O.3.5 CROSS-BORDER TRANSPORT SUSTAINABILITY ACTION PLAN

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1. Introduction

1.1. Aim and scope of this document

The MIMOSA project has the ambition to create the knowledge and factual preconditions for more sustainable transport in the programme area. The actions that are carried out in this framework therefore include the analysis of the demand for travel at 360 degrees as well as the conditions of supply. This document draws on the knowledge developed in the project's first deliverables to identify a possible action plan to achieve the transport sustainability objectives at the heart of the project. Due to this role, this deliverable is also a prerequisite for the subsequent carbon footprint analysis (O.3.3) and further deliverables of WP4 aiming at the definition of a cross-border transport planning model (O.4.3) and of a position paper about low-carbon technological solutions (O.4.4). The following diagram frame this document in the strict context of its direct interlinkages with other MIMOSA outputs and deliverables.

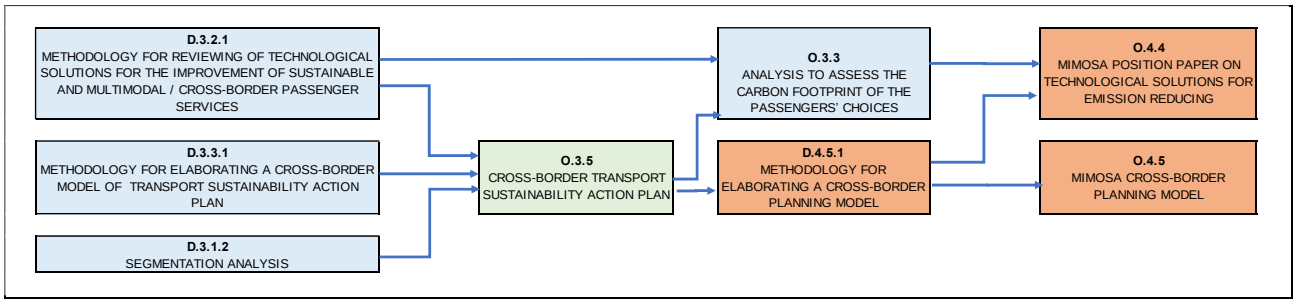

Figure 1 Interlinkages between this document, its direct premises and further steps

As the natural border between the two countries is entirely on the sea, it is obvious that a major part of the focus of this action plan is on maritime transport. The sustainability of maritime transport is, of course, a question of ship technologies, but a major role is played by the infrastructure of the passenger terminal ports and the interconnections with the coastal hinterland.

Furthermore, this deliverable (O.3.5) completely relay on the *Survey analysis for Cross-border Transport Sustainability Action Plan* which is additional separate document. The Survey analysis

document contains a detailed analysis of the existing conditions that determine most of the problems of sustainable transport between Italy and Croatia, with a significative focus on ports and maritime transport. The *Survey analysis for Cross-border Transport Sustainability Action Plan* is separate document due to complexity with in-depth analysis of the passenger terminal ports current situation.

Furthermore, the Cross-border Transport Sustainability Action Plan (O.3.5) is organised as follows. Chapter 2 presents an analysis of the present situation. It is a summary of the results of an in-depth analysis of passenger terminal ports infrastructures, passenger demands, port safety and security, environmental impact implementation for the terminal ports, cross-border passenger liner vessel used for maritime traffic in the Programme area, and cross-border maritime transportation lines with passenger flows analysis. Such analysis (available in full in a separate document: *Survey analysis for Cross-border Transport Sustainability Action Plan*) provides a snapshot of the present state with regard to environmental and social sustainability aspects. In this deliverable, main results are summarised in SWOT analysis. The study has adopted a questionnaire that can be used as a reference point for measuring the improvements that will (hopefully) take place in the coming years. As with previous deliverables, it was considered appropriate to lay the foundations for a clear and replicable methodology, so that progress could be monitored over time through new research initiatives and projects. In particular, the questionnaire that was used has a very high degree of depth, since it considers both infrastructure and the organisation of ports and their connections with the hinterland. This questionnaire is made available in its final form in the appendix of the *Survey analysis for Cross-border Transport Sustainability Action Plan*, in the hope that it will become a tool for regular and systematic use. It is a long and complex questionnaire which requires a significant effort on the part of the respondents, but the importance of the subject requires the most precise and detailed knowledge possible. In this respect, a significant difference in attitudes was noted between the various port authorities, some of which decided not to cooperate in this survey despite repeated requests. The authors of this document would like to thank all those who took the time to fill in the

questionnaire, aware that it was a demanding task in terms of the time required. We believe that this collaboration was motivated by the recognition of the importance of the actions carried out by this strategic project. We also believe that where such collaboration has not taken place, other objectives or different understandings prevailed. Elsewhere, the question arises as to the extent to which such a lack of consideration of European and macro-regional strategies is acceptable on the part of public authorities.

Chapter 3 presents the vision for Italy-Croatia transport sustainability improvement. Also, this section summarises and explains the vision of the project according to main vision at the European level, briefly outlining the documentary and substantive foundations of that vision.

By using in-depth SWOT analysis from the chapter 2, shared vision and its operationalisation provided by the goals for maritime transport main, established priorities with their importance (very important and moderately important) is presented in the chapter 4. Also, this chapter presents the gap analysis compared between the existing overall situation according to the Survey analysis with previously elaborated chapters, and the desired level of the passenger terminal port improvement by pointing three gap levels: low, medium, and high gap.

Chapter 5 presents the Action plan with Roadmap and overall policy approach. Proposed action plan elaborates description of strategies and actions for the following:

- description of ACTIONS implementing for passenger terminal in general,
- description of ACTIONS implementing on terminal services for passenger,
- description of ACTIONS implementing on safety and security of passenger terminal ports,
- description of ACTIONS for implementing of initiatives to reduce the environmental impact,
- description of ACTIONS for implementing technological solutions for the improvement of cross-border passenger liner ships,
- description of ACTIONS for implementing sustainable port accessibility and intermodal connections.

An overall policy approach presents a number of possible policy actions to guide the future development of investment in maritime and coastal transport, within the overall framework of the

analyses outlined. Furthermore, this chapter elaborates the roadmap for each strategy separate together with priority level (low, medium and high priority) and general time horizon for implementation (short term, medium term and long term) along with the following additional remarks and comments relating to the complexity (low, medium or high complexity) and financial aspect level (low, medium and high-cost typologies).

