish economy, as it serves as a major gateway for trade and investment in the region, and also as a hub for shipping and logistics in the Mediterranean. It connects the region to major markets around the world, and it is well connected to the rest of Spain through an extensive network of highways, railroads, and waterways.

The tank and compressor of the hydrogen generator which will supply hydrogen to the prototypes of port machinery have already been placed on the north quay.

[75] https://english.jschina.com.cn/23262/202101/t20210122_6956956.shtml
[76] https://www.valenciaport.com/en/community/valencia/the-port/

Figure 29 Port of Valencia

The European project which will enable Valencia and its port to work and move port machinery with hydrogen is called “H2PORTS – Implementing Fuel Cells and Hydrogen Technologies in Ports”. It is an initiative coordinated by the Valencia port Foundation in close collaboration with the Port Authority, and is financed by the Clean Hydrogen JU programme of the European Union. Its main objective is to test and validate hydrogen technologies on port machinery that will provide applicable and real solutions without affecting the performance and safety of port operations and producing zero local emissions.

The H2Ports project will involve a total investment of more than 4 million euros and involves, in addition to the Valenciaport Foundation and the Port Authority of Valencia, the research centers Centro Nacional del Hidrógeno and Atena Distretto Alta Tecnologia Energia Ambiente and the private companies MSC Terminal Valencia, Grimaldi Group, Hyster-Yale, Ballard Power Systems Europe, Carburos Metálicos and Enagás.

Valencia port is committed to the fight against climate change and decarbonization through different actions. Green hydrogen is one of the lines of work being carried out by the PAV, which has been recognized by the Spanish Government as a benchmark within the framework of the ‘Hydrogen Roadmap’. Thus, the PAV is one of the institutions, together with the València City Council, the Generalitat Valenciana and the Universitat Politécnica de València, of the ‘Valencia Hydrogen Valley’ strategy to coordinate, create synergies and promote research into green hydrogen in the transport and logistics sector in Valencia and its metropolitan area.

In addition, the PAV has signed an alliance with the Hamburg Port Authority (HPA) to generate projects for this clean energy with the support of the programmes being implemented by the European Union. Valencia port is very active in local and regional initiatives that promote this collaboration, but also at European and world level, which is why it is part of the Clean Hydrogen Alliance and the Global Ports Hydrogen Coalition. It has also created an advisory group open to more than 65 members and 30 ports around the world that is working to help develop the hydrogen value chain for ports.

The PAV is developing a series of actions, in coordination with the port community, aimed at the fight against climate change and decarbonization in order to position itself as a green port at the service of the citizens, and to be 20 years ahead of the objective of the European Green Pact. To this end, it has launched projects such as the electrical substations of the Port of Valencia, the location of photovoltaic plants in

Valencia or Gandia, the installation of wind energy, the use of alternative fuels such as LNG, the commitment to the railway, the electrical connection of the Port of Sagunto or energy efficiency actions.[777879]

4.3.10 Port of Montreal in Canada

Location	450 Rue de Boucherville, Montréal, QC H1N 0C6, Canada
Annual passenger traffic	127,041 passengers in 2018
Annual cargo traffic	1,074,000.000 TEUs in 2019
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Montréal-Pierre Elliott Trudeau International Airport (29 km)
Railway connection	Yes
Green and Smart Port Themes	Electricity-powered; Intermodal, Digitalization

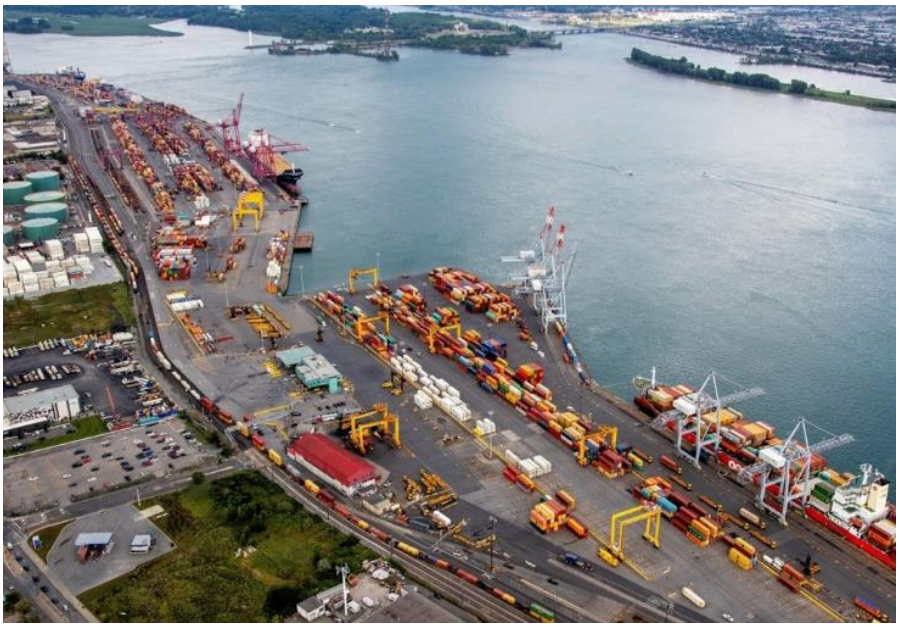
The Port of Montreal[80] is a major seaport located in Montreal, Quebec, Canada. It is situated on the St. Lawrence River, and it handles a wide range of cargo, including containerized cargo, bulk goods, and general cargo. It serves as a key hub for shipping and logistics in the region, connecting the Canadian Midwest and the northeastern United States to major markets around the world. It is also the second largest port in Canada by total cargo volume.

In 2017, the MPA implemented an electrical power system at its cruise terminal and shore power systems for wintering ships to provide cleaner energy during their stay. It lets cruise ships and wintering vessels turn off their engines while docked, while maintaining air conditioning, refrigeration, security systems and services for the duration of their stay (an average of 10 hours for cruise ships). This new technology reduces noise, vibration, smoke and GHG emissions from diesel engine combustion gases by approximately five tons of GHG emissions at each connection, and more than 2,500 tones each year. [81]

MPA has committed through the Montreal Climate Partnership to reduce its GHGs emissions by 55% by 2030 and achieve carbon neutrality by 2050.[82]

[77] https://www.valenciaport.com/en/the-port-of-valencia-now-has-its-hydrogen-plant/
[78] https://greencportsproject.eu/case-studies/#1574154556371-a77aeca1-ca7f
[79] https://www.valenciaport.com/en/the-port-of-valencia-will-install-a-hydrogen-supply-station-in-january/
[80] https://www.port-montreal.com/fr/
[81] https://www.port-montreal.com/en/the-port-of-montreal/social-responsibility/sustainable-development#espaces
[82] https://www.port-montreal.com/en/the-port-of-montreal/news/news/chainport-2022-en

Figure 30 Port of Montreal



Port of Montreal implemented a platform predicting truck turnaround times for improved route optimization. The platform was introduced in 2016 as an open desktop and mobile app to obtain real-time truck turn times at the 4 container terminals. The app also uses an algorithm that translates processing times into greenhouse gas emissions and reports on real-time truck-borne carbon emissions at the port. The app has been used by truckers and dispatchers to optimize their routings and dispatches by making optimal use of uncongested time windows and night gates so as to maximize the number of truck turns in a single day. In 2019, an AI layer was added to create truck turn time predictions up to 24 hours out. The predictions provide further visibility to inform planning of port visits and dispatches for the 2,500 trucks that visit the port daily. Combined with the introduction of a night gate program, the app has allowed increased fluidity of trucks at the gate. Since its introduction, the port has been able to decrease truck processing times by 5% despite a 30% increase of truck volumes. This efficiency gain translates into better environmental performance per transaction.

With over 100 km of rail lines and four locomotives, the Port of Montreal is a unique model in North America in that the port authority operates its own railway and offers on-dock shunting services to its Class1 railway partners. Since over 60% of greenhouse gas emissions generated by port authority activities are generated by its rail activities, the MPA began replacing its fleet of locomotives with next generation low-emission GenSet locomotives since 2010. To fully optimize the environmental benefits from these engines, the MPA is introducing and testing in 2021 an on-board dashboard that will make real-time recommendations to the conductor with the aim to optimize driving behavior and further save on fuel consumption. Locomotives are being equipped with sensors that capture a full range of data on train specifications and parameters, feeding the AI optimization algorithm. Recommendations on speed, acceleration, tractive power output and distribution will assist drivers in lowering fuel consumption. The project could reduce MPA's greenhouse gas emissions by 7 % and fuel consumption by 11 % annually.[83]

4.3.11 Southampton Port in UK

Location	Southampton SO15 1HJ, United Kingdom
Annual passenger traffic	1,900,000 passengers in 2019

[83] https://ajot.com/insights/full/ai-port-of-montreal-continues-record-cargo-pace-and-expansion-projects

Annual cargo traffic	1,500,000.000 TEUs in 2019
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Southampton Airport (10 km)
Railway connection	Yes
Green and Smart Port Themes	Electricity-powered; Intermodal, Digitalization, Green initiatives

The Port of Southampton[84] is a major seaport located in Southampton, on the south coast of England, in the United Kingdom. It is situated on the River Test, and it handles a wide range of cargo, including containerized cargo, bulk goods, and general cargo. It serves as a key hub for shipping and logistics in the region, connecting the south coast of England to major markets around the world. It's well connected to the rest of the country by road and rail and is also a major departure point for cruise ships and ferries.

Figure 31 Southampton Port in UK

Associated British Ports (ABP) air quality measures make an impact at Port of Southampton. One year on since releasing its Air Quality Strategy and pledging a series of commitments, the Port of Southampton reveals significantly improved average levels of nitrogen dioxide across the port.

Last Summer, and more than one year ahead of Government requirements, the Port of Southampton published an Air Quality Strategy including a package of proposals to accelerate improvements in air quality around the UK's number one automotive and cruise port.

ABP Southampton along with partners across the port have worked together delivering on air quality commitments and have achieved an average of 30 µg/m3 across the port - far below the UK National objective levels.

[84] https://www.southamptonvts.co.uk/

Figure 32 Solar panels at Southampton Port

Highlights:

- 3,600 solar panels installed in the last year - 7,321 in total
- 5 air quality monitors installed. 8 in total give us more monitoring coverage than any other UK port
- 12 new hybrid straddle carriers. These use 20% less fuel than standard machines
- 33 new electric forklift trucks
- 550 metres cycle dedicated highway
- 52% of our fleet is electric. 70 electric charging points have been installed across the port
- 9% increase in rail capacity. This allows 180,000 more containers to be moved by rail each year

Achievements include increasing the electric vehicle fleet so that the majority of ABP's vehicles are zero emissions. Solent Stevedores has introduced 33 electric forklifts for cruise operations and DP World has 12 new hybrid straddle carriers at the container port. A partnership project between Solent Stevedores and ABP has also increased rail provisions at the port, reducing the number of lorry movements on the road.[85]

4.3.12 Port of Genoa in Italy

Location	Viale Africa, 16149 Genova GE
Annual passenger traffic	2.5 million in 2019
Annual cargo traffic	2,400,000.000 TEUs in 2019
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Genova City Airport (7 km)
Railway connection	yes
Green and Smart Port Themes	Digitalization, Green initiatives

The Port of Genoa is a multi-service port which boasts a wide selection of specialized terminals, managed by top private terminal operating companies, equipped to accommodate all classes of ships and cater for all

[85] [85] https://www.customsolar.co.uk/case-studies/abp-port-of-hull/

key commodity sectors: container, general cargo, perishable goods, steel, forest products, solid and liquid bulk, petroleum products and cruise and ferry passengers.

Figure 33 Port of Genoa

In addition, backed-up by a group of dedicated companies, the port guarantees a full range of vital complementary services from ship maintenance and repair to customized telecommunications and data processing.[86]

The Port of Genoa[87] has implemented several sustainable actions in order to reach carbon neutrality, some of which include:

- Energy efficiency measures: The Port of Genoa has invested in energy-efficient lighting systems and equipment, as well as optimizing the use of energy throughout the port.
- Use of renewable energy: The port has installed solar panels on some of its buildings and structures, and has also set up wind turbines to generate electricity.
- Low-emission vehicles: The port has introduced low-emission vehicles for on-site transportation, including electric and hybrid trucks, forklifts, and other equipment.
- Shore power: The port has implemented a system of shore power connections, which allows ships to plug in and use electricity from the grid while at port, rather than relying on their own engines for power.
- Green logistics: The port has developed a "Green Logistics Platform" to promote sustainable transport and logistics solutions, including optimizing transport routes and modes to reduce emissions.
- Waste reduction and recycling: The port has implemented a system for separating and recycling waste, and has also established a program to recover and recycle waste oil.
- Green building: The port has constructed new buildings and facilities using environmentally-friendly materials and designs, including energy-efficient heating and cooling systems.

[86] https://www.portsofgenoa.com/en/port-basins/genoa-basins.html
[87] https://www.portsofgenoa.com/it/porti-sostenibili/green-port.html

Figure 34 The EasyLog EU project has launched a trial project to test innovative technologies at the Vado Ligure VIO Intermodal Terminal in Port of Genoa

There are also initiatives about digitalization in the Port of Genoa. The port has implemented several digital technologies and solutions to improve efficiency, safety, and sustainability. For example:

- Digital Container Tracking: The Port of Genoa has implemented a digital container tracking system that allows shippers and cargo owners to track the location and status of their containers in real-time.
- Automated Gate System: The port has installed an automated gate system that uses radio-frequency identification (RFID) technology to streamline the truck check-in and check-out process, reducing wait times and improving efficiency.
- Smart Lighting System: The Port of Genoa has implemented a smart lighting system that uses sensors to detect and adjust lighting levels based on the presence of people and vehicles, saving energy and reducing costs.
- Blockchain-based Logistics Platform: The port has also developed a blockchain-based logistics platform called the "Genoa Logistics Platform," which aims to streamline logistics processes and reduce paperwork by providing a secure, transparent, and efficient platform for data exchange.
- Digital Twins: The Port of Genoa is also developing digital twins of its facilities and operations, which are virtual replicas that allow for simulation and testing of different scenarios and optimization of processes.

4.3.13 Cagliari Port in Italy

Location	09125 Cagliari, Metropolitan City of Cagliari
Annual passenger traffic	1.2 million passengers in 2019
Annual cargo traffic	386,100.000 TEUs in 2019
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Elmas Airport (8 km)
Railway connection	No
Green and Smart Port Themes	Digitalization, Green initiatives

The Port of Cagliari[88] is taking several sustainable actions to reach carbon neutrality, some of which include:

- Use of renewable energy: The port is transitioning to using renewable energy sources such as solar and wind power to reduce carbon emissions.
- Implementation of energy efficiency measures: The port is adopting energy-efficient technologies and practices to reduce energy consumption and associated carbon emissions.
- Electrification of port vehicles and equipment: The port is converting its vehicles and equipment to electric power to reduce emissions from internal combustion engines.
- Use of low-emission fuels: The port is promoting the use of low-emission fuels such as liquefied natural gas (LNG) and biofuels to reduce the carbon footprint of ships calling at the port.
- Green infrastructure: The port is incorporating green infrastructure such as green roofs and walls, green spaces and trees to absorb CO2 emissions and improve air quality.
- Carbon offsetting: The port is also exploring the option of carbon offsetting, which involves investing in projects that reduce greenhouse gas emissions to offset the port's own emissions.

Figure 35 Port of Cagliari

4.3.14 Barcelona Port in Spain

Location	Barcelona, Spain
Annual passenger traffic	4,493,646 passengers in 2018
Annual cargo traffic	3,422,978 TEUs in 2018
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Barcelona (BCN) Airport (11.8 km)
Railway connection	Yes
Green and Smart Port Themes	Digitalization, Green initiatives

[88] https://www.adspmaredisardegna.it/chi-siamo/

Barcelona port[89] has taken significant steps to become a green port by implementing a range of sustainable actions. These actions have focused on reducing emissions, improving energy efficiency, managing waste, promoting sustainable transportation, implementing green infrastructure, and educating people about environmental issues.

One of the primary actions taken by the port of Barcelona to reduce emissions has been the implementation of a low-emission zone. This has restricted access for high-polluting vehicles and encouraged the use of electric vehicles and bike-sharing programmes. Additionally, the port has invested in energy-efficient lighting and equipment, including a solar energy system to generate renewable energy.

Figure 36 Port of Barcelona

In addition to reducing emissions and increasing energy efficiency, the port has also implemented a waste management system. This has helped to reduce waste and increase recycling, while also introducing a composting program for organic waste.

The port has also taken steps to promote sustainable transportation by encouraging walking, cycling, and the use of public transportation. This has included the implementation of a shuttle service within the port to reduce the need for individual vehicles.

Furthermore, the port has implemented green infrastructure, such as green roofs and walls, to help mitigate the urban heat island effect and provide habitat for wildlife. Finally, the port has developed educational programmes to increase awareness and understanding of environmental issues among employees and the community.

The Port of Barcelona is currently implementing several new digitalization projects aimed at improving efficiency and sustainability. These projects include:

- Digital Port Operations Centre: The port is developing a digital operations center that will use advanced data analytics, machine learning, and artificial intelligence to improve port operations. This will help optimize vessel traffic, cargo handling, and logistics.
- Blockchain-based digital platform: The port has developed a blockchain-based platform called "Tradelens" in collaboration with IBM and Maersk. The platform will enable stakeholders to

89 https://www.portdebarcelona.cat/en/home_apb%3Bjsessionid=F095650E899C907609660F0AF6EA850A.lifepro1.port.apb.es

securely share information and documents throughout the supply chain, reducing the need for paper-based transactions and increasing efficiency.

- Smart container terminal: The port is developing a smart container terminal that will use autonomous cranes, automated guided vehicles, and advanced sensors to optimize container handling and reduce energy consumption.
- Predictive maintenance: The port is implementing a predictive maintenance system that uses sensors and data analytics to identify maintenance needs before they become critical. This will help reduce downtime and improve overall efficiency.
- Digitalized customs procedures: The port is implementing a digitalized customs system that will streamline customs procedures and reduce waiting times for ships and cargo.

4.3.15 Port Klang in Malaysia

Location	42000 Pulau Indah, Selangor, Malaysia
Annual passenger traffic	no passengers
Annual cargo traffic	13,724,460 TEUs
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Kuala Lumpur International Airport (70 km)
Railway connection	Pel Klang (16km)
Green and Smart Port Themes	Electricity-powered, Low and zero-emission fuels, Green initiatives

Port Klang (PKA, Northport & Westports)[90], is a town and the main gateway by sea into Malaysia. It is located in the state of Selangor, on the west coast of Peninsular Malaysia. The port is situated about 38 kilometers southwest of the capital city, Kuala Lumpur. It is the busiest port in Malaysia in terms of total cargo tonnage, and it handles a significant portion of the country's international trade. The port consists of several terminals, including the Northport and Southpoint terminals for container cargo, and the Westport terminal for bulk and general cargo. It also has a number of facilities for car handling, passenger ships and other vessels.

Port Klang's concerted efforts to transform the port industry towards adapting new practices which are environmentally sustainable has once again earned international recognition. Recently Port Klang has awarded the APSN (APEC Port Services Network) Green Port 2020 unification for the second time since 2017

This achievement was made possible through the efforts of Port Klang Authority and both its terminal operators Northport (Malaysia) Bhd and Westports Malaysia Berhad whereby various green initiative programmes were initiated and implemented related to alternate energy viz solar energy, conservation, including replacement of conventional lighting with LED lighting, investing in more energy-efficient and environmentally friendly cargo handling fleets, monitoring carbon, emissions from port equipment and vehicles, marine water quality monitoring and treatment before being released into port waters, paperless transaction, establishing waste management standard operating procedures and other ongoing green initiatives.[91]

[90] https://www.pka.gov.my/index.php/en/
[91] https://www.westportsholdings.com/2021/02/10/port-klang-awarded-apsn-green-port-2020/

Figure 37 Port Klang in Malaysia

Energy, electricity and fuel saving strategies include:

- VRF Air-Conditioner System: To reduce greenhouse gases emission
- Energy Saving Quay Crane Lighting: To reduce carbon dioxide (CO2) emissions
- Retrofitted of RTG to E – RTG: To reduce diesel consumption
- LED System at Port Areas

Environmental initiatives implemented in the port are:

- Adopting marine sanctuary area
- Collaborating with Malaysian Nature Society
- Beach cleaning
- Mangrove planting
- Environmental monitoring and waste management

The port is collaborating with Malaysian University to conduct baseline study of ballast water management at designated ports on: Heavy metals in sediment samples, Hydrocarbons (oil, grease and Hydrocarbon) in sediment samples, Marine biological in seawater and sediment samples and Bacteria in water sample

4.3.16 Port of Hualien in Taiwan

Location	No. 66, Hai'an Rd, Hualien City, Hualien County, Taiwan 970
Annual passenger traffic	65,900 passengers in 2020
Annual cargo traffic	12,938,000 TEUs in 2021
Type connection to the rest of the city	Public transport, train
Nearest airport and connection to the airport	Hualien Airport (7 km)
Railway connection	Hualien Port Train Station (1km)
Green and Smart Port Themes	Electricity-powered, Low and zero-emission fuels, Green initiatives

The Port of Hualien[92] is a seaport located in the city of Hualien on the east coast of Taiwan. It is a natural deep-water port that serves as an important transportation hub for the region. The port is situated at the mouth of the Hualien River.The Port of Hualien is an important port of call for passenger ships traveling to and from Taiwan and other parts of Southeast Asia. It also handles a significant amount of cargo traffic, including containers, general cargo, and bulk goods.

In addition to its role as a commercial port, the Port of Hualien also has a number of recreational and tourism-related facilities. This includes a cruise ship terminal, a fishing harbor, and a ferry terminal which connects the city to the nearby islands. There is also a small museum and several parks around the port area that showcase the rich history and culture of Hualien.

A series of pollution control measures have been introduced to improve air quality in the Port. These measures include a campaign to reduce vessel speeds, a shore side electric power supply system, the use of low sulfur fuels, and an automatic gate control system. To prevent suspended particles emissions, the port now requires all operators to use dust control meshes, dust suppression sprinklers, car washing stations, water lanes, enclosed conveyors, and unloading facilities. The Port offers its full cooperation with other government agencies at both the local and national level such as Ministry of Transportation's Maritime Port Bureau or the Hualien County Environmental Protection Bureau (especially with regard to pollution prevention and auditing measures. The Port also collaborates with the EPA in evaluating the efficacy of air and marine pollution control programmes.