In another words, chapter 5 has a reference basis for defining an overall picture of possible types of intervention, classified according to the degree of difficulty of implementation in terms of the amount of investment and the organisational and coordination complexity of their implementation. Furthermore, it will be noted that this Action plan contains a much more detailed description of the results of the preliminary analysis of the current state than is normally found in documents of this type. The reason for this is that only through a detailed analysis is it possible to express an opinion on the real feasibility (or otherwise) of actions and measures.

Finally, the study represents a first step towards looking at the problem of sustainable transport in the North Adriatic as a whole, rather than as the sum of several separate measures. A tool helping to prioritise is adopted that underlies a logic not only based on available resources or emergencies, but on the overall picture of possible actions assessed according to their actual feasibility. The tool used (the investment/coordination matrix) has been presented in the methodology defined above (D.3.2.1 and D.3.3.1). This has the advantage of bringing together the previous analysis, which, having to provide an in-depth view, gives an inevitably fragmented picture of the actions that can be undertaken.

Before going into Chapter 2, the following paragraph summarises the drivers of actions for transport system innovation and draws the boundaries of the action plan proposed in this deliverable.

1.2. The drivers of change in transport systems

Transport is critical to the economy and society of the EU. From a functional standpoint, transportation infrastructure is a type of large-scale public work that has a significant impact on a country's politics, economy, society, science, technology development, environmental protection, public health, and national security. The most fundamental impacts of transportation-related to the physical capacity to convey passengers and goods and the associated costs to support this mobility.

Mobility is critical for the internal market and for citizens' quality of life as they enjoy the freedom to travel. Transportation promotes economic growth and job creation, but it must be sustainable in light of the challenges faced. Because transportation is a global phenomenon, effective action necessitates strong international cooperation.

The current business environment is posing new challenges to the transportation industry and maritime traffic. Ports must adapt to changing economic structures, logistics demands, and shifting travel and leisure patterns. To ensure the competitiveness of sea connections, ports must fully improve their multilateral cross-border understanding and cooperation.

Maritime transportation is made up of maritime shipping and port dimensions. Focus areas include developing a vision for the future of maritime transportation, identifying the innovative technologies, business models, and policies that will drive change, overcoming barriers to innovation, and establishing governance structures at the global and national levels to foster the innovations that our societies will require for a more sustainable and efficient future transportation system. Policy, demography & society, energy & environment, technology, economics, and finance are the six major drivers of change for the transportation system (Fig. 2).

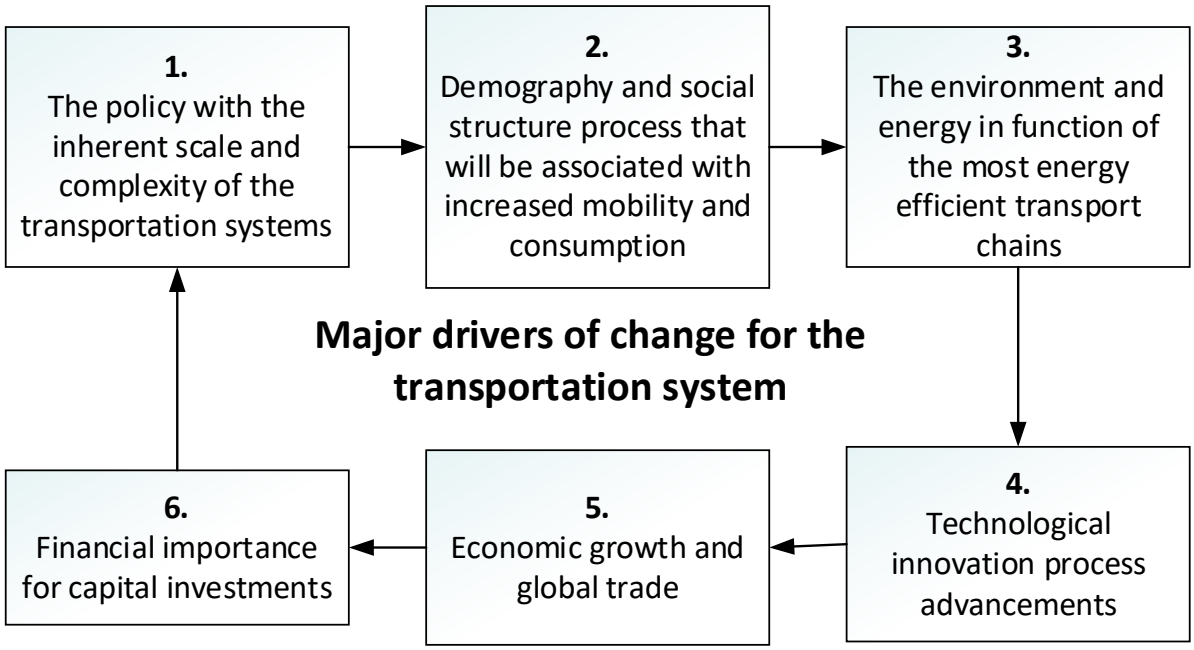

Figure 2 Major drivers of change for the future transportation system

1st driver of change - The inherent scale and complexity of transportation systems, especially when they span multiple jurisdictions, will necessitate novel governance approaches. As regulations lead to inefficient practices and unintended consequences, the role and impact of government policy are frequently subject to cycles of increasing commitments followed by various forms of retrenchment (e.g. privatization). Despite deregulation, transportation is subject to a variety of regulations concerning safety, security, and the environment. These regulations, as well as the taxation of transportation activities, increase the complexity of management and the cost burden.

2nd driver of change - Population growth is expected to continue in many parts of the world until the mid-twentieth century, a process that will be associated with increased mobility and consumption. However, in other parts of the world, such as Western Europe, North America, and Japan, rapid population aging and an increase in the number of people reaching retirement age will be associated with changes in mobility and lower levels of consumption per capita.

3rd driver of change - Issues concerning the availability of energy and raw materials, particularly fossil fuels, are likely to persist and worsen. Higher energy prices will reflect this, and because each mode has a different elasticity, the comparative advantages of modal options will shift toward the most energy efficient transport chains.

4th driver of change - Technological innovation is a difficult process to predict, and its consequences are even more difficult to assess. Technological advancements in transportation either concern management, mode (or infrastructure), or motion (engine). It is expected that information technologies (IT) will transform mobility through improved flow control and supply chain management practices. This is frequently associated with improved asset utilization and resulting productivity gains.

5th driver of change - Economic growth and global trade have been important drivers of mobility growth. However, this process is subject to growth and recession cycles, as well as credit-based consumption limits. The level of activity and structure of national economies, as well as trade patterns, have a significant impact on national and global transportation systems. Economic integration is likely to continue, favoring more comprehensive and seamless regional transportation systems. The relative cost of transportation is also linked to the viability of various supply chains and the comparative advantages from which they extract value. In the medium term, transportation costs are expected to rise.

6th driver of change - Transportation projects are becoming more capital intensive as they grow in size and technological complexity. Only the largest financial institutions, often in collaboration with the public sector, can provide an adequate level of capitalization in several cases. The value of transportation assets, as well as the revenue generated by them, are likely to be important factors in their financing.

Each one of these drivers has a role to play, both individually and collectively; the definition of a wide-ranging action plan must necessarily take into account all these drivers. For some of those drivers (policies and adoption of new technologies) it is possible to establish investment trajectories and implementation roadmaps. The other factors, although partly related to macro-

economic policy effects, are environmental macro-variables and should be understood as context parameters underlying possible scenarios. The results of the MIMOSA scenario analysis (D.3.1.4, being completed as this document is written) will be taken into account in this document, while the action plan will focus on policy actions and possible investments that specifically concern the territorial authorities of the programme area, port authorities, maritime operators and any other stakeholders.

2. Analysis of the present situation

The analysis of the present situation, as stated in the introduction chapter, is detailed and comprehensive elaborated in separate document *Survey analysis for Cross-border Transport Sustainability Action Plan* which is part of this deliverable (O.3.5). In the following chapters are visible only main outcomes from each section together with the SWOT analyses which is significant for the Action Plan.

2.1. Overview on passenger terminals

Two types of sources were used for the analysis presented in this chapter. The main instrument is a (particularly long and complex) questionnaire that was submitted to the Adriatic ports. Such questionnaire investigates a list of infrastructure parameters of the starting and ending points of all passenger transportation lines and passenger terminals, together with aspects related to passenger services, port connectivity and services in support of accessibility and multimodal mobility.

The second type of sources were public ones (databases, reports, previous studies, etc.) including data from AIS maritime datasets and maritime traffic information, and data provided by project partners and other subjects.

In Italy and Croatia there are 24 ports that provide access to cross-border travels (table 1). The Italian coast is home to 14 of the 24 ports, with the 10 remaining on the Croatian side of the Adriatic area. 14 passenger terminals on both sides of the Adriatic region in total were analysed. A minority of ports (10) decided not to answer the questionnaire despite several reminders. Even for these ports, however, it was possible to collect various data thanks to the availability of public information sources. Also, partners used this opportunity not only to collect valuable information, but also to introduce stakeholders to the project, to explain what results the project will achieve, how the information gathered from them contributes to the larger picture, and what the data

value means. Taking advantage of the opportunity to form or strengthen successful partnerships between partners and institutions.

Table 1 The List of the passenger terminal

ITALY	CROATIA
Ancona	Zadar
Bari	Dubrovnik
Cesenatico	Hvar
Civitanova Marche	Novalja
Grado	Rab
Lignano	Split
Marano	Hvar Stari Grad
Ortona	Mali Lošinj
Pesaro	Poreč
Pescara	Umag
Ravenna	
Trieste	
Vasto	
Venezia	

Furthermore, the general (basic) information regarding each passenger terminal port in *Survey analysis for Cross-border Transport Sustainability Action Plan* consists of the following analysis:

- length of the operational shore intended for international shipping,
- berth information's and ferry ramps,
- port limits determination,
- concession of economic activities,
- problems with ownerships in the port area together with special planning,
- port's conflict with urban space.

The results given in the *Survey analysis* are significant and numbers are varying for each passenger terminal. According to the *Survey analysis*, in this chapter are shown consequent results which can be presented in the SWOT analysis (Table 2).

Table 2 SWOT analysis for passenger terminal

STRENGHTS	WEAKNESSES

▪ Terminal Location – passenger terminals are located near widely known sights and they get visited by millions of tourists each year ▪ Sufficient length of operational shore and number of ro-ro ramps for existing traffic demand ▪ Sufficient general terminal infrastructure for existing traffic demand and needs	▪ Not reacting to trends quick enough (slow in decision making) due to limited cooperation between relevant government (public sector) and numerous business (private sector) port stakeholders ▪ Insufficient length of operational shore and number of ro-ro ramps for increasing of traffic demand ▪ Low possibility for terminal infrastructure area expands ▪ Conflict with urban place risking that development might be hindered
OPPORTUNITES ▪ Cooperation with other passenger ports and stakeholders ▪ Development of passenger transportation lines outside the Croatia-Italy borders ▪ Constant improvement in passenger ports ▪ EU Funding enabling upgrades ▪ Focusing on catering for different types of customers	**THREATS** ▪ Low financial investments ▪ Congestion in administration and legislative regulations ▪ Situations like COVID which we witnessed can seriously impact throughput

The concept of a seaport is traditionally defined as a transit area, a gateway through which goods and people move from and to the sea. Passenger ports come in various sizes and functions and cannot be narrowed down simply to the geographical notion of a delimited spatial area. Despite the fact that some ports may benefit from shelter policies enacted by regional or national government agencies, passenger seaports generally operate in an efficiency-driven, competitive, and highly dynamic market environment.

To examine the efficiency of a passenger terminal as well as the entire port system within a maritime state, it is better to observe the port as a multi-layered entity and to examine both the external and internal factors affecting port activity within its immediate as well as wider

environment, to examine its business operation, results, and more or less strong conjunction of its business operation micro and macroscopic.

In today's seaborne passenger transportation, a distinction should be made between passenger liner service and tourist shipping service. Passenger terminals are being integrated into a single transportation network and should be better coordinated with air, rail, and road transport to ensure the fastest possible passenger traffic. Despite that, passenger terminals should have possibility to extend port limits and general activities in function of prosperity and future development.