Figure 38 Port of Hualien

Shore power is to install power supply equipment on the shore after the ship docks to provide the power required for the maintenance or routine maintenance of the berthing ship through the ship cable, replacing the diesel used by the internal combustion engine of the ship, thereby greatly reducing air pollution. In addition to the full use of ultra-low-sulfur low-pollution fuel super diesel as fuel for ships, shore power facilities have been set up for all port handling vessels at Piers 1 to 4, 15 and 16, and Piers 5-7 cooperate with sea patrols. The department was relocated, and shore power facilities were newly set up for the full use of shore power by the official ships of the Coast Guard, reducing pollution emissions from ships. At present, there are 6 shore power terminals from 1 to 4.7 from 5 to 7.5 from 15 and 16 a total of 18.

After the outer ring road along the northern coast was built, vehicles change their route to the underground road, thus reducing the air and noise pollution suffered by communities along the northern coast, ensuring the safety of people and vehicles, and quality of life of the community. In addition, access roads to the Port of Hualien have been built to separate port traffic from the commuting routes of nearby residents. A green belt, railings, bicycle pathway, promenade, and jogging trail have been built upon the

[92] https://hl.twport.com.tw/en/CP.aspx

box culvert road. In addition to its extensive, ongoing environmental monitoring and management work, the Port is also deeply invested in the surrounding community. To mitigate the impact of the commercial and industrial activity it generates, the Port has constructed an 11 acre green belt between it and the neighboring residential community. This green belt serves as a noise barrier and, more importantly, as a green buffer zone between the Port and the city.

In accordance with the Environmental Protection Agency's "Port Area Pollution Prevention and Reduction Measures Plan", Hualien Port Branch has built the Outer Harbor Wharf's runoff wastewater interception and treatment system year by year to reduce the pollution of stormwater runoff wastewater. In 2015, the Outer Harbor Pier 25 runoff wastewater collection system was completed, with a water treatment capacity of 500CMD, reducing the discharge of suspended solids by 90%.

Taiwan has scarce water resources. The Hualien Branch of TIPC adjacent to the Meilun Mountain is favorable for collecting and filtering surface runoff because it is low lying and has gravel at the surface layer and mudstone at the bottom layer. According to the concept of water resource banks, the Branch built 12 water storage facilities in the port to provide nondomestic water in replacement of tap water for flushing toilets in the administrative building, greening, containing dust at the sand and gravel storage site, and washing vehicles. In 2018 Hualien Port salvaged approximately 4000m 3 of concrete blocks after disasters and screened for concrete blocks that were viable for use in the creation of concrete breakwater foot protection blocks. Though this process, Hualien Port reduced processing costs of soil and stone resource processing and protected the port from ocean wave erosion.

With the increase in environmental protection awareness and the rise in prevalence of adopting renewable energy, Hualien Port began installing solar panels on the rooftops of its buildings in 2018. This led to an increase in the port’s income and reduction in its CO 2 emissions. At the end of 2020, a total of 2,407 kilowatts of capacitors will be completed. According to statistics, a total of 1,283,841 kWh of electricity will be produced in 2020, reducing carbon dioxide emissions by approximately 684 metric tons.

For the waste in Hualien Port area, garbage and recycling bins are set up in the frequent activities of the port area, and garbage trucks are dispatched to collect and transport them at regular intervals. The recycling rate is about 13%. In 2021, the amount of waste generated is 156.3 metric tons, and the recycling volume is 35 metric tons. The resource recovery rate is about 18%.

Every year, the Port of Hualien Taiwan International Ports Corporation calls on its employees and related divisions in the harbor area to undertake a beach cleaning activity and to collect beach trash in the harbor area. This activity helps participating units and employees understand the importance of protecting the marine environment.

4.3.17 Tan Cang Port in Vietnam

Location	G257+48Q, Phước Hoà, Tân Thành, Bà Rịa - Vũng Tàu, Vietnam
Annual passenger traffic	NA
Annual cargo traffic	167,312.000 TEUs in 2021
Type connection to the rest of the city	Public transport
Nearest airport and connection to the airport	Tan Son Nhat International Airport (70 km)
Railway connection	NA
Green and Smart Port Themes	Electricity-powered, Intermodal, Green initiatives

Tan Cang Port[93] is the name used to refer to the Cai Mep International Terminal (CMIT) in Vietnam. It is one of the largest deep-water ports in Southeast Asia and is located in the Cai Mep-Thi Vai area in the Ba Ria-Vung Tau province in southern Vietnam.

The CMIT has been designed to handle large vessels and container ships, and has a total capacity of around 5 million TEUs per year, which includes a combination of deep-water berths, gantry cranes and advanced equipment such as RTGs (rubber-tired gantry cranes) to efficiently handle the containers and other cargo.

In addition to handling container cargo, the CMIT also handles other types of cargo including dry bulk and break bulk cargos. The port also provides stevedoring services and a wide range of logistics services such as warehousing, distribution, and transportation.

TCIT has invested in a system of electrical-operated equipment such as Ship-to-Shore cranes (STS), electric-Rubber Tyred Gantry cranes (e-RTG), etc. which help to reduce CO2 emissions instead of diesel-operated equipment . Other strategies to reduce CO2 emissions includes:

• To use barging for transporting cargos from TCIT to Ho Chi Minh (HCM) city, as an effort to reduce roadway carbon emission;

• To continuously improve handling productivity to minimize negative impacts on the environment;

• To held training programmes for staff on environmental protection as well as activities to protect the green, clean and beautiful environment.

Figure 39 Tan Cang - Cai Mep International Terminal

In addition, TCIT is constantly innovating equipment using clean and natural energy to further improve operational efficiency and protect the environment; changing and replacing the entire lighting system from using light bulbs, OSRAM to use LED on crane system. Continuously improving handling productivity, TCIT not only helps the customers in saving costs and reduces waiting time at terminal but also minimizes negative impacts on the environment. There are solutions to reduce dust in the air, reduce noise and

[93] https://www.tcit.com.vn/

radiation such as planting trees along berths and constructing internal roads in terminal to improve the landscape as well as to improve the surrounding air environment, installing specialized treatment and recycle system for hazardous and solid waste. Especially TCIT paid special attention to the training programmes of staff on environmental protection as well as organizing many activities to protect the green, clean and beautiful environment.[94]

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4.3.18 Po Kai Tak Cruise Terminal in Hong Kong

Location	Kai Tak, Hong Kong
Annual passenger traffic	250.000 passengers (in and out) in 2021
Annual cargo traffic	no cargo traffic
Type connection to the rest of the city	Public transport and shuttles
Nearest airport and connection to the airport	Hong Kong International Airport (42 km)
Railway connection	Hung Hom Station (5km)
Green and Smart Port Themes	Electricity-powered, low and zero-emission fuels

Kai Tak Cruise Terminal[95] is a cruise ship terminal on the former Kai Tak Airport runway in Hong Kong. Its completion date was delayed into 2013 due to re-tendering. It has the capacity to host two large 360 meters long vessel with a capacity of 5.400 passenger each.

Figure 40 Po Kai Tak Cruise Terminal in Hong Kong

Green features in relation to conservation of energy and adoption of renewable energy include:

The Cruise Terminal Building utilizes the Kai Tak District Cooling System (DCS) as its main chilled water circulation system. There are DCS sub-stations in the terminal to cater for the air-conditioning required for the terminal operation facilities and commercial area.

[94] https://vlr.vn/tan-cang-cai-mep-international-terminal-tcit-awarded-green-port-2020-7373.html
[95] https://www.kaitakcruiseterminal.com.hk/

The carriageway on the ground and first floors are naturally ventilated, with wind flows assisted by ceiling mounted extraction fans along the boundary.

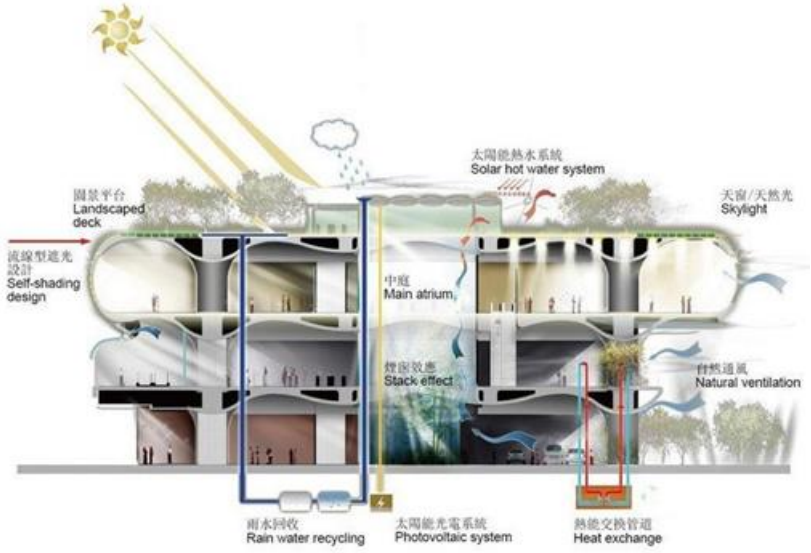
The main heating plant for the air-conditioning is provided by water-to-water heat pumps in energy efficient manner. Solar panels and photovoltaic panels for renewable energy sources.

Rainwater and A/C condensate water recycling assist in reducing the potable water demand for irrigation.

Landscape roof decks to minimize the heat island effect.

Curved building facades with triangular-shaped low-e double glazing, maximizing view while optimizing the heat gain.

Figure 41 Kai Tak Cruise Terminal Passive and Active Sustainable Solutions



A number of atria and large skylights to draw natural light to the building.

A portion of external lighting at the roof garden area is provided by solar energized lighting system.

Kai Tak Cruise Terminal has been awarded a BEAM Plus Platinum rating (a comprehensive environmental assessment scheme for buildings recognized by the HKGBC, Hong Kong Green Building Council).

4.4 Inventory of existing projects with reference to the framework of green and smart ports in the macro region

The following chapter provides detailed and timely inventory of existing projects with reference to the framework of objectives and actions previously illustrated and to analyze and evaluate them in terms of effectiveness and replicability.

4.4.1 Albania

Durres

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**EFINTIS** aims to increase efficiency of the intermodal transport flows in the programmed area by upgrading management information systems. The project will enable, improve, or establish new ICT connections between different modes of transport for passengers as well as for goods
Theme	Cross Border ICT system connection in ports
Timeline	2020 – ongoing
Involved stakeholders	NA
Cost and funding	NA

Description	**ISACC** aims to define information methodologies, models, processes, and structures that can simplify and harmonize the introduction of innovative approaches in the anti-fraud inspection and control phases in Italy, Albania and Montenegro
Theme	Information Technology (IT) platform for antifraud customs controls
Timeline	2020 – ongoing
Involved stakeholders	NA
Cost and funding	NA

4.4.2 Croatia

Rijeka

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**ATLANTIS – Improved resilience of Critical Infrastructures AgainsT LArge scale transNational and sysTemic rISks:** ATLANTIS aims at enhancing resilience and Cyber-Physical-Human (CPH) security of the key European Critical Infrastructures (ECI), going beyond the scope of distinct assets, systems, and single CI, by addressing resilience at the systemic level against major natural hazards and complex attacks that could potentially disrupt vital functions of the society.

	ATLANTIS will offer security to cross-CI, cross-sector, cross-border interdependent ECIs by considering the complete infrastructure as a distributed, large scale Cyber-Physical System (CPS) and System of Systems, calling for combined and integrated security management. Its sustainability and acceptance do not only target economic impact in a cost-benefit analysis and financial business continuity, but also considers environmental and societal impact both by actually offering cybersecurity and ECI protection from system risks but also by offering the feeling of security to EU citizens.
Theme	• Enhancing transport safety and security • Development of efficient capacity allocation and traffic management system • Diffusion of innovation, data and AI for smart mobility
Timeline	01/10/2022-30/09/2025
Involved stakeholders	Engineering – Ingegneria Informatica SPA, CS Group, SIXENSE ENGINEERING, INTRASOFT International S.A., SingularLogic, Telecom Slovenia d.d., SIEMENS AG, Synelixis Solutions S.A., NetU Consultants Ltd., Byte Computer S.A., Snep Asset Management d.o.o., Athens Technology Center S.A., Cybercrime Research Institute GmbH, Luka Koper, Port of Rijeka Authority, DARS, Slovenske Zeleznice, Petrol, Slovenska energetska družba, d.d, Ferrovie dello Stato Technology S.p.A., JRC Capital Management, CaixaBank S.A., Hygeia, SITAF S.p.A., Service Départemental d'Incendie et de Secours de la Savoie, KEMEA – Centre for Security Studies, Institute of Corporate Security studies, European Union Satellite Centre, University of Rijeka, Faculty of Maritime Studies, Jozef Stefan Institute, CEA List institute, Centre of Research & Technology Hellas, Links Foundation, Vicomtech Foundation
Cost and funding	Total cost: € 12 728 564,46, EU contribution: € 9 998 535

Port of Riejka – closed projects

Description	**COSTA II EAST POSEIDON MED:** which aims to introduce LNG as the main fuel for the shipping industry and develop a sufficient infrastructure network of bunkering value chain. It focuses in the eastern Mediterranean region with five Member States (Cyprus, Greece, Italy, Croatia and Slovenia) involved. The members of the NAPA joined the project "COSTA II East Poseidon MED" approved by the EC Decision of 5 December 2014. With a total of 14 partners (port authorities, shipping companies, operators) from the eastern Mediterranean, the project involved studies that analyse the state of supply of ships and other consumers of alternative energy (LNG, etc.) in East Mediterranean ports.
Theme	• Improvement of the energy efficiency and reduction of emissions of vessels • Creation of a comprehensive network of recharging and refuelling infrastructure • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels • Greening ground port services and operations
Timeline	01/6/2015– 31/12/2021

Involved stakeholders	Croatia, Italy, Cyprus, Greece.
Cost and funding	The project is worth a total of 5.126.000 EUR while the TEN-T fund's share is 50% (without VAT).

Description	**DIGLOGS – Digitalising Logistics processes:** DigLogs aimed to create the technological solutions, models and plans to establish the most advanced digitalised logistic processes for multimodal freight transport and passengers' services in the Italy-Croatia area. This project has a significant impact on the quality, safety and environmental sustainability. • Analysis of the main sector innovations focusing on the trend of digitization of the process in the program area and managing the data for mobility of cargo and passengers • Development of a "travel map" based on major innovations over the next five years • Defining the steps to be taken to implement innovative solutions • Seven pilot-focused actions regarding cargo and passenger traffic continuing with implementation of combined pilot -activities to test the real situation in private and public management • A plan that will help all future participants to understand the results of the project pilot activities in the program area • An action plan for the collection of experience and results in order to make possible the implementation of further measures to support the digitalization process after the closure of the project
Theme	• Diffusion of innovation, data and AI for smart mobility • Development of efficient capacity allocation and traffic management systems • Enhancing transport safety and security • Improvement of the energy efficiency and reduction of emissions of vessels, • Greening ground port services and operations
Timeline	Start date: 01/01/2019. End date: 31/12/2021.
Involved stakeholders	University of Rijeka, Faculty of Maritime Studies Rijeka, Elevante Trading & Consulting S.R.L., Unione Regionale Camere I.A.A Del Veneto, Intermodal Logistics Training Consortium, University of Trieste, Actual I.T., Cluster For Innovation In Logistics And Transport System, Port of Rijeka Authority, Port of Šibenik Authority, Rovinj Port Authority.
Cost and funding	Total project budget: 2.555.427,50 € European co-financing: 2.172.173,37 €
Description	**Environmental Rehabilitation of Brownfield Site in Central Europe – GreenerSites:** The area of the former Ina oil refinery on Mlaka is an extremely attractive, functionally unused space at the very city centre, and it represents an area that needs to be revitalized. Therefore, the possibility of revitalizing this part is fully integrated into a project aimed at improving the environment of poorly used and neglected industrial areas (brownfields) by defining strategies and activities based on an integrated and sustainable approach. Increasing the ecological feasibility in neglected areas will result in improved working and living conditions of the population in the area involved (functional urban areas/FUAs). Therefore, the Port of Rijeka Authority, together with other project partners, filed a Pilot

	Project called “Renovation of the former refinery area jointly owned by the City of Rijeka, the Port of Rijeka Authority and the private company INA d.d.” Main goal of the Project was to improve the management of unused or underused industrial areas. This is to be achieved by defining strategies and tools that are based on a sustainable and integrated approach, in order to make functional urban areas (FUA) cleaner, healthier and more comfortable places to live.
Theme	• Greening ground port services and operations • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
Timeline	2016-2019
Involved stakeholders	City of Venice, Italy, ISW – Institute for Structural Policy and Economic Development, Germany, Municipality of Celje, Slovenia, Mazovia Development Agency, Poland, Municipality of Solec Kujawsky, Poland, Veneto Region, Italy, Port of Rijeka Authority, Croatia, Venice Port Authority, Italy, City of Bydgoszcz, Poand, City of Rijeka, Croatia, Ministry of Regional Development and Transport Saska Anhalt, Germany
Cost and funding	The total budget of the project GreenerSites is 3.795.796,00 EUR. Project financing is implemented in the ratio of 85% EU – 15% PRA, of which the Port of Rijeka Authority’s budget is 244.721,00 EUR.

Projects in multiple Ports

Description	**Upgrade of the Rijeka port infrastructure – Port Community Information System (POR2CORE-PCS):** The project “Upgrade of the Rijeka port infrastructure – Port Community Information System” enables the finding of an IT solution which will be used, after development, by other Croatian freight ports. The project will contribute to the improvement of regional transport flows and better multimodal integration and interoperability. The aim was to design and construction of a unique standardized port information system that is compatible with the CIMIS system (Croatian Integrated Maritime Information System). PCS implementation improves the efficiency of communication between members of the port community, avoids multiple information inputs, optimizes the circulation and timely reception of information and secures data from unauthorized access.
Theme	• Diffusion of innovation, data and AI for smart mobility • Development of efficient capacity allocation and traffic management systems • Enhancing transport safety and security
Timeline	2017-2021
Involved stakeholders	ACTUAL IT d.o.o. (Žminj, Croatia), Actual IT d.d. (Koper, Slovenia), Integra Group d.o.o. (Zagreb).
Cost and funding	The total value of the project is EUR 1.660.000,00 EUR (and it is co-financed from the Connecting European Facility (CEF) with a share of 85% with the maximum contribution of EUR 1.411.000,00.

Description	**INTERREG CBC Italy-Croatia 2014-2020 DIGSEA:** DIGSEA clusters the technical knowledge developed by realized projects and consolidates it in a single sea-port-hinterland-logistics approach, covering the whole supply chain. The project's main approach is to consolidate the technical knowledge on ICT applied to maritime and multimodal freight transport by Interreg IT-HR 2014-2020 clustered projects – and beyond – playing the role of a bridge with the new programming period, supporting potential beneficiaries in the project preparation, and transferring at transnational level. This way, the experiences and expertise of the current programming period will serve as a basis for the new one, ensuring their long-term sustainability and replicability. Also, they will be transferred to stakeholders and policy makers at EU and transnational level, to engage them and raise the awareness of the use of ICT as a powerful and efficient tool to improve the cooperation in the whole supply chain, streamlining transport flows across different modes.
Theme	• Enhancing transport safety and security • Diffusion of innovation, data and AI for smart mobility • Development of efficient capacity allocation and traffic management systems
Timeline	2014-2020
Involved stakeholders	PORT NETWORK AUTHORITY OF THE EASTERN ADRIATIC SEA, CFLI – INTERMODAL LOGISTICS TRAINING CENTRE, CENTRAL ADRIATIC PORTS AUTHORITY, RAM LOGISTICA INFRASTRUTTURE E TRASPORTI S.P.A., UNIVERSITY OF RIJEKA, FACULTY OF MARITIME STUDIES (FMSR), INTERMODAL TRANSPORT CLUSTER, PORT OF RIJEKA AUTHORITY, PORT OF PLOČE AUTHORITY
Cost and funding	The Port Authority of Rijeka is a partner in the European project DIGSEA, co-financed through the Interreg Italy-Croatia program. The value that will be available to the Port of Rijeka Authority amounts to EUR 65,000 with 85% of European contribution, and 15% of its own funds.