Further on, Adriatic ports have a great location that attracts tourists because of their location and history, which ports should capitalize on. Ports have recently discovered that mutual collaboration (through common projects such as EU-funded projects) frequently result in connections and the development of new ideas. However, due to the uncertainty of the times we live in, ports must be ready to react quickly and adjust themselves as much as possible in order to maintain the number of guests and passengers they attract – thus constant innovation and market monitoring is critical, which ports are working on as they constantly invest in both physical and human capital.

2.2. Overview on terminal services for passenger

Classic passenger ports have become modern passenger terminals with the task to meet shippers' needs as well as passengers' needs. These are terminals which function is not used up through ship accommodation, but shall be extended to ship accommodation of quality, comfort during passenger stay on terminal and efficient accommodation for means of other traffic branches.[1]

For the proper provision of maritime public transport, it is necessary to ensure safety, regularity, reliability and comfort and to coordinate the services among them with the integrated transport

[1] Jugović, A., Mezak, V., Lončar, S. (2007). Organization of Maritime Passenger Ports, *Pomorski zbornik*. 44:1. pp. 93-104.

systems in the mainland.[2] A deeper knowledge about passenger demand is crucial to stimulate behavioural change, with the ultimate aim of increasing tourism transport sustainability.[3]

According to the in-depth *Survey analyses for Cross-border Transport Sustainability Action Plan*, this deliverable has therefore considered the services provided into passenger terminals, in order to highlight strengths and weaknesses of the present overall offer. Several aspects have been taken into consideration for the analysis:

- reception and waiting facilities,
- boarding equipment,
- luggage storage and handling facilities,
- travellers' management systems
- information boards and displays,
- bus & railway timetables information,
- real-time information systems & route planner,
- multilingual information,
- maps of origins / destinations with relevant sites,
- basic country-based information (rules, emergency numbers, relevant contacts…)
- app-based / QR-based services,
- accessibility and ticket integration,
- connectivity and multimodality facilities
- facilities or services for passengers with reduced mobility,
- play areas for children,
- car gas stations,

[2] Transport Development Strategy of the Republic of Croatia (2017 - 2030), Ministry of the Sea, Transport and Infrastructure, Croatia, 2017

[3] Scuttari, A., Isetti, G. (2019). E-mobility and Sustainable Tourism Transport in Remote Areas, ZfTW, Vol. 11: (2). pp. 237-256.

- recharge points for electric vehicles,
- other customer service facilities. (Free WI-FI, charging plugs, ATM, restaurants, shops, exchange office, etc.).

The analysis led to the main results that are summarised in the following table (Table 3).

Table 3 SWOT analysis for service improvement of sustainable and multimodal/cross-border passenger terminal ports in function of passenger demands

STRENGTHS	**WEAKNESSES**
▪ Appropriate conditions for ticket sales and buying tickets on site ▪ International passenger terminal/ports in vicinity of the larger city area with minimum service activities ▪ International passenger terminal/ports in vicinity of the tourist attractions	▪ Deficiency of specific port infrastructure and equipment in function of passenger demands and comfort (proper boarding equipment, passenger short-stay accommodation facilities, luggage management system, sanitary facilities, etc.) ▪ Lack of adequate service activities/infrastructure inside the Port area or in vicinity (passenger long-stay accommodation facilities, food facilities, Rent a car/bike, etc.) ▪ Lack of facilities/services for passengers with reduced mobility and children ▪ Lack of communication services through ICT integration which support interoperability (Free Wi-Fi availability, ICT tools for providing adequate real-time information for the passenger, on-line ticket purchasing, etc.)
OPPORTUNITIES	**THREATS**
▪ Increased collaboration between ports ▪ Passenger Terminals Digitalization ▪ Investment in chargers for electric vehicles and bicycles – sustainability ▪ Improvement of multimodality in ports ▪ Use of EU fonds for investing and infrastructure/services improving	▪ Significant investments ▪ Insufficient resources for realisation of action plan ▪ Ports' obsolescence and lack of previous investments ▪ Lack of connectivity with other modes of transport

According to the SWOT analysis, for every sustainable and multimodal/cross-border passenger terminal ports it is very important to have appropriate port infrastructure and equipment in function of passenger demands and comfort (passenger short-stay accommodation facilities (resting area), proper sanitary facilities, etc.)

Furthermore, the passenger demands also require adequate service activities/infrastructure inside the Port area or in vicinity (passenger long-stay accommodation facilities, food facilities, Rent a car/bike, etc.). Also, in nowadays passenger terminal development, the specific communication services through ICT integration are necessary to support interoperability and easy real-time communication with the passengers (ICT tools for providing adequate real-time information for the passenger, on-line ticket purchasing, Free Wi-Fi availability etc.).

Aspects of medium importance that is advisable for passenger terminal in order to satisfy passenger needs are closed or open sheltered space on terminal, luggage storage space, traveller and luggage management systems, facilities/services for passengers with reduced mobility and children).

Furthermore, as medium importance, for promote sustainability in function of environmental protection, port area vicinity should have possibility for rent and infrastructure to charge of electric vehicles and bicycles.

2.3. Overview on safety and security of passenger terminal ports

Ports' safety and security features are significant factors in their sustainable development and competitiveness. Safety and health in ports is usually mandated by the International Labor Office's (ILO) code of practice[4]. According to the ILO's code of practice, special attention should be paid to ensuring the safety of passengers in passenger ports. In addition, each port should have emergency or safety plan, which should cover all types of emergencies that could occur in the port

[4] International Labour Office, ILO code of practice: Safety and health in ports (Revised 2016), Geneva, 2018

and include responses that are appropriate to the severity of the incident. Security in ports is determined primarily by the International Code for the Security of Ships and Port Facilities[5] (ISPS Code). According to the ISPS Code, ports should ensure the protection of all people (employees and passengers), as well as their facilities, from any threats (both from the sea and from the land). Therefore, it is very important to examine and analyze the level of security in the ports involved.

Several aspects have been taken into consideration for the Safety and security analysis:

- protection from adverse weather conditions,
- equipment, staff and procedures for fire prevention and firefighting,
- pollution prevention equipment, staff and procedures,
- air and water quality monitoring equipment and procedures,
- safety, health-monitoring and disease-prevention equipment and procedures,
- secured footpaths/zones,
- border security screening equipment and procedures,
- custom services,
- check-in and boarding management systems,
- vehicle access control system, traffic monitoring system,
- cyber security level.

The safety and security improvement of sustainable and multimodal/cross-border passenger terminal ports could be essential for categorizing significant factors to advocate as an analytic tool for improvement. Meanwhile, the *Survey analyses for Cross-border Transport Sustainability Action Plan* consists of the in-depth chapter regarding Safety and security improvement of sustainable and multimodal/cross-border passenger terminal ports. Furthermore, here in this chapter the

[5] International Maritime Organization, International Ship and Port Facility Security Code (ISPS Code), 2003

main outcomes regarding above-mentioned aspects of safety and security are presented through SWOT analysis (table 4).

Table 4 SWOT analysis on safety and security plan in passenger ports

STRENGTHS	**WEAKNESSES**
▪ Appropriate and sufficient firefighting, pollution prevention and medical service in vicinity ▪ Sufficient port protection against poor environmental condition ▪ Implemented port safety and security plan (according to ISPS Code)	▪ Lack of sufficient firefighting, pollution prevention and medical infrastructure/equipment with trained personnel in the port infrastructure ▪ Lack of Port safety and security plan implementation including Cyber security plan according to the latest EU Directive ▪ Lack of communication services through ICT integration which support mobility and interoperability (automated vehicle access, traffic/parking monitoring system, ICT tools for providing adequate traffic information, ICT security management system, etc.) ▪ Lack of appropriate custom facility inside the passenger terminal under Custom's Administration legislative with adequate equipment (e.g., check-in system and boarding process with passenger/luggage screening and inspection possibility)
OPPORTUNITIES	**THREATS**
▪ Automated vehicle access control and traffic monitoring system implemented ▪ Sea, air and environmental pollution monitoring and surveillance ▪ Training and evaluation of employees for providing first aid, firefighting, pollution prevention and security protection ▪ Investment in secured ICT systems for facilitation and automation of processes – sustainability ▪ Invest in the decision process systems with data storage and technical analyses in function of collecting data regarding to port safety and security	▪ Natural hazards ▪ Criminal activity ▪ Cyber security attacks ▪ Health issues ▪ Environmental impacts ▪ Equipment, system, and service failure

A significant part of the security and safety requirements still seems to need further development. The Survey analyses for Cross-border Transport Sustainability Action Plan and this SWOT analysis provide evidence of significant threats as for natural and health hazards, criminal activity and overall environmental impact.

2.4. Overview on the state of implementation of initiatives to reduce the environmental impact

The improvement of coastal and transport services between destinations implies ports and their respective areas as an essential link in transport process. Together with established intermodality and recognised passenger demands, the development of environmental impact procedures of a particular port acts as a key indicator of port's sustainable development in terms of reduction of pollution in any form.

Certain initiatives and procedures taken by port areas and respective stakeholders are necessary to develop and maintain the port system in a sustainable and environment-friendly means. The common denominators of all actions, initiatives and procedures are the activities towards *pollution reduction*, and the mitigation of *potential environmental impact* which appears in function of the transport process and all related services. Our study dealt also with the status of implementation of environmental impact procedures and/or initiatives in ports' services and operations. The procedures/initiatives taken into consideration are the following:

- alternative energy production,
- alternative fuels / low sulphur bunkering,
- circular economies,
- climate initiatives,
- cold ironing,
- efficient vessel handling,
- emissions inventories,

- emissions monitoring,
- energy management system,
- environmental plan,
- environmental report,
- environmental risk management,
- footprint assessment,
- key environmental performance indicators,
- life cycle assessment,
- vessel impact-related incentives,
- vessel impact-related port dues / penalties

The analyses consist of two parts. The first part refers to the overview of a particular procedure representation, providing also insights in procedures' implementation in general. Most represented and least represented procedures were identified here as well. The second part of analysis deals with the representation of procedures as taken by a particular port, giving insights into ports' engagement towards pollution reduction activities. This part is included in the separate document *Survey analysis for Cross-border Transport Sustainability Action Plan*. The overall results are, as usual, summarised in the final section through a SWOT analysis representation.
In Table 5, the status of particular procedure/initiative between ports is presented, referring to the reduction of the environmental impact. The possible answers are 'Yes' (particular procedure/initiative taken), 'No' (particular procedure/initiative not taken) and N/A (the particular port authority did not specify the status on a specific procedure).

Table 5 Status of particular procedure/initiative implementation between ports

Procedure/Initiative	Status		
	Yes	No	N/A
Alternative energy production	2	11	0
Alternative fuels / low sulphur bunkering	2	11	0
Circular economies	3	9	1
Climate initiatives	4	9	0
Cold ironing	4	9	0
Efficient vessel handling	5	5	3
Emissions inventories	4	9	0
Emissions monitoring	4	9	0
Energy management system	5	6	2
Environmental plan	5	8	0
Environmental report	4	7	2
Environmental risk management	5	6	2
Footprint assessment	5	7	1
Key environmental performance indicators	3	8	2
Life cycle assessment	1	9	3
Vessel impact-related incentives	1	12	0
Vessel impact-related port dues / penalties	0	13	0

In Figure 3, an overview of the level of implementation of a particular procedure within ports is briefly presented from the *Survey analysis for Cross-border Transport Sustainability Action Plan.*

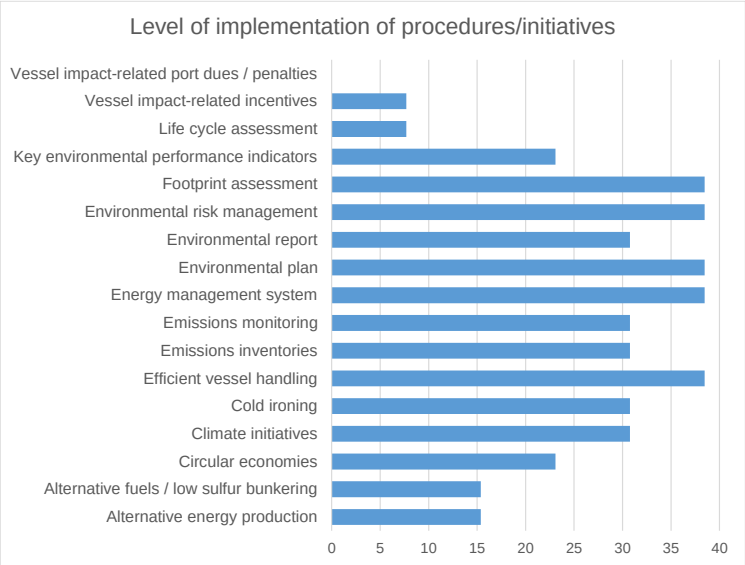

Figure 3 Overview on the level of implementation of procedures/initiatives for the reduction of environmental impact (in %)