Description	**SUSPORT – SUStainable PORTs:** SUSPORT – SUStainable PORTs is an EU project funded by the Interreg Italy-Croatia programme, with the main objective of enhancing the environmental sustainability and energy efficiency of the ports in the Programme area through increased institutional cooperation to create the basis for coordinated and permanent governance in the context of port environmental sustainability and energy efficiency at the cross-border level. Ports of the Programme Area will be able to share best practices and develop common methodologies for environmental sustainability and energy efficiency, which will be tested in the project's pilot actions. The main expected result of SUSPORT is the enhancement of institutional capacity of the ports in the Programme Area regarding the key issues of environmental sustainability and energy efficiency. The project also aims to achieve the following specific results: 1. Improvement of port competences in the joint planning of environmental sustainability and energy efficiency 2. Harmonization of policies and actions to strengthen environmental sustainability and port energy efficiency at cross-border level 3. Institutionalization of cross-border governance of environmental sustainability and energy efficiency
Theme	• Improvement of the energy efficiency and reduction of emissions of vessels, • Greening ground port services and operations

	• Enhancing transport safety and security • Diffusion of innovation, data and AI for smart mobility
Timeline	01/07/2020-31/06/2023
Involved stakeholders	ORT NETWORK AUTHORITY OF THE EASTERN ADRIATIC SEA, CONSORZIO DI SVILUPPO ECONOMICO DEL FRIULI, NORTH ADRIATIC SEA PORT AUTHORITY – PORTS OF VENICE AND CHIOGGIA, VENICE INTERNATIONAL UNIVERSITY, INSTITUTE FOR TRANSPORT AND LOGISTICS FOUNDATION, PORT OF RAVENNA AUTHORITY, CENTRAL ADRIATIC PORTS AUTHORITY, AGENZIA DI SVILUPPO, SPECIAL AGENCY OF THE CHAMBER OF COMMERCE CHIETI PESCAR, SOUTHERN ADRIATIC SEA PORT AUTHORITY, LUČKA UPRAVA RIJEKA, KLASTER INTERMODALNOG PRIJEVOZA, LUČKA UPRAVA ZADAR, LUČKA UPRAVA SPLIT, LUČKA UPRAVA PLOČE, LUČKA UPRAVA DUBROVNIK, DUBROVAČKO-NERETVANSKA ŽUPANIJA, AUTONOMOUS REGION OF FRIULI VENEZIA GIULIA
Cost and funding	European co-financing: 85% ERDF Total budget: 7.142.000,00 Eura

4.4.3 Greece

Igoumenitsa

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**ALFION Project**: Alternative Fuel Implementation at Igoumenitsa Port. The main scope of ALFION is to transform Igoumenitsa port into an energy hub of the Adriatic-Ionian Sea, providing sustainable solutions based on the requirements of the port's marine and vehicle traffic. The action aims to contribute to the fulfilment of three key needs: 1. Significant upgrade of the port infrastructure that will increase the port's power management efficiency 2. Deployment of Renewable Energy Sources inside and in the broader area of the port so that significant portions of energy required by the port is provided by its own resources 3. Provision of green electric energy to ships at berth via ship-to-shore power interconnections and to road vehicles via recharging power stations, reducing ship emissions and noise of their auxiliary engines (electric generators) and the overall environmental footprint of transport activities
Theme	• Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels • Greening ground port services and operations Development of efficient capacity allocation and traffic management systems
Timeline	Ongoing

Involved stakeholders	Igoumenitsa Port Authority S.A., Hellenic Electricity Distribution Network Operator S.A., PROTASIS Engineering & Consulting S.A., HYDRUS Engineering Ltd, National Technical University of Athens
Cost and funding	1.08 million, 50% co-financing by CEF

Piraeus

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**CIPORT:** Cold ironing in the Port of Piraeus – Taking the Final Step. The Action includes the elaboration of the following main studies: 1. Technical studies for the installation of OPS for the four identified cruise vessels positions, including the infrastructure that will allow the connection of the Port's grid to the city's local grid 2. Technical requirements and operational procedures for the electric connection and power provision to cruise vessels by the Port. 3. Environmental studies required for the installation and operation ofthe OPS system 4. A study for the appropriate commercial model for the electricity supply to cruise vessels as well as a calculation of the appropriate pricing methodology In the frame of CIPORT, PPA SA will implement all studies to prepare and accelerate the effective launch of cold ironing in the cruise sector.
Theme	• Greening ground port services and operations • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
Timeline	01/08/2021 – 30/11/2023
Involved stakeholders	**Lead Partner: Piraeus Port Authority SA,** HEDNO SA - Hellenic Electricity Distribution Network Operator SA, PROTASIS SA, HYDRUS Engineering SA, National Technical University of Athens, GATES – Global Transport and Engineering Systems
Cost and funding	Project total budget: € 1.376.00, PPA SA budget: € 170.000, Funding: 50% EU contribution CEF

Description	**ARSINOE**: Climate-resilient regions through systemic solutions and innovations. The ARSINOE project will shape the pathways to resilience by bringing together SIA (Systems Innovation Approach) and CIW (Climate Innovation Window) with the purpose to build an ecosystem for climate change adaptation solutions. Case study 2: Mediterranean Ports To apply adaptation strategies, the ARSINOE project foresees to: 1. Facilitate a fundamental transformation of economic, social and financial systems that will trigger exponential change in decarbonisation rates and strengthen climate resilience through a Systems Innovation Approach

	2. Support recovery from the COVID-19 crisis and climate resilience through the implementation of the EU Next Generation Fund Recovery and Resilience Plans (RRP's) in a co-integrated way 3. Offer advanced Environmental Intelligence services and tools, through an interactive platform allowing multiple stakeholders to collaborate; 4. Quantify, model and manage climate risk in a systematic way through resilience;
Theme	• Diffusion of innovation, data and AI for smart mobility • Enhancing transport safety and security • Development of efficient capacity allocation and traffic management systems • Greening ground port services and operations
Timeline	10/2021-10/2025
Involved stakeholders	Piraeus Port Authority S.A., Athens University of Economics and Business, ATHENA: Research & Innovation Information Technologies, Fundacion Valenciaport, Cyprus University of Technology, Consejo Superior de Investigaciones Científicas
Cost and funding	Total project budget: €15.643.021 (European Union's Horizon H2020)

Description	**Green C Ports:** The GREEN C Ports Action will pilot the use of sensors, big data platforms, business intelligence tools and artificial intelligence modelling at the ports of Valencia, Venice, Piraeus, Wilhelmshaven and Bremerhaven, contributing this way to the future roll out of these technologies in the market. 1. The first phase of the project will comprise the design, acquisition, engineering adaptation and installation of the different sensor networks at the participant ports. These sensor networks will gather environmental data of different types 2. The second phase of the project will start once the installation of the necessary equipment to build the required environmental sensor network is completed. At this stage, partners of the GREEN C Ports project will develop methods and analytics following big data techniques and advanced modelling, which will allow predictive analyses of ports' environmental performance 3. By analysing the data gathered from the sensor networks, it will be possible to build models and advanced algorithms to predict in real time the impact of the environmental conditions over port operations and also over nearby city areas in terms of air quality, noise and other relevant parameters <u>Specific Objectives of the Action</u> i. Upgrade existing sensor networks with new sensors at the pilot ports. ii. Implement a Port Environmental Performance (PEP) IT platform that will receive real time data from the sensor networks and from existing port systems (i.e. PCS, PMIS and TOS). iii. Reduce the impact of port operations on their cities. iv. Monitor emissions from ports and vessels. v. Increase the efficiency of port operations and optimize handling of cargo in core ports. vi. Facilitate access of cargo in and out of core ports.
Theme	• Development of efficient capacity allocation and traffic management systems • Diffusion of innovation, data and AI for smart mobility, including • Greening ground port services and operations

Timeline	01/04/2019 – 31/03/2023
Involved stakeholders	**Piraeus Port Authority S.A., Municipality of Piraeus**
Cost and funding	Project total budget: € 7.155.708 PPA budget: € 455.500,00 (50% financed by the CEF)

Description	**MultiAPPRO PLUS**-Interreg ADRION will promote freight transport logistics, strive to make intermodal transportation more competitive and put maritime freight transport on equal footing with other transport modes, as well as continue the creation of frameworks that incentivise investments for the modernization of ports in the Adriatic-Ionian region and continue reviewing the progress made in the development of sustainable mobility as previously proposed by the European Commission.
Theme	• Enhancing transport safety and security • Diffusion of innovation, data and AI for smart mobility
Timeline	01/01/2022-30/06/2022
Involved stakeholders	Piraeus Ports Authority S.A., National Technical University of Athens
Cost and funding	Total project budget: € 145.688,40 EU Contribution for GR: € 34,408.00

Description	**SUPER-LNG PLUS**-Interreg ADRION: Environmental pressure in port areas and in urban areas close to ports is high owing to emissions from ships, port machinery and transport to/from the port areas. LNG is proposed as a low-carbon clean fuel for marine transport in port areas. The boost of LNG for marine and terrestrial propulsion may be a key to enhance the sustainability of port areas, protecting health of population and cultural heritage. However, distribution networks and port infrastructures for the bunkering of LNG-powered ships requires technologies and solutions assuring a high level of safety in touristic areas of the Adriatic and Ionian sea, avoiding trade-offs among environment protection and safety of passengers and personnel. The overall objective of the SUPER-LNG PLUS project is to increase the level of safety, environmental quality and sustainability of LNG maritime transportation in the Adriatic and Ionian seas, while the goals are to promote the SUPER-LNG project outcomes and results to national/regional/ level and also to promote the use of project outcomes to potential beneficiaries.
Theme	• Improvement of the energy efficiency and reduction of emissions of vessels • Creation of a comprehensive network of recharging and refuelling infrastructure • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power • Enhancing transport safety and security
Timeline	01/01/2022 – 31/08/2022
Involved stakeholders	National Center for Scientific Research "DEMOKRITOS – Lead Partner, University of Bologna, Jozef Stefan Institute, **Piraeus Port Authority SA**, Port of Bar JSC – Associated Partner

Cost and funding	Total project budget: € 149.800,32 EU Contribution: 85% CEF

Description	**EALING:** EALING aims at implementing the following specific objectives: 1. Defining a common harmonised and interoperable Legal and Regulatory framework in order to facilitate the implementation phase of OPS infrastructure in the ports of the consortium 2. Ensuring the port to vessel compatibility in the TEN-T Maritime Network, for vessels calling at the ports of the consortium 3. Leading all the necessary technical, financial, legal and environmental studies to prepare and accelerate the effective launch of cold ironing and electric bunkering equipment in the ports. In the frame of EALING, PPA SA will implement all studies to prepare and accelerate the effective launch of cold ironing and electric bunkering equipment within port area. Additionally, PPA SA, as a core port of Europe, will contribute into the development of a common EU harmonised and interoperable framework for deployment of OPS infrastructure and equipment in the ports with close cooperation between all the stakeholders of the maritime sector.
Theme	• Improvement of the energy efficiency and reduction of emissions of vessels, including • Creation of a comprehensive network of recharging and refuelling infrastructure, including • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power, including • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuel • Greening ground port services and operations
Timeline	1/6/2020 – 31/12/2022
Involved stakeholders	Valenciaport (ES), CIRCLE SPA (IT), Symbios Funding & Consulting GmbH (DE), Ocean Finance LTD (GR), Autoridad Portuaria De Valencia (ES), Autoridad Portuaria De Barcelona (ES), Autoridad Portuaria De Huelva (ES), Autoridad Portuaria De Gijon (ES), North Adriatic Sea port Authority (IT), Bulgarian Ports Infrastructure Company (BG), Autorità di Sistema Portuale del Mare Adriatico Orientale (IT), Protasis S.A. (GR), National Company Maritime Ports Administration SA Constanta (RO), Autorita' Di Sistema Portuale Del Mare Adriatico Centrale (IT**), Piraeus Port Authority S.A** (GR), Luka Koper (SI), Hydrus Engineering Limited (GR), Organismos Limenos Rafinas AE (GR), Marine Institute (IE), Administração dos Portos do Douro, Leixões e Viana do Castelo, S.A. (PT), Fincantieri SI S.p.A. (IT), Portos Dos Açores, S.A. (PT)
Cost and funding	Total Budget: € 6.960.240, PPA Budget: € 190.300, 50% EU contribution CEF

Description	**ELEMED** - Elemed is (Electrification in the Eastern Mediterranean) project, a breakthrough maritime initiative which prepared the ground for the introduction of cold ironing, electric bunkering and hybrid ships across the Eastern Mediterranean Sea corridor, aiming at eliminating emissions & noise in ports and surrounding urban area. It is a co-funded by

	European Union project, studying all technical, regulatory and financial issues related to the establishment of cold-ironing infrastructure, in four ports (Piraeus, Killini, Lemesos, Koper), involving three countries. Within elemed framework, the first pilot cold-ironing infrastructure in Eastern Mediterranean was established in Killini Port. ELEMED aims at eliminating emissions & noise in ports and surrounding urban area preparing the ground for the introduction of cold ironing, electric bunkering, and hybrid ships across the Eastern Mediterranean Sea corridor.
Theme	• Improvement of the energy efficiency and reduction of emissions of vessels • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
Timeline	2016-2018
Involved stakeholders	**Piraeus Port Authority S.A.**, Port of Killini
Cost and funding	Actual CEF co-funding for Greece Beneficiaries: € 766,922 Eligible costs for Greece Beneficiaries: € 1,115,735

Heraklion

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**ELECTRIPORT** - Alternative maritime power in the Port of Heraklion aims to transform the Port of Heraklion to the first Greek Port that will apply fully integrated electrification services for any ship type at berth. The Action covers the elaboration of a complete set of studies and engineering designs for the development of onshore power supply (OPS) technology for all types of vessels at the core maritime Port of Heraklion. Further to the participation of the Port of Heraklion to the LNG bunkering station development (Project Poseidon MED II – CEF Project), the port aims at becoming the first Greek Port that will apply fully integrated electrification services for any ship type approaching alongside. ELECTRIPORT provides all the detailed studies that are needed for "cold ironing" to become eligible for funding timely and effectively. Apart from the Technical options, studies cover the economic and financial aspects, delivering the financial dimensions in a complete input – output CBA approach. The expected outcomes contribute to the development of know-how, implementation of environmental policies, reduction of CO2 emissions in the port and consequently in the neighbouring Port–City of Heraklion.
Theme	• Diffusion of innovation, data and AI for smart mobility, including • Greening ground port services and operations • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
Timeline	End date: 15/03/2023
Involved stakeholders	**Heraklion Port Authority S.A.**

Cost and funding	Actual CEF Co-funding: € 1,230,324

Project in multiple ports

The following projected are planned in multiple ports within the scopes and themes of green and smart ports.

Description	**BlueHUBS: LNG and CNG Supply Chains Upgrading Core TEN-T Ports in Eastern Mediterranean.** The Action aims at establishing the supply chain for the distribution of LNG for vessels and LNG/CNG for port heavy duty vehicles and buses, including bunkering and refuelling facilities the Port of Limassol (in Cyprus), and the Ports of Piraeus and Heraklion (in Greece). The action focuses on the construction of two LNG Bunkering Vessels (indicative capacity 3,000 m3 each) serving the purposes of bunkering LNG fuelled vessels and the small-scale mobile LCNG stations to service the ports of Heraklion and Limassol. The action also focuses on the development, procurement and commissioning of: 1. one Mobile LCNG Station to service the Core TEN-T Port of Heraklion; 2. two Mobile LCNG Stations to service the Core TEN-T Port of Limassol (Terminal 1 and Terminal 2) for bunkering LNG fuelled vessels and refuelling the LNG/CNG for port heavy duty vehicles and buses; 3. a small fleet of eight LNG Tanker Trucks with bunkering equipment.
Theme	• Improvement of the energy efficiency and reduction of emissions of vessels • Creation of a comprehensive network of recharging and refuelling infrastructure • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
Timeline	Ongoing
Involved stakeholders	Piraeus Port Authority S.A., Heraklion Port Authority S.A.
Cost and funding	Total project cost: €65 963 400 EU Contribution: €19 789 020 (TEN-T Ports in Eastern Mediterranean)

Description	**Poseidon Med II:** This project is a continuation and a unification of the "COSTA II–East (Poseidon-Med)" and the "Archipelago-LNG" projects and it is a part of the Global Project aiming to take all the necessary steps towards adoption of LNG -as marine fuel- in Eastern Mediterranean Sea while making Greece an international marine bunkering and distribution hub for LNG in South Eastern Europe. Poseidon Med II aims to contribute to reducing negative impacts of heavy fuel oil powering and to facilitate the implementation of the requirements of a number of EU Directives regarding alternative fuels for a sustainable future in the shipping industry. The specific objectives of the project are to:

	1. facilitate the adoption of the regulatory framework for the LNG bunkering 2. design the extension of Revithoussa LNG terminal 3. design and construct an LNG fuelled specific feeder vessel 4. implement technical designs and plan approvals for the retrofit/new building of LNG fuelled vessels and for additional ports' infrastructure for bunkering operations 5. examine potential synergies with other uses of LNG 6. develop a sustainable LNG trading and pricing pattern 7. develop financial instruments to support the port and vessel installations 8. develop synergies with other sectors (mainly Energy) that will create economies of scale in the use of LNG.
Theme	• Improvement of the energy efficiency and reduction of emissions of vessels • Creation of a comprehensive network of recharging and refuelling infrastructure • Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power • Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels • Greening ground port services and operations
Timeline	01/6/2015– 31/12/2021
Involved stakeholders	DEPA Commercial S.A, (lead Partner), Hellenic Gas Transmission System Operator S.A., Hellenic Lloyd's S.A.,OceanFinance Ltd., Environmental Protection Engineering S.A., NAP Engineering P.C., Rogan Associates S.A., **Piraeus Port Authority S.A., Heraklion Port Authority S.A., Patras Port Authority S.A., Igoumenitsa Port Authority S.A.,** Cyprus Ports Authority, North Adriatic Sea Port Authority, Rimorchiatori Riunti Panfido & C. SRL, Minoan Lines Shipping S.A., Blue Star Ferries Maritime S.A., Attica Ferries Maritime Company, Shipping Company of Crete S.A., Neptune Lines Shipping & Managing Enterprises S.A., Hellenic Seaways Maritime S.A., Arista Shipping Co. Ltd., Lavar Shipping S.A., Bunkernet Ltd., Hellenic Shortsea Shipowners Association, Association of Passenger Shipping Companies – SEEN, Centre for Research and Technology Hellas
Cost and funding	Project budget 53.279.405,00 € EU Contribution: 50% CEF

4.4.4 Italy

Trieste

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**Upgrade of the port railway system** The upgrade of the port railway system in Trieste is a project aimed at improving the efficiency and capacity of the railway infrastructure within the port area. The project involves several key tasks, including the modernization of existing railway lines and the construction of new railway tracks.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2018 - 2023

Involved stakeholders	Port Network Authority of the Eastern Adriatic Sea , RFI
Cost and funding	32,7M € partially financed by EU funds (CEF/TEN-T)

Description	**Railway works inside and outside the port area of Trieste** This project is an initiative aimed at upgrading the railway infrastructure and services in the port area of Trieste, Italy. The project aims to improve the connectivity and efficiency of rail transport in the port area, which is an important gateway for goods to and from Central and Eastern Europe. The primary objective of the project is to upgrade the railway infrastructure in the port area, including the construction of new tracks, the upgrading of existing tracks, and the improvement of intermodal facilities. The project also aims to improve the interoperability and interconnectivity of the rail system, including the integration of rail and sea transport.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2020 - 2023
Involved stakeholders	Azienda Speciale per il Porto di Monfalcone, Port Network Authority of the Eastern Adriatic Sea , RFI
Cost and funding	187M € partially covered from PNRR fund (100.5M €)

Description	**ISTEN - Integrated and Sustainable Transport in Efficient Network** The ISTEN (Integrated and Sustainable Transport in Efficient Network) project includes a focus on the maritime sector and aims to promote sustainable and efficient transport in European ports and shipping routes. The ISTEN project aims to address the challenges (environmental impacts, including air and water pollution, greenhouse gas emissions, and noise) by developing an integrated and sustainable transport system that supports economic growth, reduces carbon emissions, and enhances the quality of life for European citizens. In terms of sustainable shipping, the project involves the development and deployment of low-carbon shipping technologies and practices, such as alternative fuels and energy-efficient vessel design, to reduce the environmental impact of shipping. The initiative also aims to promote sustainable shipping practices, such as slow steaming and efficient route planning. In terms of port infrastructure and operations, the project focuses on improving the energy efficiency of port operations, including the use of renewable energy sources, such as wind and solar power, and the deployment of shore-side power supply systems to support the use of cold ironing by ships. The initiative also promotes the use of digital technologies to improve the efficiency and safety of port operations. Finally, the ISTEN project aims to improve the multimodal transport network by promoting the integration of different transport modes, such as shipping, rail, and road, and by developing innovative transport solutions that reduce the environmental impact of transport and support economic growth.

Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2017 - 2020
Involved stakeholders	Mediterranea University of Reggio Calabria, Port Network Authority of the Eastern Adriatic Sea, Centre for Research and Technology Hellas (CERTH), Chamber of Commerce and Industry of Serbia, Institute for Transport and Logistics Foundation, Port Authority of Šibenik-Knin County, Port of Bar Holding Company, Port of Koper, port and logistic system, public limited company, Regional Council of Durres, Thessaloniki Port Authority S.A
Cost and funding	1,32M € EU contribution: 920.550€ ERDF budget and 211.650 € IPAII budget

Description	**INTESA - Improving maritime transport efficiency and safety in the Adriatic** INTESA (Improving maritime transport efficiency and safety in the Adriatic) is a European project aimed at improving the safety and efficiency of maritime transport in the Adriatic Sea. The primary objective of the INTESA project is to develop and implement innovative technologies and systems to enhance the safety and efficiency of maritime transport in the Adriatic Sea. In terms of maritime traffic management, the project aims to improve the safety and efficiency of maritime transport by developing and deploying advanced systems for vessel traffic monitoring and control. The initiative also aims to promote the use of digital technologies to enhance the efficiency of port operations and reduce the risk of accidents. In terms of environmental protection, the project focuses on reducing the environmental impact of maritime transport in the Adriatic Sea. The initiative involves the development and deployment of innovative technologies and systems to reduce air and water pollution, including the use of low-emission vessels, advanced waste management systems, and the monitoring of water quality. Finally, the INTESA project aims to enhance the capacity of maritime stakeholders in the Adriatic region by providing training and support to improve the skills and knowledge of maritime professionals. The initiative also involves the development of networks and partnerships to promote cooperation and collaboration among stakeholders in the region.
Theme	Safety in ports - Enhancing transport safety and security Ports as green hubs - Greening ground port services and operations
Timeline	2019 - 2022
Involved stakeholders	Italian Ministry of Sustainable Infrastructures and Mobility - Coast Guard Headquarters, RAM- Logistica Infrastrutture e Trasporti SpA, Port Network Authority of The Eastern Adriatic Sea, Ravenna Port Authority, Central Adriatic Sea Ports Authority, Southern Adriatic Port Authority, Split Port Authority, Ministry of the Sea, Transport and Infrastructure, Meteorological and Hydrological Service of Croatia DHMZ
Cost and funding	2,9M € covered by EU funds

Description	**PROMARES - Promoting maritime and multimodal freight transport in the Adriatic Sea** PROMARES (Promoting maritime and multimodal freight transport in the Adriatic Sea) is a European project aimed at promoting the development of sustainable and efficient transport solutions in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, and Slovenia. The primary objective of the PROMARES project is to promote the development of a sustainable and efficient transport network in the Adriatic Sea region by improving the connectivity and interoperability of the region's ports and transport modes. The initiative aims to enhance the efficiency and sustainability of maritime transport by reducing waiting times for ships, improving transport links, and promoting the use of low-carbon transport modes. The PROMARES project is expected to have a significant impact on the efficiency and sustainability of maritime transport in the Adriatic Sea region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport and promoting the development of sustainable and innovative transport solutions.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2019 - 2022
Involved stakeholders	North Adriatic Sea Port Authority – Ports of Venice and Chioggia, Venice International University, Interporto Trieste, Institute for Transport And Logistics Foundation – Itl, Central Adriatic Ports Authority, Port of Ravenna, Southern Adriatic Sea Port Authority (Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli), RAM- Rete Autostrade Mediterranee Spa, Port of Rijeka Authority, Port of Ploče Authority, University of Rijeka - Faculty of Maritime Studies
Cost and funding	2,8M € covered by EU funds

Description	**SUSPORT- SUStainable PORTs** The European project SUSPORT (SUStainable PORTs) is a multi-year initiative aimed at promoting sustainable development in European ports. The primary objective of the SUSPORT project is to develop and implement sustainable strategies and practices in European ports that reduce the environmental impact of port operations, promote resource efficiency, and support economic growth. The initiative focuses on four key areas: energy efficiency, air quality, water quality, and waste management. The project involves the development and deployment of innovative technologies and systems to reduce energy consumption and emissions of greenhouse gases, air pollutants, and other harmful substances from port operations. The initiative also includes the promotion of renewable energy sources, such as solar and wind power, to support the transition to a low-carbon economy. In addition, the SUSPORT project aims to improve water quality in ports by reducing the discharge of pollutants and promoting sustainable water management practices. The initiative also focuses on waste management, with the goal of reducing waste generation and promoting the use of sustainable waste management practices, such as recycling and composting.

Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2023
Involved stakeholders	Port Network Authority Of The Eastern Adriatic Sea, Consorzio Di Sviluppo Economico Del Friuli, Intermodal Transport Cluster, Split Port Authority, Port Of Zadar Authority, Ploče Port Authority, Dubrovnik Port Authority¸ Dubrovnik Neretva County, North Adriatic Sea Port Authority – Ports Of Venice And Chioggia, Venice International University, Institute For Transport And Logistics Foundation, Port Of Ravenna Authority, Central Adriatic Ports Authority, Special Agency Of The Chamber Of Commerce Chieti Pescara, Southern Adriatic Sea Port Authority (Ports Of Bari, Brindisi, Manfredonia, Barletta And Monopoli), Rijeka Port Authority, Autonomous Region Of Friuli Venezia Giulia
Cost and funding	7,1M € covered by EU funds

Description	**CLEAN BERTH** CLEAN BERTH is a European project aimed at reducing the environmental impact of the maritime sector by developing and deploying innovative technologies and systems to improve the efficiency and sustainability of port operations. The primary objective of the CLEAN BERTH project is to reduce air and water pollution, noise, and greenhouse gas emissions from port operations by promoting the use of clean energy sources, such as electricity, hydrogen, and LNG. The initiative also aims to improve the efficiency of port operations by reducing waiting times for ships and optimizing the use of port infrastructure and equipment. The CLEAN BERTH project is expected to have a significant impact on the efficiency and sustainability of port operations in the Mediterranean region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2022
Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Consorzio di Sviluppo Economico del Friuli, Autorità di Sistema Portuale del Mare Adriatico Settentrionale – Porti di Venezia e Chioggia, Luka Koper, pristaniški in logistični sistem, d.d., Univerza na Primorskem
Cost and funding	881.842,06€

Description	**Adriatic MoS Up-grated Services – Adri-Up**[96] Adri-Up, also known as "Adriatic MoS Up-grated Services," is a project aimed at improving the efficiency and sustainability of the maritime transport sector in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, Slovenia, and Montenegro. The primary objective of the project is to upgrade the maritime transport infrastructure in the Adriatic Sea region and develop new transport services that are more efficient and sustainable. The initiative involves the improvement of the existing transport infrastructure, including ports, terminals, and intermodal connections, to enhance the efficiency and effectiveness of transport operations. The project also involves the development of new transport services that are more sustainable and environmentally friendly. This includes the promotion of low-carbon transport modes such as rail and inland waterways, the use of alternative fuels such as LNG and hydrogen, and the development of digital technologies to improve transport planning and management.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2016 - 2020
Involved stakeholders	Central Adriatic Sea Ports Authority, Port of Igoumenitsa, North Adriatic Sea Port Authority
Cost and funding	1,46M € co-financed with EU funds (897.000 €)

Description	**European flagship Action for coLd ironING in ports**[97] The European flagship Action for coLd ironING in ports, also known as the ALIGN project, is a multi-year initiative aimed at reducing greenhouse gas emissions from ships while they are at port. The primary focus of the project is to promote the use of "cold ironing," which involves shutting down a ship's engines and connecting it to shore-side electrical power while it is in port. By doing so, the ship can significantly reduce its emissions of air pollutants, including carbon dioxide (CO2), nitrogen oxides (NOx), and sulfur oxides (SOx). The project involves the deployment of shore-side infrastructure, including electrical grids and power supply systems, to support the use of cold ironing. The initiative also includes the development of new technologies and systems to facilitate the adoption of cold ironing by ships.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2019 - 2023

[96] https://www.onthemosway.eu/adriatic-mos-up-grated-services-adri-up/
[97] https://ealingproject.eu/ports-2/

Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Fundacion Valencia Port, Ports of Koper, Central Adriatic Sea Ports Authority, Port Network Authority of the Eastern Adriatic Sea
Cost and funding	6,96M € co-financed by EU – CEF (3,48M €)

Monfalcone

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**Railway works inside and outside the port area of Trieste** This project is an initiative aimed at upgrading the railway infrastructure and services in the port area of Trieste, Italy. The project aims to improve the connectivity and efficiency of rail transport in the port area, which is an important gateway for goods to and from Central and Eastern Europe. The primary objective of the project is to upgrade the railway infrastructure in the port area, including the construction of new tracks, the upgrading of existing tracks, and the improvement of intermodal facilities. The project also aims to improve the interoperability and interconnectivity of the rail system, including the integration of rail and sea transport.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2026
Involved stakeholders	Azienda Speciale per il Porto di Monfalcone, Port Network Authority of the Eastern Adriatic Sea, RFI
Cost and funding	112M €

Description	**PROMARES - Promoting maritime and multimodal freight transport in the Adriatic Sea** PROMARES (Promoting maritime and multimodal freight transport in the Adriatic Sea) is a European project aimed at promoting the development of sustainable and efficient transport solutions in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, and Slovenia. The primary objective of the PROMARES project is to promote the development of a sustainable and efficient transport network in the Adriatic Sea region by improving the connectivity and interoperability of the region's ports and transport modes. The initiative aims to enhance the efficiency and sustainability of maritime transport by reducing waiting times for ships, improving transport links, and promoting the use of low-carbon transport modes. The PROMARES project is expected to have a significant impact on the efficiency and sustainability of maritime transport in the Adriatic Sea region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport and promoting the development of sustainable and innovative transport solutions.

Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2019 - 2022
Involved stakeholders	North Adriatic Sea Port Authority – Ports of Venice and Chioggia, Venice International University, Interporto Trieste, Institute for Transport And Logistics Foundation – Itl, Central Adriatic Ports Authority, Port of Ravenna, Southern Adriatic Sea Port Authority (Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli), RAM- Rete Autostrade Mediterranee Spa, Port of Rijeka Authority, Port of Ploče Authority, University of Rijeka - Faculty of Maritime Studies
Cost and funding	2,8M € covered by EU funds

Description	**SUSPORT- SUStainable PORTs** The European project SUSPORT (SUStainable PORTs) is a multi-year initiative aimed at promoting sustainable development in European ports. The primary objective of the SUSPORT project is to develop and implement sustainable strategies and practices in European ports that reduce the environmental impact of port operations, promote resource efficiency, and support economic growth. The initiative focuses on four key areas: energy efficiency, air quality, water quality, and waste management. The project involves the development and deployment of innovative technologies and systems to reduce energy consumption and emissions of greenhouse gases, air pollutants, and other harmful substances from port operations. The initiative also includes the promotion of renewable energy sources, such as solar and wind power, to support the transition to a low-carbon economy. In addition, the SUSPORT project aims to improve water quality in ports by reducing the discharge of pollutants and promoting sustainable water management practices. The initiative also focuses on waste management, with the goal of reducing waste generation and promoting the use of sustainable waste management practices, such as recycling and composting.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2023
Involved stakeholders	Port Network Authority Of The Eastern Adriatic Sea, Consorzio Di Sviluppo Economico Del Friuli, Intermodal Transport Cluster, Split Port Authority, Port Of Zadar Authority, Ploče Port Authority, Dubrovnik Port Authority¸ Dubrovnik Neretva County, North Adriatic Sea Port Authority – Ports Of Venice And Chioggia, Venice International University, Institute For Transport And Logistics Foundation, Port Of Ravenna Authority, Central Adriatic Ports Authority, Special Agency Of The Chamber Of Commerce Chieti Pescara, Southern Adriatic Sea Port Authority (Ports Of Bari, Brindisi, Manfredonia, Barletta And Monopoli), Rijeka Port Authority, Autonomous Region Of Friuli Venezia Giulia
Cost and funding	7,1M € covered by EU funds

Description	**CLEAN BERTH** CLEAN BERTH is a European project aimed at reducing the environmental impact of the maritime sector by developing and deploying innovative technologies and systems to improve the efficiency and sustainability of port operations. The primary objective of the CLEAN BERTH project is to reduce air and water pollution, noise, and greenhouse gas emissions from port operations by promoting the use of clean energy sources, such as electricity, hydrogen, and LNG. The initiative also aims to improve the efficiency of port operations by reducing waiting times for ships and optimizing the use of port infrastructure and equipment. The CLEAN BERTH project is expected to have a significant impact on the efficiency and sustainability of port operations in the Mediterranean region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2022
Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Consorzio di Sviluppo Economico del Friuli, Autorità di Sistema Portuale del Mare Adriatico Settentrionale – Porti di Venezia e Chioggia, Luka Koper, pristaniški in logistični sistem, d.d., Univerza na Primorskem
Cost and funding	881.842,06€

Description	**SMOOTH PORTS – Reducing CO2 Emissions in ports (INTERREG)**[98] SMOOTH PORTS is an INTERREG project aimed at reducing CO2 emissions in ports by promoting sustainable and energy-efficient solutions. The project is funded by the European Union and involves a consortium of partners from different countries. The primary objective of the project is to reduce the environmental impact of ports by promoting sustainable practices and energy-efficient solutions. This includes the development and implementation of new technologies and systems that reduce the energy consumption and carbon emissions of port operations. The initiative involves the use of innovative solutions such as smart grid systems, energy storage, and renewable energy sources such as wind and solar power to reduce the energy consumption of ports. The project also promotes the use of low-carbon transport modes such as electric vehicles, hydrogen fuel cells, and LNG-powered ships to reduce the carbon emissions of port operations.
Theme	Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels Improving sustainability in maritime vessels operations - Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power

[98] https://projects2014-2020.interregeurope.eu/smoothports/

Timeline	2019 - 2023
Involved stakeholders	Municipality of Monfalcone, Port Network Authority of the Eastern Adriatic Sea
Cost and funding	1,140M €

Venice

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**Channelling the Green Deal for Venice.** The project "Channelling the Green Deal for Venice" aims to promote sustainable development and reduce the environmental impact of the port and city of Venice. The project is inspired by the European Green Deal, which sets out a comprehensive plan to make the European Union's economy more sustainable and resilient. The project involves several key actions, including the promotion of sustainable mobility solutions and the reduction of emissions from transport. This will be achieved through the development of new infrastructure for cycling and walking, the improvement of public transport services, and the promotion of electric vehicles and other low-emission modes of transport.
Theme	Ports as green hubs: greening ground port services and operations
Timeline	2020 - 2023
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	1,7M €

Description	**Upgrading of last mile connections to Malcontenta node** The project for the upgrading of last mile connections to the Malcontenta node aims to improve the efficiency and sustainability of freight transportation in the Venice region. The Malcontenta node is a strategic transportation hub located in the municipality of Venice, and the project aims to improve the connections between the node and the surrounding areas. The project involves several key actions, including the development of new last-mile delivery solutions for goods and the improvement of existing transportation infrastructure. This will involve the construction of new cycle lanes, the improvement of pedestrian areas, and the installation of new charging stations for electric vehicles.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2022 - 2026
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	46M € partially covered by PNRR

Description	**Upgrading road and rail infrastructure inside the Port area** The project for upgrading road and rail infrastructure inside the port area in Venice aims to improve the efficiency and safety of transportation operations within the port. The project involves several key actions, including the modernization of existing road and rail infrastructure and the construction of new infrastructure where necessary.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2022 - 2026
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	78M € partially covered by EU funds (ESIF)

Description	**New rolling stock vehicle maintenance and repair depot in the Marghera Scalo Station** The project for the new rolling stock vehicle maintenance and repair depot in the Marghera Scalo Station aims to improve the maintenance and repair services for train vehicles in the Venice region. The Marghera Scalo Station is a strategic railway hub located in the municipality of Venice, and the new depot will be located in the vicinity of the station. The project involves the construction of a new depot with state-of-the-art facilities for the maintenance and repair of train vehicles. The depot will include specialized equipment and infrastructure for the maintenance of a variety of rolling stock, such as locomotives, passenger cars, and freight wagons.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2024 - 2026
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	3,5M €

Description	**Venice Onshore-Offshore Port System** The Venice Onshore-Offshore Port System project is a comprehensive plan to upgrade and modernize the port and logistics infrastructure in the Venice region. The project is aimed at improving the efficiency and sustainability of transportation operations in the area and promoting economic growth and development.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2022 - 2024
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	184,46M € cofinanced by PNRR

Description	**Upgrade of rail links between the South Industrial Area of Marghera and Marghera Scalo Station** The Upgrade of Rail Links project between the South Industrial Area of Marghera and Marghera Scalo Station is an infrastructure initiative aimed at improving the transportation network and connectivity between the industrial area and the railway station. The project involves the upgrading and modernization of the railway lines, tracks, and other rail infrastructure to improve the efficiency and capacity of the rail transport system.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2018 - 2024
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	8M € partially covered by PNRR

Description	**Last mile connection project** The Last Mile Connection project in Venice is an infrastructure initiative aimed at improving the transportation network and connectivity within the city's urban areas. The project involves the upgrading and modernization of the last mile connections, which are the final legs of the transportation network that connect the ports, airports, and railway stations to the city center and surrounding neighborhoods. The project includes a range of measures to improve the last mile connections, including the construction of new bike lanes, pedestrian walkways, and dedicated bus lanes, as well as the installation of new traffic management systems and the upgrading of existing transportation infrastructure.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2021 - 2024
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	23M € partially covered by EU funds (CEF)

Description	**Enhancement of accessibility infrastructures of port of Venice** The Enhancement of Accessibility Infrastructures project at the Port of Venice is an infrastructure initiative aimed at improving the accessibility and connectivity of the port facilities for both cargo and passenger traffic. The project includes a range of measures to upgrade and modernize the port's infrastructure and facilities, including the construction of new terminals, the expansion of existing terminals, and the installation of new equipment and technologies.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2020 - 2024

Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	8M €

Description	**Installation of safety devices** The Installation of Safety Devices project in Venice is an infrastructure initiative aimed at improving the safety and security of the city's transportation network. The project involves the installation of a range of safety devices, such as traffic lights, speed cameras, and pedestrian crossings, at strategic locations throughout the city.
Theme	Safety in ports: enhancing transport safety and security
Timeline	2021 - 2023
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	15M € with a contribution of EU funds (ESIF)

Description	**Environmental embanking restoration works** The Environmental Embanking Restoration Works project in Venice is an infrastructure initiative aimed at improving the environmental sustainability and resilience of the city's embankments. The project involves the restoration and rehabilitation of existing embankments along the city's canals, as well as the construction of new embankments using innovative materials and techniques.
Theme	Ports as green hubs: greening ground port services and operations
Timeline	2021 - 2026
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	27,5M € partially covered by PNRR

Description	**Multimodal Direct Connection** The Multimodal Direct Connection project in Venice is an infrastructure initiative aimed at improving the connectivity and accessibility of the city's port facilities. The project involves the construction of a new multimodal transport hub that will provide direct connections between the port of Venice and other major transportation networks, including highways, railways, and airports. The project aims to enhance the efficiency and reliability of cargo transportation to and from the port of Venice, and to improve the overall competitiveness of the port in the global market. The new transport hub will be designed to handle a wide range of cargo types, including containers, bulk goods, and vehicles, and will incorporate state-of-the-art equipment and technologies to improve cargo handling and storage.
Theme	Ports as green hubs: greening ground port services and operations

Timeline	2020 - 2030
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	**Multimodal Direct Connection** The Multimodal Direct Connection project in Venice is an infrastructure initiative aimed at improving the connectivity and accessibility of the city's port facilities. The project involves the construction of a new multimodal transport hub that will provide direct connections between the port of Venice and other major transportation networks, including highways, railways, and airports. The project aims to enhance the efficiency and reliability of cargo transportation to and from the port of Venice, and to improve the overall competitiveness of the port in the global market. The new transport hub will be designed to handle a wide range of cargo types, including containers, bulk goods, and vehicles, and will incorporate state-of-the-art equipment and technologies to improve cargo handling and storage.

Description	**Embanking of Malamocco - Marghera Canal** The Embanking of Malamocco-Marghera Canal project is an infrastructure initiative aimed at improving the safety and resilience of the canal system in Venice. The project involves the construction of new embankments along the Malamocco-Marghera Canal, which is a critical waterway that connects the port of Venice to the industrial area of Marghera.
Theme	Ports as green hubs: greening ground port services and operations
Timeline	2022 - 2024
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	56,5M € partially financed by EU funds (CEF/TEN-T).

Description	**Reshaping of Molo Sali wharf** The Reshaping of Molo Sali wharf project in Venice is a major infrastructure initiative aimed at improving the functionality and efficiency of the city's port facilities. The project involves the redevelopment of the Molo Sali wharf, which is one of the largest and busiest cargo handling areas in the port of Venice. The project will involve several key actions, including the construction of new wharf facilities, the upgrading of existing infrastructure, and the installation of new equipment and technologies to improve the handling and storage of cargo. The project also includes the implementation of new safety and security measures to protect workers and the environment.
Theme	Ports as green hubs: greening ground port services and operations
Timeline	2021 - 2024
Involved stakeholders	North Adriatic Sea Port Authority

Cost and funding	31M €

Description	**Upgrading of the railway link to the Port of Venice** The Upgrading of the railway link to the Port of Venice is a project aimed at improving the efficiency and capacity of the railway infrastructure that connects the port to other parts of the region. The project involves several key actions, including the upgrading of existing rail lines, the construction of new tracks and infrastructure, and the installation of new signalling and safety systems.
Theme	Ports as green hubs: greening ground port services and operations
Timeline	2022 - 2030
Involved stakeholders	North Adriatic Sea Port Authority, RFI
Cost and funding	597M €

Description	**INTESA - Improving maritime transport efficiency and safety in the Adriatic** INTESA (Improving maritime transport efficiency and safety in the Adriatic) is a European project aimed at improving the safety and efficiency of maritime transport in the Adriatic Sea. The primary objective of the INTESA project is to develop and implement innovative technologies and systems to enhance the safety and efficiency of maritime transport in the Adriatic Sea. In terms of maritime traffic management, the project aims to improve the safety and efficiency of maritime transport by developing and deploying advanced systems for vessel traffic monitoring and control. The initiative also aims to promote the use of digital technologies to enhance the efficiency of port operations and reduce the risk of accidents. In terms of environmental protection, the project focuses on reducing the environmental impact of maritime transport in the Adriatic Sea. The initiative involves the development and deployment of innovative technologies and systems to reduce air and water pollution, including the use of low-emission vessels, advanced waste management systems, and the monitoring of water quality. Finally, the INTESA project aims to enhance the capacity of maritime stakeholders in the Adriatic region by providing training and support to improve the skills and knowledge of maritime professionals. The initiative also involves the development of networks and partnerships to promote cooperation and collaboration among stakeholders in the region.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2019 - 2022
Involved stakeholders	Italian Ministry of Sustainable Infrastructures and Mobility - Coast Guard Headquarters, RAM- Logistica Infrastrutture e Trasporti SpA, Port Network Authority of The Eastern Adriatic Sea, Ravenna Port Authority, Central Adriatic Sea Ports Authority, Southern

	Adriatic Port Authority, Split Port Authority, Ministry of the Sea, Transport and Infrastructure, Meteorological and Hydrological Service of Croatia DHMZ
Cost and funding	2,9M €

Description	**PROMARES - Promoting maritime and multimodal freight transport in the Adriatic Sea** PROMARES (Promoting maritime and multimodal freight transport in the Adriatic Sea) is a European project aimed at promoting the development of sustainable and efficient transport solutions in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, and Slovenia. The primary objective of the PROMARES project is to promote the development of a sustainable and efficient transport network in the Adriatic Sea region by improving the connectivity and interoperability of the region's ports and transport modes. The initiative aims to enhance the efficiency and sustainability of maritime transport by reducing waiting times for ships, improving transport links, and promoting the use of low-carbon transport modes. The PROMARES project is expected to have a significant impact on the efficiency and sustainability of maritime transport in the Adriatic Sea region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport and promoting the development of sustainable and innovative transport solutions.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2019 - 2022
Involved stakeholders	North Adriatic Sea Port Authority – Ports of Venice and Chioggia, Venice International University, Interporto Trieste, Institute for Transport And Logistics Foundation – Itl, Central Adriatic Ports Authority, Port of Ravenna, Southern Adriatic Sea Port Authority (Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli), RAM- Rete Autostrade Mediterranee Spa, Port of Rijeka Authority, Port of Ploče Authority, University of Rijeka - Faculty of Maritime Studies
Cost and funding	2,8M € covered by EU funds

Description	**SUSPORT- SUStainable PORTs** The European project SUSPORT (SUStainable PORTs) is a multi-year initiative aimed at promoting sustainable development in European ports. The primary objective of the SUSPORT project is to develop and implement sustainable strategies and practices in European ports that reduce the environmental impact of port operations, promote resource efficiency, and support economic growth. The initiative focuses on four key areas: energy efficiency, air quality, water quality, and waste management. The project involves the development and deployment of innovative technologies and systems to reduce energy consumption and emissions of greenhouse gases, air pollutants, and other harmful substances from port operations. The initiative also includes the

	promotion of renewable energy sources, such as solar and wind power, to support the transition to a low-carbon economy. In addition, the SUSPORT project aims to improve water quality in ports by reducing the discharge of pollutants and promoting sustainable water management practices. The initiative also focuses on waste management, with the goal of reducing waste generation and promoting the use of sustainable waste management practices, such as recycling and composting.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2023
Involved stakeholders	Port Network Authority Of The Eastern Adriatic Sea, Consorzio Di Sviluppo Economico Del Friuli, Intermodal Transport Cluster, Split Port Authority, Port Of Zadar Authority, Ploče Port Authority, Dubrovnik Port Authority¸ Dubrovnik Neretva County, North Adriatic Sea Port Authority – Ports Of Venice And Chioggia, Venice International University, Institute For Transport And Logistics Foundation, Port Of Ravenna Authority, Central Adriatic Ports Authority, Special Agency Of The Chamber Of Commerce Chieti Pescara, Southern Adriatic Sea Port Authority (Ports Of Bari, Brindisi, Manfredonia, Barletta And Monopoli), Rijeka Port Authority, Autonomous Region Of Friuli Venezia Giulia
Cost and funding	7,1M € covered by EU funds

Description	**CLEAN BERTH** CLEAN BERTH is a European project aimed at reducing the environmental impact of the maritime sector by developing and deploying innovative technologies and systems to improve the efficiency and sustainability of port operations. The primary objective of the CLEAN BERTH project is to reduce air and water pollution, noise, and greenhouse gas emissions from port operations by promoting the use of clean energy sources, such as electricity, hydrogen, and LNG. The initiative also aims to improve the efficiency of port operations by reducing waiting times for ships and optimizing the use of port infrastructure and equipment. The CLEAN BERTH project is expected to have a significant impact on the efficiency and sustainability of port operations in the Mediterranean region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2022
Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Consorzio di Sviluppo Economico del Friuli, Autorità di Sistema Portuale del Mare Adriatico Settentrionale –

	Porti di Venezia e Chioggia, Luka Koper, pristaniški in logistični sistem, d.d., Univerza na Primorskem
Cost and funding	881.842,06€

Description	**FRESH FOOD CORRIDORS**[99] The Fresh Food Corridors (FFC) project is an initiative aimed at promoting sustainable, multimodal, and efficient transport solutions for fresh and perishable food products in Europe. The project focuses on the development of efficient and sustainable logistics solutions to transport fresh and perishable food products from production areas to consumer markets. The primary objective of the FFC project is to reduce greenhouse gas emissions and the environmental impact of the transportation of fresh and perishable food products while improving the efficiency and reliability of the logistics chains. The initiative involves the development of innovative technologies, the optimization of transport modes, and the integration of logistics systems to enhance the efficiency and sustainability of food transportation.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2014 - 2018
Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Rete Autostrade Mediterranee (RAM), Capodistria Port, Marsiglia Port
Cost and funding	**FRESH FOOD CORRIDORS**[100] The Fresh Food Corridors (FFC) project is an initiative aimed at promoting sustainable, multimodal, and efficient transport solutions for fresh and perishable food products in Europe. The project focuses on the development of efficient and sustainable logistics solutions to transport fresh and perishable food products from production areas to consumer markets. The primary objective of the FFC project is to reduce greenhouse gas emissions and the environmental impact of the transportation of fresh and perishable food products while improving the efficiency and reliability of the logistics chains. The initiative involves the development of innovative technologies, the optimization of transport modes, and the integration of logistics systems to enhance the efficiency and sustainability of food transportation.