The most represented procedures (with share of 38 %) refer to *footprint assessment*, *environmental risk management*, *environmental plan*, *energy management system*, and *efficient vessel handling*. Procedures related to *environmental report*, *emissions monitoring*, *emissions inventories*, *cold ironing* and *climate initiatives* are represented with the share of 31 %. *Key environmental performance indicators'* and *circular economies'* procedures are represented with the share of 23 %, while procedures related to *alternative energy production* and *alternative fuels / low sulphur bunkering* are represented with the share of 15 %. The procedures related to *vessel impact-related incentives* and *life cycle assessment* are represented by only one port (8 %).

The underrepresentation of procedures is presented in Figure 4. The least implemented procedures refer to *vessel impact-related port dues/penalties* (share of 100 %), *vessel impact-related incentives* (share of 92 %), *alternative fuels/low sulphur bunkering* (share of 85 %), and *alternative energy production* (share of 85 %).

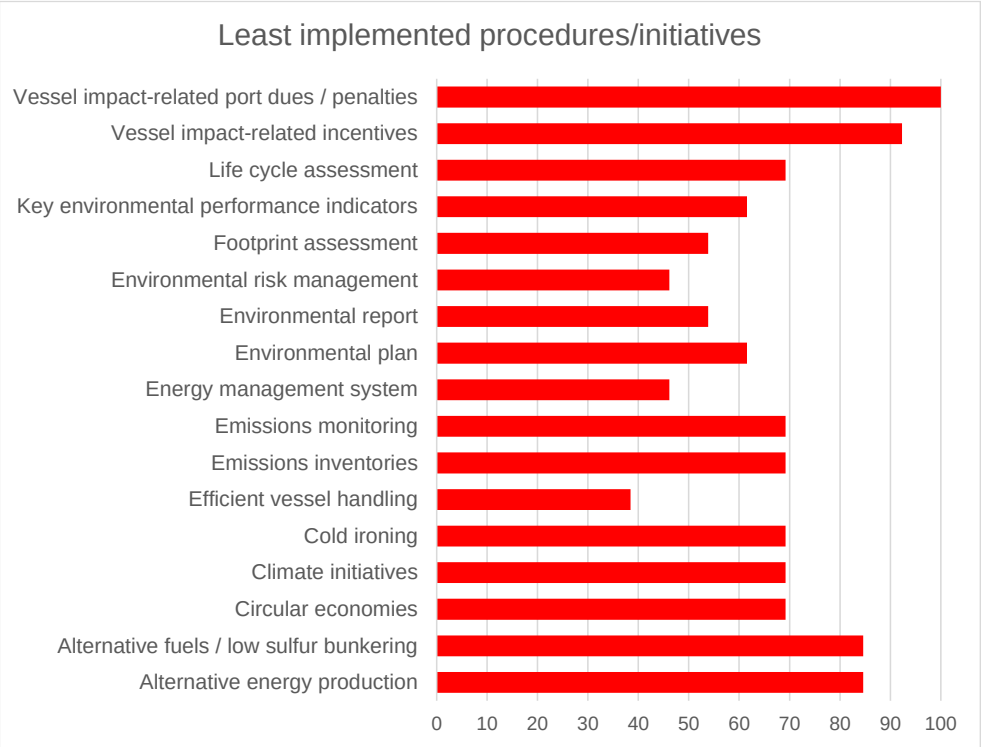

Figure 4 Least implemented procedures/initiatives (in %)

Another important goal is to ensure that the environment is safe for human life and health. Seaports and passenger liner shipping have an unavoidable impact on the atmosphere, hydrosphere, and the land.

Passenger vessels are one of the major sources of environmental pollution, posing the greatest threat to the marine environment. The lack of regulation has a direct impact on the environment, as well as the efficiency of not only the port and transportation industries, but also the overall economy. Even on short voyages, passenger liner vessels generate a surprising amount of waste, which must be stored on board until the next port of call. Meanwhile, the way ship waste is handled at the passenger terminal/port is critical.

Nowadays, there are lot of national, regional, and international legislation that lays out the rules for the proper processes. Ship waste is governed at the international level by the International Convention for the Prevention of Pollution from Ships 1973, as amended by its 1978 Protocol

(hereafter MARPOL)[6]. As a result, a preventive regime has been developed that strictly regulates harmful substances (including wastes) while at sea, limiting discharges into the marine environment[7]. Directive (EU) 2019/883 on Port Reception Facilities for Ship Waste Delivery repealed Directive No. 2000/59/EC in June 2019. The obligation to provide adequate port reception facilities is given significant weight in this Directive. Directive (EU) 2019/883 provides an important opportunity to assess the integration of ship waste management into broader EU waste legislation and national waste management plans.

Table 6 Ships' waste removal options among interviewed ports

	ANCONA	RAVENNA	PESARO	CIVITANOVA MARCHE	UBROVNI	ZADAR	ALI LOŠIN	NOVALJA	RAB	POREČ	PULA	SPLIT	UMAG	ROVINJ
General waste collection equipment	Sorting	Sorting	Sorting	Differentiated	Sorting	Common	Sorting	Common	Common	Separated	Sorting	Common	Common	Sorting
Possibility to accept ship waste	Sorting	Sorting	Sorting	Differentiated	Sorting	Common	Sorting	Common	Common	Separated	Sorting	Common	Common	Sorting
Sufficiency of reception devices for ship waste	Sorting	Sorting	Sorting	Differentiated	Sorting	Common	Sorting	Common	N/A	Separated	Sorting	Common	Common	Sorting
Capacity of receiving devices for ship waste (in m3)	N/A	N/A	N/A	It is not currently present in the passenger boarding / disembarkation area	No limit	Various	1,1	120	General 5 m3, sorted 3 m3 (3 x 3)	Municipal Waste 1 m3, Plastic Waste 1 m3, the rest as needed	25	7 m2	Communa l truck capacity	Up to 3 m3
Sufficiency of receiving devices for waste oils and oily wate	Sorting	Sorting	Sorting	Differentiated	Sorting	Common	Sorting	Does not exist	N/A	In common	Sorting	Does not exist	Sorting	Common
Capacity of receiving devices for waste oils and oily waters (in m3)	N/A	N/A	N/A	N/A	100 m3 per day (5,7,10,17 ,25 m3)	N/A	1,5	N/A	oil 1 m3	0,5	20	None	300l	500 l

Conducted analyses and consequent results on environmental impact procedures led to several findings, which can be presented in terms of SWOT analysis (Table 7).

[6] https://www.imo.org/en/OurWork/Environment/Pages/Garbage-Default.aspx
[7] https://jshippingandtrade.springeropen.com/articles/10.1186/s41072-020-00068-w

Table 7 General SWOT analysis based on results: reduction of environmental impact

STRENGTHS	WEAKNESSES
▪ Cooperation between stakeholders ▪ Initiatives towards pollution reduction ▪ Starting development of procedures according to new regulations	▪ Lack of environmental procedures and initiatives towards pollution reduction, and the mitigation of potential environmental impact which appears in function of the transport process and all related services inability of particular procedures ▪ Lack of environmental' s infrastructure facilities and/or organisational reception aspect for ship waste (Garbage Management), waste oils and oily water, ballast water sediments, air pollution, etc.) ▪ Unprepared for implement of alternative energy production and alternative fuel deliverable according to new environmental regulations
OPPORTUNITIES	**THREATS**
▪ Enhanced collaboration between international passenger terminal ports in the Programme area ▪ Implementation of environmental procedures which will lead to environmental impact during all port operations ▪ Incentives and initiatives towards ship owners ▪ Knowledge transfer between stakeholders ▪ Developing of the decision process systems with data storage and technical analyses in function of collecting environment data ▪ Supporting and developing port environmental infrastructure in road transportation (eCar or eBike rent together with adequate chargers) in function of reduction of environmental impact	▪ Unpreparedness of particular ports towards environment sustainable actions ▪ Complexity of particular procedures and initiatives ▪ Insufficient resources for realisation of procedures

The path towards the vision related to the reduction of the environmental impact is set, as elaborated in the analysis, through the respective initiatives, proper infrastructure and procedures

required in order to reach a satisfactorily level of measures for pollution reduction and the potential environmental impact mitigation.

2.5. Overview on technological solutions for the improvement of cross-border passenger liner ships

Passenger ships are defined as a ship carrying more than 12 passengers (SOLAS (I/2)[8]. Furthermore, passenger transportation is based on national or international voyages. Passenger ships in international voyage must comply with all relevant International Maritime Organization (IMO) standards, including safety regulations in Safety of Life at Sea (SOLAS) Convention and requirements for the prevention of pollution from ships together with Load Lines Convention regulations[9]. Nevertheless, national passenger ships also play a crucial role for passenger movement while the regulations for passenger ship safety in IMO's SOLAS Convention do not generally apply to passenger ships on domestic voyages, but many countries base their regulations on the IMO standards.

Generally, passenger liner ship consists of four main types: a) Coastal liner passenger ship, b) Ro-ro passenger ship (Ferry), c) High-speed passenger craft (HSC), and d) Passenger-cargo ship[10]. Details on these four types of vessels can be found in the separate document *Survey analysis for Cross-border Transport Sustainability Action Plan*, while the overall characteristics of the passenger vessels operating between Italy and Croatia and islands are summarized in table 8. The parameters noted in the table are relevant to the overall efficiency of the propulsion, the power required and the behaviour of the ship in the various possible sailing conditions, not least the effects of adverse weather conditions (e.g.: adverse effect of the wind when maneuvering the ship

[8] International Maritime Organization (IMO). (1974/2011). *International Convention for the Safety of Life at Sea* (SOLAS I/2), with amendments. London: IMO.
[9] Frančić, V., Njegovan, M. & Maglić, L. (2009) Safety analysis of passenger ships in domestic voyages. *Scientist Journal of Maritime Research*. 23(2). Pp. 539-555.
[10] Jugović, A., Mezak, V., Lončar, S. (2006) Organization of Maritime Passenger Ports. *Journal of Maritime and Transportation Sciences.* 44(1). pp. 93-104.

due to the large surface areas in relation to the small draft). Age itself is related to overall efficiency and environmental impact.

Table 8 Main features of passenger vessels

Vessel	Gross Tonnage - GT	Length Over All - LOA [m]	Ship's Beam [m]	Draft [m]	Speed [knots]	Age (In 2021.)
Coastal Liner						
LARA	229	38	6.4	1.69	16.5	33
POSTIRA	335	45	8.1	3.00	13.9	61
PREMUDA	347	45	8.2	2.42	13.0	64
TIJAT	191	38	7.0	2.23	12.4	66
Coastal Liner average age						**56**
Short & medium distance RO-RO Passenger Vessels						
HANIBAL LUCIĆ	1387	50	12.8	3.10	12.5	27
MATE BALOTA	1500	65	13.4	2.84	11.0	32
BARTOL KAŠIĆ	2296	65	13.8	3.20	13.5	31
PETAR HEKTOROVIĆ	6721	91	18.0	3.80	15.8	31
VLADIMIR NAZOR	1686	88	14.0	3.00	11.5	34
RO-RO Passenger Vessels average age						**31**
Long distance RO-RO Passenger Vessels						
DUBROVNIK	9795	122	18.8	4.82	20.0	41
MARKO POLO	10325	129	19.6	5.78	19.5	47
ZADAR	9487	116	18.9	5.14	16.5	27
AURELIA	21518	148	25.4	5.80	20.0	41
Long distance RO-RO passenger vessels average age						**39**
High-speed passenger craft (**HSC**)						
SAN FRANGISK	395	35	11.3	2.15	46.00	32
ZENIT	391	37	11.3	2.00	35.00	31
SAN PAWL	389	35	11.5	2.05	46.00	31
FIAMMETTA M	172	31	6.7	1.54	33.00	32
SPEED CAT 1 (ex. Adriatic Jet))	338	42	10.6	1.68	34.00	19
PRINCE OF VENICE	369	40	15.6	2.01	27.00	32
NAUTILUS (ex. Don Paolo)	391	47	7.6	1.26	35.00	31
SOFIA M	242	38	7.0	3.00	31.50	11
Long distance RO-RO passenger vessels average age						**27**

Conducted analyses and consequent results on passenger liner vessels led to several findings, which can be presented in terms of SWOT analysis (Table 9).