Description	**Poseidon Med II – LNG Bunkering Project**[101] Poseidon Med II is a project aimed at promoting the use of LNG (Liquefied Natural Gas) as a cleaner and more sustainable fuel for shipping operations in the Mediterranean region. The project focuses on the development of LNG infrastructure and the promotion of the use of LNG as a low-emission fuel for ships.

[99] https://www.ramspa.it/cosa-facciamo/progetti-europei/in-corso/fresh-food-corridors
[100] https://www.ramspa.it/cosa-facciamo/progetti-europei/in-corso/fresh-food-corridors
[101] https://www.poseidonmedii.eu/

	The primary objective of the Poseidon Med II project is to demonstrate the technical and economic feasibility of using LNG as a fuel for shipping operations in the Mediterranean region. The project involves the development of LNG bunkering facilities in different ports, the conversion of ships to use LNG as a fuel, and the optimization of LNG supply chains.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2015 - 2021
Involved stakeholders	DEPA Commercial S.A, Hellenic Gas Transmission System Operator S.A, Hellenic Lloyd's S.A, OceanFinance Ltd, Environmental Protection Engineering S.A, NAP Engineering P.C, Rogan Associates S.A, Piraeus Port Authority S.A, Heraklion Port Authority S.A, Patras Port Authority S.A, Igoumenitsa Port Authority S.A, Cyprus Ports Authority, North Adriatic Sea Port Authority, Rimorchiatori Riunti Panfido & C. SRL, Minoan Lines Shipping S.A, Blue Star Ferries Maritime S.A, Attica Ferries Maritime Company, Shipping Company of Crete S.A, Neptune Lines Shipping & Managing Enterprises S.A, Hellenic Seaways Maritime S.A, Centre for Research and Technology Hellas, Association of Passenger Shipping Companies – SEEN, Hellenic Shortsea Shipowners Association, Bunkernet Ltd, Lavar Shipping S.A, Arista Shipping Co. Ltd
Cost and funding	53,280M € co-financed by EU – CEF (26,6M €)

Description	**Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS)** [102] The Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS) is a project aimed at promoting the use of LNG (Liquefied Natural Gas) as a cleaner and more sustainable fuel for ports and shipping operations. The project focuses on the development of innovative pilot actions to promote the use of LNG in different areas of the maritime sector. The primary objective of the GAINN4MOS project is to demonstrate the technical and economic feasibility of using LNG as a low-emission fuel for ports and shipping operations. The project involves the development of innovative pilot actions, including the construction of LNG bunkering facilities, the conversion of ships to use LNG as a fuel, and the optimization of LNG supply chains.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2015 - 2019

[102] https://www.fundacion.valenciaport.com/en/project/gainn4mos-sustainable-lng-operations-for-ports-and-shipping-innovative-pilot-actions-2/

Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Fundacion Valencia Port, Ports of Koper, Ports of Rijeka, Port of La SpeziaM Port of Fos-Marseille, Port of Nantes-Saint Nazaire
Cost and funding	24,2M € co-financed by EU – CEF (9,8M €)

Description	**GAINN for South Europe mAritime LNG roll-out**[103] GAINN (Green Atlantic and Mediterranean Network) is a project aimed at promoting the use of LNG (Liquefied Natural Gas) as a cleaner and more sustainable fuel for maritime transport. The project focuses on the development of LNG infrastructure and the promotion of the use of LNG as a low-emission fuel for ships. The GAINN for South Europe Maritime LNG Roll-Out project is a specific initiative within the broader GAINN project. The initiative focuses on the development of LNG infrastructure in the South of Europe, including the construction of LNG terminals and bunkering facilities in the Mediterranean and Atlantic regions. The primary objective of the GAINN for South Europe Maritime LNG Roll-Out project is to promote the use of LNG as a low-emission fuel for ships in the South of Europe. This includes the development of LNG bunkering facilities, the construction of LNG terminals, and the promotion of LNG as a viable alternative to traditional marine fuels.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2018 - 2022
Involved stakeholders	North Adriatic Sea Port Authority, Consorzio 906 Societa Consortile A R.l.
Cost and funding	77,72M € co-financed by EU – CEF (14,33M €)

Description	**LNG Facility in the port of Venice**[104] The LNG (Liquefied Natural Gas) Facility in the port of Venice is a project aimed at promoting the use of LNG as a cleaner and more sustainable fuel for ships. The project involves the construction of a new LNG terminal in the port of Venice, which will provide LNG refuelling services for ships operating in the Mediterranean Sea. The primary objective of the LNG Facility is to reduce the environmental impact of shipping operations by promoting the use of LNG as a low-emission fuel. LNG is a cleaner alternative to traditional marine fuels such as heavy fuel oil, and it has the potential to significantly reduce greenhouse gas emissions, sulfur oxides, and nitrogen oxides. The facility will include a storage tank for LNG, a regasification plant, and a loading platform for refuelling LNG-powered ships. The terminal will have the capacity to store

[103] https://trimis.ec.europa.eu/project/gainn-south-europe-maritime-lng-roll-out
[104] https://www.port.venice.it/en/venice-lng-facility.html

	up to 8,000 cubic meters of LNG and provide refuelling services for up to 4,000 LNG-powered ships per year.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2017 - 2022
Involved stakeholders	North Adriatic Sea Port Authority
Cost and funding	60,72M € co-financed by EU – CEF (12,14M €)

Description	**European flagship Action for coLd ironING in ports**[105] The European flagship Action for coLd ironING in ports, also known as the ALIGN project, is a multi-year initiative aimed at reducing greenhouse gas emissions from ships while they are at port. The primary focus of the project is to promote the use of "cold ironing," which involves shutting down a ship's engines and connecting it to shore-side electrical power while it is in port. By doing so, the ship can significantly reduce its emissions of air pollutants, including carbon dioxide (CO2), nitrogen oxides (NOx), and sulfur oxides (SOx). The project involves the deployment of shore-side infrastructure, including electrical grids and power supply systems, to support the use of cold ironing. The initiative also includes the development of new technologies and systems to facilitate the adoption of cold ironing by ships.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2019 - 2023
Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Fundacion Valencia Port, Ports of Koper, Central Adriatic Sea Ports Authority, Port Network Authority of the Eastern Adriatic Sea
Cost and funding	6,96M € co-financed by EU – CEF (3,48M €)

Venice Chioggia

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**INTESA - Improving maritime transport efficiency and safety in the Adriatic**

[105] https://ealingproject.eu/ports-2/

	INTESA (Improving maritime transport efficiency and safety in the Adriatic) is a European project aimed at improving the safety and efficiency of maritime transport in the Adriatic Sea. The primary objective of the INTESA project is to develop and implement innovative technologies and systems to enhance the safety and efficiency of maritime transport in the Adriatic Sea. In terms of maritime traffic management, the project aims to improve the safety and efficiency of maritime transport by developing and deploying advanced systems for vessel traffic monitoring and control. The initiative also aims to promote the use of digital technologies to enhance the efficiency of port operations and reduce the risk of accidents. In terms of environmental protection, the project focuses on reducing the environmental impact of maritime transport in the Adriatic Sea. The initiative involves the development and deployment of innovative technologies and systems to reduce air and water pollution, including the use of low-emission vessels, advanced waste management systems, and the monitoring of water quality. Finally, the INTESA project aims to enhance the capacity of maritime stakeholders in the Adriatic region by providing training and support to improve the skills and knowledge of maritime professionals. The initiative also involves the development of networks and partnerships to promote cooperation and collaboration among stakeholders in the region.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2019 - 2022
Involved stakeholders	Italian Ministry of Sustainable Infrastructures and Mobility - Coast Guard Headquarters, RAM- Logistica Infrastrutture e Trasporti SpA, Port Network Authority of The Eastern Adriatic Sea, Ravenna Port Authority, Central Adriatic Sea Ports Authority, Southern Adriatic Port Authority, Split Port Authority, Ministry of the Sea, Transport and Infrastructure, Meteorological and Hydrological Service of Croatia DHMZ
Cost and funding	2,9M € covered by EU funds

Description	**PROMARES - Promoting maritime and multimodal freight transport in the Adriatic Sea** PROMARES (Promoting maritime and multimodal freight transport in the Adriatic Sea) is a European project aimed at promoting the development of sustainable and efficient transport solutions in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, and Slovenia. The primary objective of the PROMARES project is to promote the development of a sustainable and efficient transport network in the Adriatic Sea region by improving the connectivity and interoperability of the region's ports and transport modes. The initiative aims to enhance the efficiency and sustainability of maritime transport by reducing waiting times for ships, improving transport links, and promoting the use of low-carbon transport modes. The PROMARES project is expected to have a significant impact on the efficiency and sustainability of maritime transport in the Adriatic Sea region. The initiative is also expected to contribute to the economic development of the region by improving the

	efficiency and competitiveness of maritime transport and promoting the development of sustainable and innovative transport solutions.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2019 - 2022
Involved stakeholders	North Adriatic Sea Port Authority – Ports of Venice and Chioggia, Venice International University, Interporto Trieste, Institute for Transport And Logistics Foundation – Itl, Central Adriatic Ports Authority, Port of Ravenna, Southern Adriatic Sea Port Authority (Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli), RAM- Rete Autostrade Mediterranee Spa, Port of Rijeka Authority, Port of Ploče Authority, University of Rijeka - Faculty of Maritime Studies
Cost and funding	2,8M € covered by EU funds

Description	**SUSPORT- SUStainable PORTs** The European project SUSPORT (SUStainable PORTs) is a multi-year initiative aimed at promoting sustainable development in European ports. The primary objective of the SUSPORT project is to develop and implement sustainable strategies and practices in European ports that reduce the environmental impact of port operations, promote resource efficiency, and support economic growth. The initiative focuses on four key areas: energy efficiency, air quality, water quality, and waste management. The project involves the development and deployment of innovative technologies and systems to reduce energy consumption and emissions of greenhouse gases, air pollutants, and other harmful substances from port operations. The initiative also includes the promotion of renewable energy sources, such as solar and wind power, to support the transition to a low-carbon economy. In addition, the SUSPORT project aims to improve water quality in ports by reducing the discharge of pollutants and promoting sustainable water management practices. The initiative also focuses on waste management, with the goal of reducing waste generation and promoting the use of sustainable waste management practices, such as recycling and composting.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2023
Involved stakeholders	Port Network Authority Of The Eastern Adriatic Sea, Consorzio Di Sviluppo Economico Del Friuli, Intermodal Transport Cluster, Split Port Authority, Port Of Zadar Authority, Ploče Port Authority, Dubrovnik Port Authority¸ Dubrovnik Neretva County, North Adriatic Sea Port Authority – Ports Of Venice And Chioggia, Venice International University, Institute For Transport And Logistics Foundation, Port Of Ravenna Authority, Central Adriatic Ports Authority, Special Agency Of The Chamber Of Commerce Chieti Pescara, Southern Adriatic Sea Port Authority (Ports Of Bari, Brindisi, Manfredonia, Barletta And Monopoli), Rijeka Port Authority, Autonomous Region Of Friuli Venezia Giulia

Cost and funding	7,1M € covered by EU funds

Description	**CLEAN BERTH** CLEAN BERTH is a European project aimed at reducing the environmental impact of the maritime sector by developing and deploying innovative technologies and systems to improve the efficiency and sustainability of port operations. The primary objective of the CLEAN BERTH project is to reduce air and water pollution, noise, and greenhouse gas emissions from port operations by promoting the use of clean energy sources, such as electricity, hydrogen, and LNG. The initiative also aims to improve the efficiency of port operations by reducing waiting times for ships and optimizing the use of port infrastructure and equipment. The CLEAN BERTH project is expected to have a significant impact on the efficiency and sustainability of port operations in the Mediterranean region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2022
Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Consorzio di Sviluppo Economico del Friuli, Autorità di Sistema Portuale del Mare Adriatico Settentrionale – Porti di Venezia e Chioggia, Luka Koper, pristaniški in logistični sistem, d.d., Univerza na Primorskem
Cost and funding	881.842,06€

Ravenna

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**Ravenna Port Hub** The Ravenna Port Hub project is a major infrastructure initiative aimed at enhancing the competitiveness and efficiency of the Ravenna port and promoting economic growth in the surrounding region. The project involves the development of a new intermodal logistics platform, equipped with state-of-the-art technologies and facilities, to improve the port's connectivity with other modes of transportation, including rail, road, and waterways. The project includes the construction of new rail tracks, road connections, and a container terminal, as well as the installation of new cranes and other handling equipment, to increase the port's handling capacity and accommodate larger vessels. The intermodal logistics platform will allow for seamless transfer of goods between different modes of transportation, enabling faster and more cost-effective transportation of goods.

Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems Ports as green hubs: promotion of ports as testbeds for waste reuse and the circular economy
Timeline	2020 - 2024
Involved stakeholders	Port Authority of Ravenna
Cost and funding	157,37M €

Description	**Ro-Ro terminal upgrading** The Ro-Ro (Roll-on/roll-off) terminal upgrading project is a modernization project aimed at enhancing the port's ability to handle Ro-Ro cargo. The project includes the construction of a new dedicated Ro-Ro terminal, which will be equipped with modern and efficient handling equipment, as well as advanced IT systems for cargo tracking and management. The new Ro-Ro terminal will be able to handle up to 30,000 units of Ro-Ro cargo per year, with a focus on high-value and time-sensitive goods such as cars, trucks, and other heavy equipment. The terminal will feature a large marshalling area for the efficient staging and loading of cargo, as well as a covered storage area for the protection of cargo from the elements.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2021 - 2024
Involved stakeholders	Port Authority of Ravenna
Cost and funding	30M €

Description	**Extension of the rail tracks** The extension of the rail tracks project in Ravenna Port is a significant investment aimed at improving the port's intermodal connectivity and capacity. The project involves the construction of new rail tracks within the port area, as well as the extension of existing tracks to increase the length of the rail terminal.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2017 - 2026
Involved stakeholders	Port Authority of Ravenna
Cost and funding	3,5M €

Description	**Last Mile railway upgrading**

	The Last Mile railway upgrading project in Ravenna Port is aimed at improving the rail connectivity between the port and the surrounding areas, specifically the last mile of the railway line leading to and from the port. The project involves upgrading and modernizing the railway infrastructure, including the construction of new tracks, switches, signals, and other equipment. The upgraded railway system will enable faster and more efficient transportation of goods between the port and inland destinations, reducing the time and costs associated with last-mile transport. The project also includes the construction of new intermodal terminals at strategic locations along the rail network, which will provide direct connections to major European markets and allow for the seamless transfer of cargo between rail and road transport modes.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2017 - 2026
Involved stakeholders	Port Authority of Ravenna
Cost and funding	NA

Description	**Construction of a dredged material treatment plant** The Construction of a dredged material treatment plant is aimed at improving the port's capacity to handle dredged materials and reduce the environmental impact of dredging operations. The project involves the construction of a new treatment plant that will be able to process dredged materials and separate them into different components for reuse or disposal. The treatment plant will be able to handle up to 700,000 cubic meters of dredged material per year and will use a variety of technologies to separate the different components of the material. These technologies may include screening, dewatering, sedimentation, and chemical treatments, depending on the type and quality of the dredged material.
Theme	Ports as green hubs: promotion of ports as testbeds for waste reuse and the circular economy
Timeline	2027
Involved stakeholders	Port Authority of Ravenna
Cost and funding	85M €

Description	**Renovation work of the Marcegaglia quay** The Renovation work of the Marcegaglia quay project is aimed at modernizing and upgrading the existing infrastructure of the quay to improve its capacity and efficiency. The project involves the renovation of the existing quay, including the replacement of outdated equipment and the installation of new infrastructure. The quay will be renovated to handle a wider range of cargo, including containers, Ro-Ro cargo, and bulk materials. It will also be equipped with new loading and unloading facilities, including cranes and other handling equipment, to enable faster and more efficient operations.
Theme	Ports as green hubs - Greening ground port services and operations

Timeline	
Involved stakeholders	Port Authority of Ravenna
Cost and funding	12,57M €

Description	**New Maritime Station** The New Maritime Station project in Ravenna Port is aimed at building a new state-of-the-art passenger terminal to improve the port's capacity and efficiency for cruise ships and other passenger vessels. The project involves the construction of a new terminal building with modern facilities for passengers, including check-in counters, waiting areas, retail spaces, and dining options. The new terminal will be designed to accommodate larger and more modern cruise ships, with multiple berths for vessels up to 320 meters in length. It will also be equipped with new infrastructure, including gangways, boarding bridges, and baggage handling systems, to enable faster and more efficient embarkation and disembarkation of passengers.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2022 - 2024
Involved stakeholders	Port Authority of Ravenna
Cost and funding	25,68M €

Description	**INTESA - Improving maritime transport efficiency and safety in the Adriatic** INTESA (Improving maritime transport efficiency and safety in the Adriatic) is a European project aimed at improving the safety and efficiency of maritime transport in the Adriatic Sea. The primary objective of the INTESA project is to develop and implement innovative technologies and systems to enhance the safety and efficiency of maritime transport in the Adriatic Sea. In terms of maritime traffic management, the project aims to improve the safety and efficiency of maritime transport by developing and deploying advanced systems for vessel traffic monitoring and control. The initiative also aims to promote the use of digital technologies to enhance the efficiency of port operations and reduce the risk of accidents. In terms of environmental protection, the project focuses on reducing the environmental impact of maritime transport in the Adriatic Sea. The initiative involves the development and deployment of innovative technologies and systems to reduce air and water pollution, including the use of low-emission vessels, advanced waste management systems, and the monitoring of water quality. Finally, the INTESA project aims to enhance the capacity of maritime stakeholders in the Adriatic region by providing training and support to improve the skills and knowledge of maritime professionals. The initiative also involves the development of networks and partnerships to promote cooperation and collaboration among stakeholders in the region.

Theme	Safety in ports - Enhancing transport safety and security Ports as green hubs - Greening ground port services and operations
Timeline	2019 - 2022
Involved stakeholders	Italian Ministry of Sustainable Infrastructures and Mobility - Coast Guard Headquarters, RAM- Logistica Infrastrutture e Trasporti SpA, Port Network Authority of The Eastern Adriatic Sea, Ravenna Port Authority, Central Adriatic Sea Ports Authority, Southern Adriatic Port Authority, Split Port Authority, Ministry of the Sea, Transport and Infrastructure, Meteorological and Hydrological Service of Croatia DHMZ
Cost and funding	2,9M € covered by EU funds

Description	**PROMARES - Promoting maritime and multimodal freight transport in the Adriatic Sea** PROMARES (Promoting maritime and multimodal freight transport in the Adriatic Sea) is a European project aimed at promoting the development of sustainable and efficient transport solutions in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, and Slovenia. The primary objective of the PROMARES project is to promote the development of a sustainable and efficient transport network in the Adriatic Sea region by improving the connectivity and interoperability of the region's ports and transport modes. The initiative aims to enhance the efficiency and sustainability of maritime transport by reducing waiting times for ships, improving transport links, and promoting the use of low-carbon transport modes. The PROMARES project is expected to have a significant impact on the efficiency and sustainability of maritime transport in the Adriatic Sea region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport and promoting the development of sustainable and innovative transport solutions.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2019 - 2022
Involved stakeholders	North Adriatic Sea Port Authority – Ports of Venice and Chioggia, Venice International University, Interporto Trieste, Institute for Transport And Logistics Foundation – Itl, Central Adriatic Ports Authority, Port of Ravenna, Southern Adriatic Sea Port Authority (Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli), RAM- Rete Autostrade Mediterranee Spa, Port of Rijeka Authority, Port of Ploče Authority, University of Rijeka - Faculty of Maritime Studies
Cost and funding	2,8M € covered by EU funds

Description	**SUSPORT- SUStainable PORTs** The European project SUSPORT (SUStainable PORTs) is a multi-year initiative aimed at promoting sustainable development in European ports. The primary objective of the SUSPORT project is to develop and implement sustainable strategies and practices in European ports that reduce the environmental impact of port

	operations, promote resource efficiency, and support economic growth. The initiative focuses on four key areas: energy efficiency, air quality, water quality, and waste management. The project involves the development and deployment of innovative technologies and systems to reduce energy consumption and emissions of greenhouse gases, air pollutants, and other harmful substances from port operations. The initiative also includes the promotion of renewable energy sources, such as solar and wind power, to support the transition to a low-carbon economy. In addition, the SUSPORT project aims to improve water quality in ports by reducing the discharge of pollutants and promoting sustainable water management practices. The initiative also focuses on waste management, with the goal of reducing waste generation and promoting the use of sustainable waste management practices, such as recycling and composting.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2023
Involved stakeholders	Port Network Authority Of The Eastern Adriatic Sea, Consorzio Di Sviluppo Economico Del Friuli, Intermodal Transport Cluster, Split Port Authority, Port Of Zadar Authority, Ploče Port Authority, Dubrovnik Port Authority¸ Dubrovnik Neretva County, North Adriatic Sea Port Authority – Ports Of Venice And Chioggia, Venice International University, Institute For Transport And Logistics Foundation, Port Of Ravenna Authority, Central Adriatic Ports Authority, Special Agency Of The Chamber Of Commerce Chieti Pescara, Southern Adriatic Sea Port Authority (Ports Of Bari, Brindisi, Manfredonia, Barletta And Monopoli), Rijeka Port Authority, Autonomous Region Of Friuli Venezia Giulia
Cost and funding	7,1M € covered by EU funds

Ancona

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**New rail-road terminal in the Scalo Marotti area** The New Rail-Road Terminal in the Scalo Marotti area project in Ancona is an infrastructure initiative aimed at improving the efficiency and capacity of the port's transportation network by constructing a new rail-road terminal. The project involves the construction of a new terminal building, along with supporting infrastructure such as rail tracks, loading/unloading platforms, and parking facilities, to provide a modern and efficient freight handling facility. The new rail-road terminal will provide a direct connection between the port and the national rail network, enabling faster and more efficient transportation of goods. The terminal will also support the shift towards more sustainable transportation modes, reducing the carbon footprint of the port's operations.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems

Timeline	2014 - 2022
Involved stakeholders	Central Adriatic Sea Ports Authority
Cost and funding	12,0M €

Description	**INTESA - Improving maritime transport efficiency and safety in the Adriatic** INTESA (Improving maritime transport efficiency and safety in the Adriatic) is a European project aimed at improving the safety and efficiency of maritime transport in the Adriatic Sea. The primary objective of the INTESA project is to develop and implement innovative technologies and systems to enhance the safety and efficiency of maritime transport in the Adriatic Sea. In terms of maritime traffic management, the project aims to improve the safety and efficiency of maritime transport by developing and deploying advanced systems for vessel traffic monitoring and control. The initiative also aims to promote the use of digital technologies to enhance the efficiency of port operations and reduce the risk of accidents. In terms of environmental protection, the project focuses on reducing the environmental impact of maritime transport in the Adriatic Sea. The initiative involves the development and deployment of innovative technologies and systems to reduce air and water pollution, including the use of low-emission vessels, advanced waste management systems, and the monitoring of water quality. Finally, the INTESA project aims to enhance the capacity of maritime stakeholders in the Adriatic region by providing training and support to improve the skills and knowledge of maritime professionals. The initiative also involves the development of networks and partnerships to promote cooperation and collaboration among stakeholders in the region.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2019 - 2022
Involved stakeholders	Italian Ministry of Sustainable Infrastructures and Mobility - Coast Guard Headquarters, RAM- Logistica Infrastrutture e Trasporti SpA, Port Network Authority of The Eastern Adriatic Sea, Ravenna Port Authority, Central Adriatic Sea Ports Authority, Southern Adriatic Port Authority, Split Port Authority, Ministry of the Sea, Transport and Infrastructure, Meteorological and Hydrological Service of Croatia DHMZ
Cost and funding	2,9M € covered by EU funds

Description	**MIMOSA - Maritime and multimodal sustainable passenger transport solutions and services** MIMOSA (Maritime and Multimodal Sustainable Passenger Transport Solutions and Services) is a project funded by the European Union aimed at developing sustainable and innovative solutions for passenger transport in Europe. The project involves a consortium

	of partners from different countries, including research organizations, universities, public transport operators, and technology providers. The primary objective of the MIMOSA project is to promote the use of sustainable passenger transport solutions and services that reduce the environmental impact of transport operations, improve passenger comfort and safety, and enhance the efficiency and effectiveness of transport services. This includes the development and deployment of new technologies and systems that promote the use of low-carbon transport modes, such as electric buses and ferries, and the integration of different transport modes to create a seamless passenger experience.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2020 - 2023
Involved stakeholders	Central European Initiative Executive Secretariat, Autonomous Region Of Friuli Venezia Giulia, Institute For Transport And Logistics Foundation, Abruzzo Region, Apulia Region, Ministry Of Regional Development And EU Funds - Department For Islands, Regional Development Agency Of Primorje Gorski Kotar County, Split Port Authority, Rovinj Port Authority, Public Institution Development Agency Of Lika-Senj County – Lira, County Port Authority Zadar, Hz Passenger Transport Ltd, University Of Rijeka, Faculty Of Maritime Studies, Central Adriatic Ports Authority, Sibenik Port Authority, Dubrovnik Neretva Region, Istrian Development Agency – Ida Ltd, Ca' Foscari University Of Venice
Cost and funding	7.14M € covered by EU funds

Description	**PROMARES - Promoting maritime and multimodal freight transport in the Adriatic Sea** PROMARES (Promoting maritime and multimodal freight transport in the Adriatic Sea) is a European project aimed at promoting the development of sustainable and efficient transport solutions in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, and Slovenia. The primary objective of the PROMARES project is to promote the development of a sustainable and efficient transport network in the Adriatic Sea region by improving the connectivity and interoperability of the region's ports and transport modes. The initiative aims to enhance the efficiency and sustainability of maritime transport by reducing waiting times for ships, improving transport links, and promoting the use of low-carbon transport modes. The PROMARES project is expected to have a significant impact on the efficiency and sustainability of maritime transport in the Adriatic Sea region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport and promoting the development of sustainable and innovative transport solutions.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2019 - 2022
Involved stakeholders	North Adriatic Sea Port Authority – Ports of Venice and Chioggia, Venice International University, Interporto Trieste, Institute for Transport And Logistics Foundation – Itl,

	Central Adriatic Ports Authority, Port of Ravenna, Southern Adriatic Sea Port Authority (Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli), RAM- Rete Autostrade Mediterranee Spa, Port of Rijeka Authority, Port of Ploče Authority, University of Rijeka - Faculty of Maritime Studies
Cost and funding	2,8M € covered by EU funds

Description	**SUSPORT- SUStainable PORTs** The European project SUSPORT (SUStainable PORTs) is a multi-year initiative aimed at promoting sustainable development in European ports. The primary objective of the SUSPORT project is to develop and implement sustainable strategies and practices in European ports that reduce the environmental impact of port operations, promote resource efficiency, and support economic growth. The initiative focuses on four key areas: energy efficiency, air quality, water quality, and waste management. The project involves the development and deployment of innovative technologies and systems to reduce energy consumption and emissions of greenhouse gases, air pollutants, and other harmful substances from port operations. The initiative also includes the promotion of renewable energy sources, such as solar and wind power, to support the transition to a low-carbon economy. In addition, the SUSPORT project aims to improve water quality in ports by reducing the discharge of pollutants and promoting sustainable water management practices. The initiative also focuses on waste management, with the goal of reducing waste generation and promoting the use of sustainable waste management practices, such as recycling and composting.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2023
Involved stakeholders	Port Network Authority Of The Eastern Adriatic Sea, Consorzio Di Sviluppo Economico Del Friuli, Intermodal Transport Cluster, Split Port Authority, Port Of Zadar Authority, Ploče Port Authority, Dubrovnik Port Authority¸ Dubrovnik Neretva County, North Adriatic Sea Port Authority – Ports Of Venice And Chioggia, Venice International University, Institute For Transport And Logistics Foundation, Port Of Ravenna Authority, Central Adriatic Ports Authority, Special Agency Of The Chamber Of Commerce Chieti Pescara, Southern Adriatic Sea Port Authority (Ports Of Bari, Brindisi, Manfredonia, Barletta And Monopoli), Rijeka Port Authority, Autonomous Region Of Friuli Venezia Giulia
Cost and funding	7,1M € covered by EU funds

Description	**Adriatic MoS Up-grated Services – Adri-Up**[106]

[106] https://www.onthemosway.eu/adriatic-mos-up-grated-services-adri-up/

	Adri-Up, also known as "Adriatic MoS Up-grated Services," is a project aimed at improving the efficiency and sustainability of the maritime transport sector in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, Slovenia, and Montenegro. The primary objective of the project is to upgrade the maritime transport infrastructure in the Adriatic Sea region and develop new transport services that are more efficient and sustainable. The initiative involves the improvement of the existing transport infrastructure, including ports, terminals, and intermodal connections, to enhance the efficiency and effectiveness of transport operations. The project also involves the development of new transport services that are more sustainable and environmentally friendly. This includes the promotion of low-carbon transport modes such as rail and inland waterways, the use of alternative fuels such as LNG and hydrogen, and the development of digital technologies to improve transport planning and management.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2016 - 2020
Involved stakeholders	Central Adriatic Sea Ports Authority, Port of Igoumenitsa, North Adriatic Sea Port Authority
Cost and funding	1,46M € co-financed with EU funds (897.000 €)

Description	**European flagship Action for coLd ironING in ports**[107] The European flagship Action for coLd ironING in ports, also known as the ALIGN project, is a multi-year initiative aimed at reducing greenhouse gas emissions from ships while they are at port. The primary focus of the project is to promote the use of "cold ironing," which involves shutting down a ship's engines and connecting it to shore-side electrical power while it is in port. By doing so, the ship can significantly reduce its emissions of air pollutants, including carbon dioxide (CO2), nitrogen oxides (NOx), and sulfur oxides (SOx). The project involves the deployment of shore-side infrastructure, including electrical grids and power supply systems, to support the use of cold ironing. The initiative also includes the development of new technologies and systems to facilitate the adoption of cold ironing by ships.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2019 - 2023

[107] https://ealingproject.eu/ports-2/

Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Fundacion Valencia Port, Ports of Koper, Central Adriatic Sea Ports Authority, Port Network Authority of the Eastern Adriatic Sea
Cost and funding	6,96M € co-financed by EU – CEF (3,48M €)

Brindisi

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**PROMARES - Promoting maritime and multimodal freight transport in the Adriatic Sea** PROMARES (Promoting maritime and multimodal freight transport in the Adriatic Sea) is a European project aimed at promoting the development of sustainable and efficient transport solutions in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, and Slovenia. The primary objective of the PROMARES project is to promote the development of a sustainable and efficient transport network in the Adriatic Sea region by improving the connectivity and interoperability of the region's ports and transport modes. The initiative aims to enhance the efficiency and sustainability of maritime transport by reducing waiting times for ships, improving transport links, and promoting the use of low-carbon transport modes. The PROMARES project is expected to have a significant impact on the efficiency and sustainability of maritime transport in the Adriatic Sea region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport and promoting the development of sustainable and innovative transport solutions.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2019 - 2022
Involved stakeholders	North Adriatic Sea Port Authority – Ports of Venice and Chioggia, Venice International University, Interporto Trieste, Institute for Transport And Logistics Foundation – Itl, Central Adriatic Ports Authority, Port of Ravenna, Southern Adriatic Sea Port Authority (Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli), RAM- Rete Autostrade Mediterranee Spa, Port of Rijeka Authority, Port of Ploče Authority, University of Rijeka - Faculty of Maritime Studies
Cost and funding	2,8M € covered by EU funds

Description	**SUSPORT- SUStainable PORTs** The European project SUSPORT (SUStainable PORTs) is a multi-year initiative aimed at promoting sustainable development in European ports. The primary objective of the SUSPORT project is to develop and implement sustainable strategies and practices in European ports that reduce the environmental impact of port operations, promote resource efficiency, and support economic growth. The initiative focuses on four key areas: energy efficiency, air quality, water quality, and waste management.

	The project involves the development and deployment of innovative technologies and systems to reduce energy consumption and emissions of greenhouse gases, air pollutants, and other harmful substances from port operations. The initiative also includes the promotion of renewable energy sources, such as solar and wind power, to support the transition to a low-carbon economy. In addition, the SUSPORT project aims to improve water quality in ports by reducing the discharge of pollutants and promoting sustainable water management practices. The initiative also focuses on waste management, with the goal of reducing waste generation and promoting the use of sustainable waste management practices, such as recycling and composting.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2023
Involved stakeholders	Port Network Authority Of The Eastern Adriatic Sea, Consorzio Di Sviluppo Economico Del Friuli, Intermodal Transport Cluster, Split Port Authority, Port Of Zadar Authority, Ploče Port Authority, Dubrovnik Port Authority¸ Dubrovnik Neretva County, North Adriatic Sea Port Authority – Ports Of Venice And Chioggia, Venice International University, Institute For Transport And Logistics Foundation, Port Of Ravenna Authority, Central Adriatic Ports Authority, Special Agency Of The Chamber Of Commerce Chieti Pescara, Southern Adriatic Sea Port Authority (Ports Of Bari, Brindisi, Manfredonia, Barletta And Monopoli), Rijeka Port Authority, Autonomous Region Of Friuli Venezia Giulia
Cost and funding	7,1M € covered by EU funds

Bari

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**AISMART - Adriatic Ionian SMAII Port Network V-A Greece – Italy** AISMART (Adriatic Ionian SMAII Port Network V-A Greece – Italy) is a European project aimed at developing a sustainable and efficient transport network in the Adriatic-Ionian region. The project is funded by the European Union and involves a consortium of partners from Italy and Greece. The primary objective of the AISMART project is to promote the development of a sustainable and efficient transport network in the Adriatic-Ionian region by improving the connectivity and interoperability of the region's ports. The initiative aims to enhance the efficiency and sustainability of maritime transport by reducing waiting times for ships, improving transport links, and promoting the use of low-carbon transport modes. In terms of port infrastructure, the project involves the development and modernization of port facilities and equipment to improve the efficiency and capacity of the region's ports. The initiative also aims to promote the use of clean energy sources in port operations, such as electricity, hydrogen, and LNG. In terms of intermodal transport, the project aims to improve the efficiency and connectivity of the region's transport network by promoting the use of intermodal

	transport modes, such as short-sea shipping, inland waterways, and rail transport. The initiative also aims to improve the connectivity of ports to the hinterland, including the development of multimodal logistics platforms. Finally, in terms of digital technologies, the AISMART project aims to promote the use of digital technologies to enhance the efficiency and sustainability of port operations. The initiative involves the development of digital platforms and tools to support the interoperability and connectivity of the region's ports and transport network.
Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems Digitalisation in ports: diffusion of innovation, data and AI for smart mobility
Timeline	2019 - 2023
Involved stakeholders	Apulia Region - Department of Mobility (Italy) Region of Western Greece (Greece) Region of Ionian Islands (Greece) Region of Epirus (Greece)
Cost and funding	17,250M €

Description	**PROMARES - Promoting maritime and multimodal freight transport in the Adriatic Sea** PROMARES (Promoting maritime and multimodal freight transport in the Adriatic Sea) is a European project aimed at promoting the development of sustainable and efficient transport solutions in the Adriatic Sea region. The project is funded by the European Union and involves a consortium of partners from Italy, Croatia, and Slovenia. The primary objective of the PROMARES project is to promote the development of a sustainable and efficient transport network in the Adriatic Sea region by improving the connectivity and interoperability of the region's ports and transport modes. The initiative aims to enhance the efficiency and sustainability of maritime transport by reducing waiting times for ships, improving transport links, and promoting the use of low-carbon transport modes. The PROMARES project is expected to have a significant impact on the efficiency and sustainability of maritime transport in the Adriatic Sea region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport and promoting the development of sustainable and innovative transport solutions.
Theme	Ports as green hubs - Greening ground port services and operations
Timeline	2019 - 2022
Involved stakeholders	North Adriatic Sea Port Authority – Ports of Venice and Chioggia, Venice International University, Interporto Trieste, Institute for Transport And Logistics Foundation – Itl, Central Adriatic Ports Authority, Port of Ravenna, Southern Adriatic Sea Port Authority (Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli), RAM- Rete Autostrade Mediterranee Spa, Port of Rijeka Authority, Port of Ploče Authority, University of Rijeka - Faculty of Maritime Studies
Cost and funding	2,8M € covered by EU funds

Description	**SUSPORT- SUStainable PORTs** The European project SUSPORT (SUStainable PORTs) is a multi-year initiative aimed at promoting sustainable development in European ports. The primary objective of the SUSPORT project is to develop and implement sustainable strategies and practices in European ports that reduce the environmental impact of port operations, promote resource efficiency, and support economic growth. The initiative focuses on four key areas: energy efficiency, air quality, water quality, and waste management. The project involves the development and deployment of innovative technologies and systems to reduce energy consumption and emissions of greenhouse gases, air pollutants, and other harmful substances from port operations. The initiative also includes the promotion of renewable energy sources, such as solar and wind power, to support the transition to a low-carbon economy. In addition, the SUSPORT project aims to improve water quality in ports by reducing the discharge of pollutants and promoting sustainable water management practices. The initiative also focuses on waste management, with the goal of reducing waste generation and promoting the use of sustainable waste management practices, such as recycling and composting.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2023
Involved stakeholders	Port Network Authority Of The Eastern Adriatic Sea, Consorzio Di Sviluppo Economico Del Friuli, Intermodal Transport Cluster, Split Port Authority, Port Of Zadar Authority, Ploče Port Authority, Dubrovnik Port Authority¸ Dubrovnik Neretva County, North Adriatic Sea Port Authority – Ports Of Venice And Chioggia, Venice International University, Institute For Transport And Logistics Foundation, Port Of Ravenna Authority, Central Adriatic Ports Authority, Special Agency Of The Chamber Of Commerce Chieti Pescara, Southern Adriatic Sea Port Authority (Ports Of Bari, Brindisi, Manfredonia, Barletta And Monopoli), Rijeka Port Authority, Autonomous Region Of Friuli Venezia Giulia
Cost and funding	7,1M € covered by EU funds

Taranto

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**PNRR.** New outer dam of protection of the port outside oadstead of Taranto (eastern and western stretchs). The new breakwater integrates and completes the wave motion protections of the docks intended for mooring and port operations. The benefits are the improvement of navigation safety and mooring maneuvers, mooring safety, better usability of the docks and the increase in port operations.
Theme	· Development of efficient capacity allocation and traffic management systems · Enhancing transport safety and security

Timeline	Unknown
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto Region of Puglia EU
Cost and funding	35.760.000,00 euro

Description	**PNRR.** Realization of cold ironing implant The project includes a cold ironing implant for “public quay”, “molo settoriale” quay and “pontile petroli” quay.
Theme	· Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Diffusion of innovation, data and AI for smart mobility · Improvement of the energy efficiency and reduction of emissions of vessels · Creation of a comprehensive network of recharging and refuelling infrastructure · Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
Timeline	2026
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto Region of Puglia EU
Cost and funding	58.000.000,00 euro

Description	**AdSP**. Centro Servizi Polivalente for port uses. With the realization of Centro Servizi Polivalente agrees to activate a process of requalification of the waterfront harbour and of integration between city and port, generating a pedestrian continuity between spaces publics and interconnections from Molo S.Eligio until Piazza Fontana.
Theme	· Greening ground port services and operations
Timeline	2013 - in progress
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto Region of Puglia
Cost and funding	77.000.000,00 euro

Description	**AdSP – Masterplan**. Upgrade of railway connections The project is divided in two lots: the upgrading of railway equipment and new tracks for new logistics platform connection with the national railway line.
Theme	· Greening ground port services and operations · Enhancing transport safety and security · Development of efficient capacity allocation and traffic management systems
Timeline	2020-2023
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto Region of Puglia
Cost and funding	37.500.000,00 euro

Description	**AdSP – Masterplan**. Construction of intermodal logistic hub The project consists in the construction of a 75 hectars logistic platform in the retro port area.
Theme	· Greening ground port services and operations · Development of efficient capacity allocation and traffic management systems
Timeline	No data
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto Region of Puglia
Cost and funding	219.140.000,00 euro

Description	**PON-IR 14/20**. Port Community System. The project includes several interventions to reduce handling time and to improve the logistic chain through the digital dialogue between the different port stakeholders with the digital platform “Taranto Digital Port”
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security · Greening ground port services and operations
Timeline	2021-2022
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto

	Region of Puglia EU
Cost and funding	6.185.849,46 euro

Description	**Interreg IPA CBC Italy-Albania-Montenegro 2014-2020**. SMARTPORT - Smart and Sustainable Energy Port. It is proposed to introduce an optimization of energy savings and achieve high levels of energy efficiency with the aim of promoting the energy efficiency of ports, in line with the emission reduction EU objectives. The project seeks to provide innovative answers to the challenges of technological and energy modernization of ports. Project Specific Objectives: -Achieve energy savings in SA port areas -Promote better use of energy in the port areas involved -Emphasize the importance of the exploitation of renewable energy sources (RES) and the rational use of energy (RUE) -Reduce of light pollution -Reach, with the LEDs and intelligent poles, the optimum degree of illumination -Consume savings of up to 60% of the traditional installed power -Train energy managers (to increase the skills of the Public Administration in reducing energy waste)
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security · Greening ground port services and operations · Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
Timeline	01/07/2020 – 31/12/2021
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto Region of Puglia Agenzia Regionale per la Prevenzione e la Protezione dell'Ambiente ARPAP Italia, Comune di Termoli Port of Bar (MN) Port of Valona (AL) EU

Cost and funding	Total budget: 722.500,00 euro IPA co-financing 85%

Description	**Interreg V-B Adriatic Ionian Adrion 2014-2020.** ECOWAVES project aims to support more sustainable and green development by strengthening the level of capacities of involved institutions to operate jointly and transnationally, by elaborating and adopting a transnational strategy based on waste management model to provide services for prevention of pollution. In addition, the project is expected to increase the availability of data and information for delivering effective responses by implementing interoperability and systematic monitoring.
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security · Greening ground port services and operations · Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Promotion of ports as testbeds for waste reuse and the circular economy
Timeline	01/03/2020 – 31/08/2022
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto Region of Puglia Autorità di Sistema Portuale del Mar Adriatico Centrale (IT), Autorità portuale di Igoumenitsa (GR), Agenzia di Sviluppo Rurale della Contea di Zadar (CRO), Agenzia di Sviluppo Regionale del Nord Primorska Ltd Nova Gorica (SLO), Associazione Commerciale per lo sport, il tempo libero e il recupero ambientale ECO ZONE Ada Huja (SRB), Porto di Vlora (ALB), Ministero dei Trasporti per gli Affari Marittimi del Montenegro (MNE). Arpa Puglia (IT), Agenzia di Protezione Ambientale (SRB), JVP Beogradvode (SRB) e Autorità Portuale di Zadar (CRO)
Cost and funding	Total budget: 2.395.000,01 euro AdSP MI Contribution: 455.000,00 euro

Description	**Interreg Greece-Italy 2014-2020.** SWAN – Enhancing regional transportation through Sustainable Water Aerodrome Network. Swan project aims to develop seaplane infrastructure within Ports and coastal areas supporting multimodal integration & interconnection of transport modes in the

	Cross Border territory. The project aim to increase in the number of maritime transport passengers in the involved ports via the set up of water aerodromes and mini terminals that will function as a mini-hub for local transport needs. One of the main output will be 8 water aerodromes & mini terminals; 3 in Diapontia Islands, 1 in Corfu & Paxos Ports, 1 in Taranto, Gallipoli & Nardo Ports.
Theme	· Development of efficient capacity allocation and traffic management systems · Enhancing transport safety and security · Greening ground port services and operations
Timeline	2019 - 2020
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto Region of Puglia Municipality of Corfù Municipality of Gallipoli Municipality of Nardò
Cost and funding	401.390,00 euro

Description	**Programma IPA CBC Italia- Albania- Montenegro.** The PORTS project aims at strengthening the Apulian sea links with Montenegrin and Albanian coasts, in order to support socio-economic growth of the two main coastal area cross border systems. Joint actions will be encouraged to develop new sustainable solutions for maritime transport and sustainable mobility networks in order to improve internal links of tourist transport and pleasure cruises. Integrated transport (passenger and freight) will also be strengthened across Ionian and Adriatic Seas, in order to boost sustainable development and full inclusion of areas characterized by complex accessibility.
Theme	· Development of efficient capacity allocation and traffic management systems · Enhancing transport safety and security · Greening ground port services and operations
Timeline	15.03.2018 - 14.12.2020
Involved stakeholders	AdSP Mar Ionio Municipality of Taranto Region of Puglia ITS GE.IN.LOGISTIC Politecnico di Bari Institut Transporti (Albania) Università del Montenegro Autorità Portuale di Durazzo (Albania) Autorità portuale di Kotor (Montenegro)

	Consorzio Nautico Puglia (IT)
Cost and funding	Total budget: 1.091.053,08 euro Budget for AdSP MI: 130.157,00 euro

Catania

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**PAC 14/20 asse Green Port (MIMS)**. Construction of shading canopies with photovoltaic roofing for electricity production from renewable sources in the parking areas at the ports of Augusta and Catania.
Theme	· Creation of a comprehensive network of recharging and refuelling infrastructure · Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power · Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Diffusion of innovation, data and AI for smart mobility
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta Municipality of Catania Sicily district MIMS EU
Cost and founding	2.023.000,00 euro

Description	**AdSP**. Lighting maintenance work: replacement of traditional lamps with new generation LED lamps in ports of Augusta and Catania.
Theme	· Promotion of ports as new clean energy hubs for integrated

	electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta Municipality of Catania Sicily district
Cost and founding	529.050,00 euro

Description	**Decreto MIMS n. 330 del 13/08/2021 (PNRR)**. Electrification (cold ironing) of the docks of port of Catania.
Theme	· Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Diffusion of innovation, data and AI for smart mobility · Improvement of the energy efficiency and reduction of emissions of vessels · Creation of a comprehensive network of recharging and refuelling infrastructure · Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Catania Sicily district MIMS

	University of Catania EU
Cost and founding	56.500.000,00 euro

Description	**AdSP - Legge 30/12/2020, n. 178**. Removal and disposal of wrecks located in the relevant body of water, after environmental protection investigations.
Theme	· Greening ground port services and operations · Promotion of ports as testbeds for waste reuse and the circular economy · Enhancing transport safety and security
Timeline	2021-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Catania Municipality of Augusta Sicily district MIMS MDIF
Cost and founding	14.000.000,00 euro

Description	**PAC 14/20 Infrastrutture e Reti (MIMS)**. Digital ecosystem project "Smart Port" to strengthen rail and road "fast corridor".
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Greening ground port services and operations · Enhancing transport safety and security · Promotion of ports as new clean energy hubs for integrated

	electricity systems, hydrogen and other low-carbon fuels · Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Catania Municipality of Augusta Sicily district MIMS
Cost and founding	5.221.123,88 euro

Description	**AdSP**. The main objectives of the CYBER SECURITY project are to build a baseline of good practices to ensure cybersecurity of port systems and services, while mapping the relevant cybersecurity challenges and threats and highlighting some attack scenarios. The study aims at being a reference point to promote collaboration on maritime port ecosystem across the European Union and raise awareness of the relevant threats. An additional important element of the study is to map port services and systems through a high-level reference model to set the scope of the work to be done and serve as a basis for future developments. This study outlines good practices for cybersecurity in the maritime port ecosystem, both concerning IT systems and OT systems.
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Catania Municipality of Augusta

	Sicily district LEONARDO S.P.A.
Cost and founding	2.034.000,00 euro

Description	**AdSP**. Construction of a Maritime Station, pertaining to the passenger traffic sector.
Theme	· Development of efficient capacity allocation and traffic management systems · Enhancing transport safety and security · Greening ground port services and operations.
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Catania Sicily district
Cost and founding	22.000.000,00 euro

Augusta

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**PON-IR 14/20, AdSP**. New quay on piles and squares backwaters for the docking of mega container ships aimed at upgrading the Commercial Port of Augusta, in order to develop containerized traffic. The simultaneous establishment of a link railway within the port structure will allow the modal exchange of transport to the interior of the Sicily Region and towards the rest national territory, significantly reducing the road traffic and making an important contribution to the implementation of the "motorways of the sea".
Theme	· Enhancing transport safety and security

	· Improvement of the energy efficiency and reduction of emissions of vessels · Greening ground port services and operations · Development of efficient capacity allocation and traffic management systems
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta Sicily district EU Company specialized in container handling
Cost and founding	28.500.000,00 euro

Description	**PON-IR 14/20, AdSP**. The intervention involves the upgrading of the commercial quay existing in order to facilitate docking of mega-container ships and related equipment with gantry cranes for container handling. This is a structural adjustment intervention of a section of the quay existing for about 150 m. They are in progress activities aimed at disassembly and storage of the unfinished gantry cranes included in the contract.
Theme	· Enhancing transport safety and security · Improvement of the energy efficiency and reduction of emissions of vessels · Greening ground port services and operations · Development of efficient capacity allocation and traffic management systems
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta Sicily district

	EU Company specialized in container handling
Cost and founding	8.300.000,00 euro

Description	**AdSP**. Renovation and upgrading works are planned of the Gennalena quay, dedicated to ship demolitions.
Theme	· Enhancing transport safety and security · Promotion of ports as testbeds for waste reuse and the circular economy · Greening ground port services and operations · Development of efficient capacity allocation and traffic management systems
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta Sicily district Soprintendenza Inter-regional Department of Public Works Sicilia-Calabria
Cost and founding	6.300.000,00 euro

Description	**PNRR**. Realization of railway station of the commercial port of Augusta and connection to the railway line Messina-Siracusa, to eliminate the crossing of town.
Theme	· Development of efficient capacity allocation and traffic management systems · Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Enhancing transport safety and security

Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta Sicily district RFI EU
Cost and founding	75.000.000,00 euro

Description	**PAC 14/20 asse Green Port (MIMS)**. Construction of shading canopies with photovoltaic roofing for electricity production from renewable sources in the parking areas at the ports of Augusta and Catania.
Theme	· Creation of a comprehensive network of recharging and refuelling infrastructure · Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power · Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Diffusion of innovation, data and AI for smart mobility
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta Municipality of Catania Sicily district MIMS EU
Cost and founding	2.023.000,00 euro

Description	**AdSP**. Lighting maintenance work: replacement of traditional lamps with new generation LED lamps in ports of Augusta and Catania.
Theme	· Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta Municipality of Catania Sicily district
Cost and founding	529.050,00 euro

Description	**Decreto MIMS n. 330 del 13/08/2021 (PNRR)**. Electrification (cold ironing) of the docks of Commercial Port of Augusta.
Theme	· Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Diffusion of innovation, data and AI for smart mobility · Improvement of the energy efficiency and reduction of emissions of vessels · Creation of a comprehensive network of recharging and refuelling infrastructure · Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta

	Sicily district MIMS University of Catania EU
Cost and founding	32.600.000,00 euro

Description	**AdSP - Legge 30/12/2020, n. 178**. Removal and disposal of wrecks located in the relevant body of water, after environmental protection investigations.
Theme	· Greening ground port services and operations · Promotion of ports as testbeds for waste reuse and the circular economy · Enhancing transport safety and security
Timeline	2021-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Catania Municipality of Augusta Sicily district MIMS MDIF
Cost and founding	14.000.000,00 euro

Description	**PAC 14/20 Infrastrutture e Reti (MIMS)**. Digital ecosystem project "Smart Port" to strengthen rail and road "fast corridor".
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Greening ground port services and operations

	· Enhancing transport safety and security · Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Catania Municipality of Augusta Sicily district MIMS EU
Cost and founding	5.221.123,88 euro

Description	**AdSP**. The main objectives of the CYBER SECURITY project are to build a baseline of good practices to ensure cybersecurity of port systems and services, while mapping the relevant cybersecurity challenges and threats and highlighting some attack scenarios. The study aims at being a reference point to promote collaboration on maritime port ecosystem across the European Union and raise awareness of the relevant threats. An additional important element of the study is to map port services and systems through a high-level reference model to set the scope of the work to be done and serve as a basis for future developments. This study outlines good practices for cybersecurity in the maritime port ecosystem, both concerning IT systems and OT systems.
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility
Timeline	2023-2025

Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Catania Municipality of Augusta Sicily district LEONARDO S.P.A.
Cost and founding	2.034.000,00 euro

Description	**MIUR**. Progetto ISYPORT ARS01_01202 – Integrated System for navigation risk mitigation in PORTs. ISYPORT faces the challenge of navigation safety in ports and in areas close to port infrastructures, those areas subject to the greatest number of maritime accidents. Creation of a coordinated system of innovative methods and tools, based on information from numerical simulations, sensors and decision support tools, aimed at recognizing dangerous events and therefore able to provide support to "situational awareness". A real-time sensor data fusion and analysis system will be created, through which users, both professional and amateur, will be able to share all the information with each other and with port operators for safe execution of maneuvers in port. A plan for the dissemination of the results and technological transfer of the project aimed at specific beneficiaries (other Research Organizations and other industrial realities, Public Administrations) of different levels (local, regional and national) will be implemented.
Theme	· Enhancing transport safety and security · Diffusion of innovation, data and AI for smart mobility
Timeline	2023-2025
Involved Stakeholders	AdSP Mare di Sicilia Orientale, Municipality of Augusta Sicily district MIUR
Cost and founding	320.000,00 euro

Palermo

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**CEF Transport 2018** (50%). INTERFACE: renovating the access to the core port of Palermo and its interactions with the urban environment (Action n. 2018-IT-TM-0045-S). The project consists in the design of new infrastructures aimed at improving the entry and exit roads of the port of Palermo, with particular relevance for the activities located at the Molo Piave of the Port of Palermo, where Ro-Ro traffic and ferries are concentrated. The intervention provides: -road infrastructure for access to the port; -new parking areas for heavy vehicles; -new sidewalks; -pier reinforcement; -improvement of complementary infrastructures: green areas, control sites and safety gates, pedestrian shelters and roofs, sanitary systems and electrical systems.
Theme	· Development of efficient capacity allocation and traffic management systems · Greening ground port services and operations · Enhancing transport safety and security
Timeline	24/10/2018- 31/12/2020
Involved stakeholders	AdSP Mare di Sicilia Occidentale, Municipality of Palermo Sicily district EU
Cost and funding	1.484.900,00 euro

Description	**PON-IR 2014-2020 (PAC 2014/2020) – ASSE A - A.2 - Linea Azione 2 - A.2 - Linea Azione 2.** Creation of an access monitoring system through integrated gates in the port areas of the AdSP Mare di Sicilia Orientale. The intervention provides for the creation of an access system through nine gates (four in Palermo, two in Trapani, two in Termini Imerese and one in Porto Empedocle) with high automation and controllable remotely, developed according to the interoperability standards defined by European and national regulations. The gates are characterized by automatic data acquisition systems relating to freight and passenger traffic, reducing the times for their control in order to increase the efficiency of the processes and improve the competitiveness of the ports.
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security
Timeline	2021 – in progress
Involved stakeholders	AdSP Mare di Sicilia Occidentale,

	Municipality of Palermo Sicily district MIMS EU
Cost and funding	5.570.000,00 euro

Description	**AdSP - Masterplan**. New Ro-Ro Terminal on Piave Quay and new access infrastructures. This intervention aims at optimizing all port volumes by means of the demolition and rebuilding of a 84,000 cubic meters single functional building.
Theme	· Enhancing transport safety and security · Development of efficient capacity allocation and traffic management systems · Greening ground port services and operations
Timeline	No data
Involved stakeholders	AdSP Mare di Sicilia Occidentale, Municipality of Palermo Sicily district
Cost and funding	77.000.000,00 euro

Description	**AdSP - Masterplan**. Linking road to the core nodes. It is a complex intervention of last mile connection to/from Port of Palermo, based on a great road and highway infrastructure, that also includes a tunnel, represents the concrete implementation of Port System of the Western Sicilian Sea, to be considered as Core TEN-T network node. It links the port of Palermo and the Termini Imerese interport to the main Sicilian traffic routes, the Palermo – Catania and Trapani Mazara Motorways included in the Core TEN-T Network.
Theme	· Enhancing transport safety and security · Development of efficient capacity allocation and traffic management systems
Timeline	No data
Involved stakeholders	AdSP Mare di Sicilia Occidentale, Municipality of Palermo Sicily district
Cost and funding	1.290.000,00 euro

Description	**AdSP - Masterplan**. Functional restoration and adaptation of ex Tirrenia building.

	This intervention aims to allocate some port functions and some commercial functions increasing the quality of port services.
Theme	· Enhancing transport safety and security · Development of efficient capacity allocation and traffic management systems · Greening ground port services and operations
Timeline	Unknown
Involved stakeholders	AdSP Mare di Sicilia Occidentale, Municipality of Palermo Sicily district
Cost and funding	19.300.000,00 euro

Description	**PNRR**. Upgrade of the lighting system and of port energy efficiency.
Theme	· Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security
Timeline	Unknown
Involved stakeholders	AdSP Mare di Sicilia Occidentale, Municipality of Palermo Sicily district EU
Cost and funding	32.000.000,00 euro

Termini Imerese

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**PON-IR 2014/20 Asse II- Linea di Azione II.1.1.** Completion works of the breakwater. Re-flowering of the breakwater in order to improve the operations and safety of the Port of Termini Imerese.
Theme	· Enhancing transport safety and security · Development of efficient capacity allocation and traffic management systems
Timeline	2019 – in progress
Involved stakeholders	AdSP Mare di Sicilia Occidentale, Municipality of Termini Imerese

	Sicily district EU
Cost and funding	20.000.000,00 euro

Description	**PNRR**. Upgrade of the lighting system and of port energy efficiency.
Theme	· Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Greening ground port services and operations · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security
Timeline	Unknown
Involved stakeholders	AdSP Mare di Sicilia Occidentale, Municipality of Termini Imerese Sicily district EU
Cost and funding	6.000.000,00 euro

Description	**PON-IR 2014-2020 (PAC 2014/2020) – ASSE A - A.2 - Linea Azione 2 - A.2 - Linea Azione 2.** Creation of an access monitoring system through integrated gates in the port areas of the AdSP Mare di Sicilia Orientale. The intervention provides for the creation of an access system through nine gates (four in Palermo, two in Trapani, two in Termini Imerese and one in Porto Empedocle) with high automation and controllable remotely, developed according to the interoperability standards defined by European and national regulations. The gates are characterized by automatic data acquisition systems relating to freight and passenger traffic, reducing the times for their control in order to increase the efficiency of the processes and improve the competitiveness of the ports.
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security
Timeline	2021 – in progress
Involved stakeholders	AdSP Mare di Sicilia Occidentale, Municipality of Termini Imerese Sicily district MIMS EU
Cost and funding	5.570.000,00 euro

Gioia Tauro

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**PON-IR 14/20 Linea II.1.2, PAC-IR 14/20.** Railway gateway. The creation of an efficient, integrated, flexible, safe and sustainable transport system to ensure functional and transport services for development. The terminal project includes the equipping with a group of bundles of tracks (n.4) divided into two distinct areas for the handling of national and international goods. the construction of storage and exchange areas.
Theme	· Development of efficient capacity allocation and traffic management systems · Enhancing transport safety and security · Greening ground port services and operations
Timeline	03/10/2016 -22/12/2016 (in progress)
Involved stakeholders	AdSP Mari Tirreno Meridionale e Ionio Municipality of Gioia Tauro Region of Calabria MIMS EU
Cost and funding	20.000.000,00 euro

4.4.5 Montenegro

Bar

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**Interreg – IPA CBC Italy-Albania-Montenegro**. LASTING Lower Adriatic Sea - Transit Intermodal Networking Grid. The main goal of LASTING project is to foster regional coordination and streamlining of passenger flows within the Lower Adriatic area and into the Trans-European Transport Network (TEN-T), calling for the relaunch of the Pan-European Corridor VIII. The project aims to improve the multimodal system of connections, based on analyses of passenger mobility in the Lower Adriatic, as well as to improve the connections between the main cross-border transit infrastructures and the trans-European corridors. As a result, a strategic plan for the transnational passenger transit system will be developed and proposed for adoption to the four Transport Authorities of the Lower Adriatic region.
Theme	· Development of efficient capacity allocation and traffic management systems · Enhancing transport safety and security
Timeline	01/01/2020 – 31/12/2021
Involved stakeholders	Port ok Bar – Luka Bar

	Agenzia Strategica per lo Sviluppo Ecosostenibile del Territorio Regione Puglia (IT) Autorità di Sistema Portuale del Mare Adriatico Meridionale (IT) Autoriteti Portual Durres (AL) Luka Bar Akcionarsko Društvo Bar (ME) Universiteti Bujqesor i Tiranes (AL) Agenzia Regionale per lo Sviluppo del Molise – Sviluppo Italia Molise S.p.A. (IT) Municipality of Bar EU
Cost and funding	Total budget: 634.710,85 euro EU Contribution: IPA co-financing 85%

Description	**Interreg ADRION 2021 Adriatic - Ionian, European Regional Development Fund (ERDF).** MultiAPPRO - Multidisciplinary approach and solutions to development of intermodal transport in region. Overall objective of the project is development of intermodal transport in Adriatic-Ionian region. The specific objective is to enhance capacity for integrated transport and mobility services and multimodality in the Adriatic-Ionian area. The thematic objective is promoting sustainable transport and removing bottlenecks in key network infrastructures by. The investment priority is developing and improving environmentally-friendly (including low-noise) and low-carbon transport systems, including inland waterways and maritime transport, ports, multimodal links and airport infrastructure, in order to promote sustainable regional and local mobility.
Theme	· Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Development of efficient capacity allocation and traffic management systems · Enhancing transport safety and security · Greening ground port services and operations
Timeline	01/02/2018 – 30/04/2021
Involved stakeholders	Port ok Bar – Luka Bar Klaster intermodalnog prijevoza Lučka uprava Ploče Luka Bar Akcionarsko društvo Ministrstvo za infrastrukturo Εθνικό Μετσόβιο Πολυτεχνείο PIREE PORT AUTORITE Instituti i Transportit Consorzio Formazione Logistica Intermodale F.lli CODOGNOTTO DI CODOGNOTTO GIANFRANCO & C.S.N.C.

	Municipality of Bar EU
Cost and funding	Total budget/expenditure: 1.177.060,00 euro European Union funding: 1.000.501,00 euro Co-financing sources: ERDF, IPA/IPA II/IPA III

Description	**Interreg ADRION 2021 Adriatic - Ionian, European Regional Development Fund (ERDF)**. ADRIPASS – Integrating multimodal connections in the Adriatic-Ionian region PLUS. The specific objective is to enhance capacity for integrated transport and mobility services and multimodality in the Adriatic-Ionian area. The ADRIPASS PLUS project seeks to increase cooperation and digitization of processes among stakeholders in multimodal freight transport in the Adriatic-Ionian region, using innovative ICT systems, including some of the most important ports, freight forwarders and terminals that create multimodal traffic flows.
Theme	· Diffusion of innovation, data and AI for smart mobility · Development of efficient capacity allocation and traffic management systems · Greening ground port services and operations · Enhancing transport safety and security
Timeline	2022
Involved stakeholders	Port ok Bar – Luka Bar Municipality of Bar CEI (Central European Initiative) EU
Cost and funding	Total budget: 176.370,00 euro ERDF budget: 61.200,00 euro

Description	**Interreg IPA CBC Italy-Albania-Montenegro 2014-2020**. SMARTPORT - Smart and Sustainable Energy Port. It is proposed to introduce an optimization of energy savings and achieve high levels of energy efficiency with the aim of promoting the energy efficiency of ports, in line with the emission reduction EU objectives. The project seeks to provide innovative answers to the challenges of technological and energy modernization of ports. Project Specific Objectives: -Achieve energy savings in SA port areas -Promote better use of energy in the port areas involved -Emphasize the importance of the exploitation of renewable energy sources (RES) and the rational use of energy (RUE) -Reduce of light pollution -Reach, with the LEDs and intelligent poles, the optimum

	degree of illumination -Consume savings of up to 60% of the traditional installed power -Train energy managers (to increase the skills of the Public Administration in reducing energy waste)
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security · Greening ground port services and operations · Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
Timeline	01/07/2020 – 31/12/2021
Involved stakeholders	Autorità di Sistema Portuale del Mar Ionio Porto di Taranto (IT) Agenzia regionale per la prevenzione e la protezione dell'ambiente (IT) Comune di Termoli (IT) Luka Bar Akcionarsko Društvo Bar (ME) Porti Detar Vlore Sh.A (AL) Municipality of Bar EU
Cost and funding	Total budget: 722.500,00 euro EU Contribution: IPA co-financing 85%

Description	**Interreg IPA CBC Italy-Albania-Montenegro 2014-2020**. SUMO -project aims to improve sustainability and mobility in some of the main port cities of the programme area, through developing a cross-border Adriatic system to encourage the use of means of transport alternative to cars (hybrid/electric motorboats and buses, bicycles). Four pilot actions will be implemented in Termoli, Brindisi, Bar, Valona, in order to improve the travel experience of tourists and citizens while reducing the carbon footprint in the involved territories. Expected results are: widening of the smart and sustainable mobility network; citizens' awareness raising on smart and green mobility; improvement of transnational coordination in the development of integrated traveller transport systems.
Theme	· Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Enhancing transport safety and security · Greening ground port services and operations · Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels

Timeline	01/07/2020 – 31/12/2021
Involved stakeholders	Società Trasporti Pubblici Brindisi S.p.A. (IT) Luka Bar Akcionarsko Društvo Bar (ME) Bashkia Vlorë (AL) Comune di Termoli (IT) Municipality of Bar EU
Cost and funding	Total budget: 1.079.535,00 euro EU Contribution: IPA co-financing 85%

Description	**Interreg IPA CBC Italy-Albania-Montenegro 2014-2020**. EFINTIS - Enhancing eFficiency of the INTermodal transport flows by Improved ict Systems. EFINTIS aims to increase efficiency of the intermodal transport flows in the programme area by upgrading management information systems. The project will enable, improve or establish new ICT connections between different modes of transport for passengers as well as for goods (maritime, road and railway transport). As ports are usually hubs for all modes of transport, data collection and exchange will be established and will enable faster administrative procedures.
Theme	· Diffusion of innovation, data and AI for smart mobility · Development of efficient capacity allocation and traffic management systems · Enhancing transport safety and security · Greening ground port services and operations
Timeline	01/07/2020 - 31/12/2021
Involved stakeholders	Luka Bar A.D. (ME) Instituti i Transportit (AL) Autorità di Sistema Portuale del Mare Adriatico Meridionale (IT) Autoriteti Portual Durres (AL) Azienda Autonoma di Soggiorno e Turismo di Termoli (IT) Municipality of Bar EU
Cost and funding	Total budget: 1.075.500,00 euro EU Contribution: IPA co-financing 85%

Description	**Interreg Mediterranean Programme 2014-2020, European Regional Development Fund (ERDF).** EnerNETMob – Electromobility Networks for intermodal and interurban low carbon transport systems. aims to draft, test and improve parallel "Sustainable Electromobility Plans" according to common standards and low carbon policies, in order to set an "Interregional Electromobility Network" crossing cities of all the Interreg MED

	area. The project promotes sharing mobility and land-sea intermodality using electric transport systems, by implementing interurban and interregional pilot networks of Electric Vehicles Supply Equipment (EVSE) also co-powered by Renewable Energy Sources. It developes electromobilty solutions and tests pilot actions to overcome medium-trip limitations and to coordinate future investments on electric transport.
Theme	· Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels · Development of efficient capacity allocation and traffic management systems · Diffusion of innovation, data and AI for smart mobility · Greening ground port services and operations
Timeline	2018 - 2022
Involved stakeholders	Region of Peloponnese-Department of Management for Development Planning, Greece Authority of transport in Malta, Malta RAM Logistica Infrastructure e Transporti S.p.a. Italy Ministry of Transport, Communications and Works, Cyprus Albanian Institute of Transport, Albania Region of Thessaly-Department of Development and Planning, Greece County of Primorje and Gorski Kotar, Croatia University of Palermo- Department of Agricultural, Food and Forest Sciences, Sicilia Italy Regional Development Agency of Northern Primorska Ltd. Nova Gorica, Slovenia Energy and Environment Agency of Arrabida, Portugal Free Municipal Consortium of Ragusa, Sicilia Italy Dynamic Vision P.C, Athens, Greece Port of Bar Holding company, Montenegro CIMNE, International Center for numeric methods in engineering, Barcelona, Spain CAPENERGIES, Aix-en-Provence, France FORSCHUNGSGES ELLSCHAFT MOBILITAT - Austrian Mobility Research FGM - AMOR, Gemeinnutzige GMBH, Austria A.I.S.B.L. European Platform on Mobility Management, Belgium Municipality of Volos, Greece Albanian Railways HSH, Albania University “Ismail Qemali” Vlore, Albania Ministry of Transport and Maritime Affairs, Montenegro Piraeus Chamber of Small and Medium Sized Industries, Greece Intermodal Transport Cluster, Croatia Regional Chamber of Craft and Small Business Nova Gorica, Slovenia Murcia Region Development agency (INFO), Spain

	Camara Municipal de Palmela, Portugal Instituto Eletrotecnico Portugues, Portugal Palermo Port Authority, Italy Regional Agency for the Protection of the Environment – Sicily, Italy Network of Sicilian Social Farms" Social Promotion Association, Italy Engomi Municipality, Cyprus Thecamp, France Sicilian Region, Regional Department of Infrastructure and Mobility, Italy Port Authority of Durres, Albania Aristotle University of Thessaloniki, Greece Municipality of Bar EU
Cost and funding	5.740.000,00 euro

4.4.7 Slovenia

Koper

The following projected are planned in the port within the scopes and themes of green and smart ports.

Description	**ISTEN - Integrated and Sustainable Transport in Efficient Network** The ISTEN (Integrated and Sustainable Transport in Efficient Network) project includes a focus on the maritime sector and aims to promote sustainable and efficient transport in European ports and shipping routes. The ISTEN project aims to address the challenges (environmental impacts, including air and water pollution, greenhouse gas emissions, and noise) by developing an integrated and sustainable transport system that supports economic growth, reduces carbon emissions, and enhances the quality of life for European citizens. In terms of sustainable shipping, the project involves the development and deployment of low-carbon shipping technologies and practices, such as alternative fuels and energy-efficient vessel design, to reduce the environmental impact of shipping. The initiative also aims to promote sustainable shipping practices, such as slow steaming and efficient route planning. In terms of port infrastructure and operations, the project focuses on improving the energy efficiency of port operations, including the use of renewable energy sources, such as wind and solar power, and the deployment of shore-side power supply systems to support the use of cold ironing by ships. The initiative also promotes the use of digital technologies to improve the efficiency and safety of port operations. Finally, the ISTEN project aims to improve the multimodal transport network by promoting the integration of different transport modes, such as shipping, rail, and road, and by developing innovative transport solutions that reduce the environmental impact of transport and support economic growth.

Theme	Digitalisation in ports: development of efficient capacity allocation and traffic management systems
Timeline	2017 - 2020
Involved stakeholders	Mediterranea University of Reggio Calabria, Port Network Authority of the Eastern Adriatic Sea, Centre for Research and Technology Hellas (CERTH), Chamber of Commerce and Industry of Serbia, Institute for Transport and Logistics Foundation, Port Authority of Šibenik-Knin County, Port of Bar Holding Company, Port of Koper, port and logistic system, public limited company, Regional Council of Durres, Thessaloniki Port Authority S.A
Cost and funding	1,32M € EU contribution: 920.550€ ERDF budget and 211.650 € IPAII budget

Description	**European flagship Action for coLd ironING in ports**[108] The European flagship Action for coLd ironING in ports, also known as the ALIGN project, is a multi-year initiative aimed at reducing greenhouse gas emissions from ships while they are at port. The primary focus of the project is to promote the use of "cold ironing," which involves shutting down a ship's engines and connecting it to shore-side electrical power while it is in port. By doing so, the ship can significantly reduce its emissions of air pollutants, including carbon dioxide (CO2), nitrogen oxides (NOx), and sulfur oxides (SOx). The project involves the deployment of shore-side infrastructure, including electrical grids and power supply systems, to support the use of cold ironing. The initiative also includes the development of new technologies and systems to facilitate the adoption of cold ironing by ships.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2019 - 2023
Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Fundacion Valencia Port, Ports of Koper, Central Adriatic Sea Ports Authority, Port Network Authority of the Eastern Adriatic Sea
Cost and funding	6,96M € co-financed by EU – CEF (3,48M €)

Description	**CLEAN BERTH** CLEAN BERTH is a European project aimed at reducing the environmental impact of the maritime sector by developing and deploying innovative technologies and systems to improve the efficiency and sustainability of port operations.

[108] https://ealingproject.eu/ports-2/

	The primary objective of the CLEAN BERTH project is to reduce air and water pollution, noise, and greenhouse gas emissions from port operations by promoting the use of clean energy sources, such as electricity, hydrogen, and LNG. The initiative also aims to improve the efficiency of port operations by reducing waiting times for ships and optimizing the use of port infrastructure and equipment. The CLEAN BERTH project is expected to have a significant impact on the efficiency and sustainability of port operations in the Mediterranean region. The initiative is also expected to contribute to the economic development of the region by improving the efficiency and competitiveness of maritime transport.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2020 - 2022
Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Consorzio di Sviluppo Economico del Friuli, Autorità di Sistema Portuale del Mare Adriatico Settentrionale – Porti di Venezia e Chioggia, Luka Koper, pristaniški in logistični sistem, d.d., Univerza na Primorskem
Cost and funding	881.842,06€

Description	**Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS)** [109] The Sustainable LNG Operations for Ports and Shipping - Innovative Pilot Actions (GAINN4MOS) is a project aimed at promoting the use of LNG (Liquefied Natural Gas) as a cleaner and more sustainable fuel for ports and shipping operations. The project focuses on the development of innovative pilot actions to promote the use of LNG in different areas of the maritime sector. The primary objective of the GAINN4MOS project is to demonstrate the technical and economic feasibility of using LNG as a low-emission fuel for ports and shipping operations. The project involves the development of innovative pilot actions, including the construction of LNG bunkering facilities, the conversion of ships to use LNG as a fuel, and the optimization of LNG supply chains.
Theme	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Timeline	2015 - 2019

[109] https://www.fundacion.valenciaport.com/en/project/gainn4mos-sustainable-lng-operations-for-ports-and-shipping-innovative-pilot-actions-2/

Involved stakeholders	Autorità di Sistema Portuale del Mare Adriatico Orientale, Fundacion Valencia Port, Ports of Koper, Ports of Rijeka, Port of La SpeziaM Port of Fos-Marseille, Port of Nantes-Saint Nazaire
Cost and funding	24,2M € co-financed by EU – CEF (9,8M €)

5. Analysis of the projects planned in the ports of the macro-region

In this section, an analysis of the possible indication emerging from the inventory of projects in the Port authorities in the EUSAIR territories. The objective is to investigate which are the "Green and Smart Port" themes that the ports are actually working on or plan to work on; this investigation allows then to derive remarks concerning possible specific priorities for the future calls of each ETC Programme.

In order to reach this aim, an association of each port projects to one or more of the "Green and Smart Port" themes has been performed and the outcomes is presented in the following table.

THEMES OF PROJECTS BY COUNTRY

Projects theme / Countries (131 Projects)	Albania	Croatia	Greece	Italy	Montenegro	Slovenia
A. Improvement of the energy efficiency and reduction of emissions of vessels		1	5	4		1
B. Creation of a comprehensive network of recharging and refuelling infrastructure		1	4	3		1
C. Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power			4	6		1
D. Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels		2	4	38	3	4
E. Greening ground port services and operations		3	7	33	4	
F. Promotion of ports as testbeds for waste reuse and the circular economy				6		
G. Enhancing transport safety and security				4		
H. Development of efficient capacity allocation and traffic management systems	1	3	3	35	7	
I. Diffusion of innovation, data and AI for smart mobility	2	4	4	13	5	

Dor the purpose of this phase, with the aim of providing useful outcomes for supporting the definition of Terms of References of future Calls, the 9 "Green and Smart Port" themes have been further detailed in the following topics.

"GREEN AND SMART PORT" THEMES AND SPECIFIC TOPICS

A. Improvement of the energy efficiency and reduction of emissions of vessels
A.1 Deployment of Liquid Natural Gas (LNG) fuelled vessels.
A.2 Test and deployment of full electric vessels and tugs.
B. Creation of a comprehensive network of recharging and refuelling infrastructure
B.1 Construction of LNG depots and facilities.
B.2 Deployment of LNG bunkering vessels.
C. Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power
C.1 Electrification of quays and deployment of onshore power supply systems (cold ironing).
D. Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels
D.1 Creation of green hydrogen sites for production and distribution of hydrogen power.
D.2 Deployment of public charging points for electric vehicles.
D.3 Use of renewable energy sources, deployment of new more efficient lighting system, creation of power management system.
E. Greening ground port services and operations

E.1 Greening port spaces.
E.2 Greening port operations.
F. Promotion of ports as testbeds for waste reuse and the circular economy
F.1 Use of secondary material in production and costruction, deployment of waste-to energy facilities.
F.2 Reconversation of industrial and port areas.
G. Enhancing transport safety and security
G.1 Improvement of infrastructure resilience and deployment of measures to contain the impact of extreme weather events.
G.2 Planning and implementation of measures to reduce the impact of pandemics and other sanitary emergencies
H. Development of efficient capacity allocation and traffic management systems
H.1 Further deployment of Vessel Traffic Monitoring and Information Systems (VTMIS).
H.2 Deployment of solutions for enabling multimodal travel planning.
H.3 Safe deployment of automated and autonomous maritime operations.
I. Diffusion of innovation, data and AI for smart mobility
I.1 Diffusion and integration of Port Community Systems at the port, port cluster, and national levels
I.2 Diffusion of Maritime Single Window solutions and deployment of automated and paperless procedures and solutions
I.3 Other IT solutions (rail traffic management, Iot, Blockchain, port operation)

The following tables synthesizes the outcome of this more detailed analysis, by “topic”.

TOPICS OF PROJECTS BY COUNTRY

	Number of projects in the ports in:					
	Albania	Croatia	Greece	Italy	Montenegro	Slovenia
A. Improvement of the energy efficiency and reduction of emissions of vessels		x	x	x		x
A.1 Deployment of Liquid Natural Gas (LNG) fuelled vessels.		1	3	4		1
A.2 Test and deployment of full electric vessels and tugs.			2			
B. Creation of a comprehensive network of recharging and refuelling infrastructure		x	x	x		x
B.1 Construction of LNG depots and facilities.		1	4	3		1
B.2 Deployment of LNG bunkering vessels.		1	3	3		1
C. Deployment of renewable and low-carbon fuels and powering stationed vessels with renewable power			x	x		x
C.1 Electrification of quays and deployment of onshore power supply systems (cold ironing).			4	6		1
D. Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels		x	x	x	x	x
D.1 Creation of green hydrogen sites for production and distribution of hydrogen power.						
D.2 Deployment of public charging points for electric vehicles.			1	2	1	
D.3 Use of renewable energy sources, deployment of new more efficient lighting system, creation of power management system.		2	4	36	3	4
E. Greening ground port services and operations		x	x	x	x	
E.1 Greening port spaces.		1	4	21	2	
E.2 Greening port operations.		2	5	15	4	
F. Promotion of ports as testbeds for waste reuse and the circular economy				x		
F.1 Use of secondary material in production and costruction, deployment of waste-to energy facilities.				2		
F.2 Conversion of industrial and port areas.				4		
G. Enhancing transport safety and security				x		
G.1 Improvement of infrastructure resilience and deployment of measures to contain the impact of extreme weather events.				4		
G.2 Planning and implementation of measures to reduce the impact of pandemics and other sanitary emergencies						
H. Development of efficient capacity allocation and traffic management systems	x	x	x	x	x	
H.1 Further deployment of Vessel Traffic Monitoring and Information Systems (VTMIS).				4	1	
H.2 Deployment of solutions for enabling multimodal travel planning.	1	2	2	26	7	
H.3 Safe deployment of automated and autonomous maritime operations.		2	1	12	1	
I. Diffusion of innovation, data and AI for smart mobility	x	x	x	x	x	
I.1 Diffusion and integration of Port Community Systems at the port, port cluster, and national levels		1	1	6	1	
I.2 Diffusion of Maritime Single Window solutions and deployment of automated and paperless procedures and solutions				3		
I.3 Other IT solutions (rail traffic management, Iot, Blockchain, port operation)	2	4	4	9	4	

The number in the cells represent the number of projects that are associated with the corresponding topic and are planned by ports located in countries within EUSAIR.

Hence, the greener cells show the topics that are more important for ports within each area and represent possible priorities for funding for the related Calls.

The following main remarks can be derived from the table:

- The theme "Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels" is the most common in the plans of the Ports, as concerns the "Green and Smart Port" concept; more specifically, the topic **"Use of renewable energy sources, deployment of new more efficient lighting system, creation of power management system"** is associated to 49 projects in EUSAIR project, of which 28 in the "Italy-Croatia" eligible area;
- The same topic is also the most relevant for ports located in the "Italy-Slovenia" eligible area (8), "Slovenia-Croatia" eligible area (6) and "Greece-Italy" eligible area (6);
- "Deployment of solutions for enabling multimodal travel planning" is also a common specific topic in ports' plans, especially for the "Italy-Albania-Montenegro" eligible area;
- The topic "Other IT solutions (rail traffic management, IoT, Blockchain, port operation)" is the most common in the ports' plan in the "Greece-Albania" eligible area.

6. Conclusions

After having investigated:

- the ETC programmes' objectives
- the ongoing and planned projects in the region
- the trends in other initiatives in a global benchmarking

it is possible to provide an insight regarding what are the Green & Smart port scopes and themes most matching with the ETC Programmes' objectives and indicative actions. These are listed in the following table.

OPPORTUNITIES FROM INTERREG PROGRAMMES

Programmes	Scope and theme most matching with indicative actions
Italy-Croatia	Ports as green hubs - Greening ground port services and operation
Adrion; Central Europe; Croatia-Bosnia and Herzegovina-Montenegro; Greece-Albania; Greece-Italy; Greece-North Macedonia; Italy-Croatia	Ports as green hubs - Promotion of ports as testbeds for waste reuse and the circular economy
Adrion; Croatia-Bosnia and Herzegovina-Montenegro; Greece-Italy	Improving sustainability in maritime vessels operations - Creation of a comprehensive network of recharging and refuelling infrastructure
Adrion	Improving sustainability in maritime vessels operations - Improvement of the energy efficiency and reduction of emissions of vessels
Central Europe; Greece-North Macedonia	Digitalization in ports - Diffusion of innovation, data and AI for smart mobility
Central Europe; Croatia-Bosnia and Herzegovina-Montenegro; Euro Med; Greece-Italy; Greece-North Macedonia; Italy-Albania-Montenegro; Italy-Slovenia; Slovenia-Croatia	Safety in ports - Enhancing transport safety and security
Greece-Albania; Croatia-Bosnia and Herzegovina-Montenegro	Ports as green hubs - Promotion of ports as new clean energy hubs for integrated electricity systems, hydrogen and other low-carbon fuels

Finally, considering the planned projects (par 4.4) and the international trends (par 4.3), the following table summarises a list of possible actions that could be financed by ETC programmes.

POSSIBLE FUTURE ACTIONS INVOLVING PORTS

SCOPE	ACTION
Improving sustainability in maritime vessels operations	Construction of new vehicles prototypes, retrofitting of vessels
	Procurement of green vessels, greening of ports' fleets and terminal cargo equipment/facilities
Ports as green hubs	Electrification of berths and small scale investments for deposits of LNG (interim transitionary fuel), hydrogen, e-ammonia and e-methane…
	Develop harmonised guidelines for construction and operation of storage/fueling equipment and vehicles
	Support the development of low carbon multimodal transport chains
	Use of secondary materials in production and construction (e.g. dredging sand in cement production -- Aalborg Portland)
	Waste-to-energy facilities (transform hydrocarbon waste into carbon-neutral fuels to be used for integrated electricity systems
	Reconversion of industrial and port areas into eco-districts, exploring possibilities to set up ship decommissioning operations
	Provide platform for start-ups and pilot projects for further development

Digitalisation in ports / Safety in ports	Installation of new technologies such as 5G/6G, digitalisation of public administration
	Virtualisation (digital twin), Internet of Things, Artificial Intelligence, Automated/unmanned terminal operations and blockchain
	Measures to develop standardised digital data sharing to support coordinated and synchronised operations
	Solutions to set up automated and paperless procedures and speed up processes at nodes and throughout the logistics chain (incl. custom, security, phytosanitary checks etc.)
	Just in time sea traffic management to improve safety, environmental performance and efficiency of maritime transport
	Real time information systems to users for traffic management and multimodal travel planner solutions
	Enhance cyber security
	Tools and actions to improve measurement and management of waste collection and treatment, land degradation, light and visual intrusion, soil and water contamination, noise and vibration impacts, loss of biodiversity and coastal erosion

Other (connectivity, human resources, R&D)	Enhancing connectivity to islands from mainland and between islands
	Integrate Short Sea Shipping routes and Motorways of the Sea with road, rail and IWW networks
	Develop/improve hinterland accessibility to freight nodes and touristic sites
	Training activities for the improvement of human skills and competences accompanying technological evolution, ecologic, energy and digital transition
	Support the participation of ports to research and development activities to test and deploy innovative solutions, attract innovative businesses and services and qualified skills