Table 9 General SWOT analysis based on results: reduction of environmental impact

STRENGTHS	**WEAKNESSES**
▪ Support sustainable multimodal transport planning in function of decrease road traffic ▪ Relatively short transportation lines between Cross-border area ▪ Established transportation with RO-RO passenger vessels and HSC	▪ Low connections between Cross-border area ▪ Minimum passenger transportation lines between the ports in the Adriatic area ▪ Very old average passenger vessels in the Cross-border area (Marco Polo – 47 years) ▪ Very old fleet average in the Cross-border area (27.38 years in average for HSC and 39 years in average for RO-RO passenger vessel) ▪ Strong pollutant according to the propulsion system, fuel in use and ship construction ▪ Lack of communication systems together with data storage and technical analyses in digitalization and automation
OPPORTUNITIES	**THREATS**
▪ Enhanced collaboration between ports ▪ Shipowner's knowledge transfer ▪ Raising awareness of transportation modality ▪ Establishment of new transportation lines according to passenger needs between Cross-border area	▪ Unpreparedness of particular shipowners due to environment legislation ▪ Complexity of particular procedures and initiatives ▪ Insufficient resources for realisation of procedures

Creating the sustainable organizational culture of cross – border maritime passenger liner shipping requires adherence to renewed vision statements. Since the cross – border area of Italy and Croatia consists of the Adriatic Sea in its full entirety, this leads to the conclusion that maritime passenger transport is the focus point for the creation of renewed vision statements. Although maritime passenger transport consists of maritime passenger liner shipping and passenger ports, passenger liner ships are considered the backbone transportation entities of the Italy – Croatia cross – border area because they are the direct means for shaping passenger flows intensity.

The most effective way of achieving renewed vision statements for sustainable transitions in the maritime passenger transport domain of the Italy – Croatia cross – border area is to assess the existing passenger liner ships in terms of contemporary technological innovation. The reason for this is that the implementation of technological innovation in general, and in ships in particular, is closely linked with sustainable development and growth, and therefore will have an essential role in the future development of the cross – border area.

Technological innovations in ships have to be based on the current operational practices of the Italy – Croatia cross – border area fleet while taking into account economic, social and environmental criteria. The economic criteria encompass decoupling of financial growth from social and environmental externalities by achieving social inclusivity (e.g., affordable ticket prices), and ecological preservation (e.g., utilization of lower carbon content fuels). The social criteria encompass ship infrastructure safety and security design in terms of mobility elements of (vulnerable) passenger groups. The ecological criteria encompass eco – efficient ship design in terms of hull shape, engine type, fuel type, propulsion and information – communication technologies use as well. Passenger liner ships have to be technologically designed in a way that will alleviate the negative consequences of passenger self – organization in terms of excessive car use, which means that ship design has to be passenger centric and focus on creating multimodality with other environmentally friendlier modes of transport such as bicycles for achieving social inclusivity.

2.6. Overview on port accessibility and intermodal connections

A resilient, up-to-date, high performance multimodal transport infrastructure is considered as a precondition for sustainable and smart transport and mobility[11]. Port accessibility, as well as

[11] European Commission: Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Sustainable and Smart Mobility Strategy – putting European transport on track for the future
COM/2020/789 final, Brussels, 9.12.2020

transport nodes connectivity in general, has a significant impact on environmental aspects to the extent it might be the driver of the diffusion of more sustainable travel behaviours, and of the reduction of car dependency in particular.

Numerous factors such as geographical location and features, port categorization, type, can influence available connectivity and services. International, regional, or national importance usually reflects in available transport infrastructure or prospects for further development. Alignment with, or proximity and importance on or near a corridor node under Trans-European Transport Network (TEN–T) contributes as well.

The importance of road transport for transfer of freight and passengers and its dominance and negative impact on sustainability is area of great research. Some of the negative effects include mission greenhouse gas emission (GHG), traffic congestion, increased energy consumption, air pollution and noise[12]. The efforts and strategies for reduction of negative effects are numerous and among others include improved traffic management, zero-emission goals and change of transport modes and patterns. Still, road infrastructure is a necessity, especially in ports where other transports networks are not so well developed or not existents.

In the presented analysis in function of Cross-Border Transport Sustainability Action Plan, connecting land infrastructure and accessibility have been evaluated in terms of road and rail infrastructure, available parking areas, boarding areas for passengers and vehicles. The availability and proximity of connections for various transport modalities from and to a port and services to reach them as well. Specifically, the parameters taken into consideration are the following (details can be found in the *Survey analysis for Cross-border Transport Sustainability Action Plan* document)

- connection to local road / both local and fast road,
- number of lanes of connecting roads,

[12] Shen, Y., Bao, Q. and Hermans, E., 2020. Applying an Alternative Approach for Assessing Sustainable Road Transport: A Benchmarking Analysis on EU Countries. Sustainability, 12(24), p.10391.

- road conditions,
- toad traffic and port influence on road congestion,
- parking spaces availability,
- parking management (fares, stay length, etc.),
- passenger waiting areas & vehicle waiting areas,
- port proximity to railway and bus stations
- availability and distances from car rental, bike rental, shuttle and taxi services

The main observations and key points from the in-depth Survey analysis for Cross-border Transport Sustainability Action Plan document are stated in SWOT analysis in the following table.

Table 10 SWOT analysis of ground transportation and intermodal connections

STRENGTHS	WEAKNESS
▪ Existing land connecting infrastructure (only for Italian ports) ▪ Initiatives and improvement willingness ▪ High support through EU policies and initiatives	▪ Limited connections between sea and land transportation (road and rail connection improvement in each passenger terminal environment) ▪ Main transportation nodes without proper intermodality and environmentally awareness ▪ low or non-use of e-sharing mobility service with appropriate infrastructure ▪ First-last-mile, rental and sharing service diversity approach ▪ Lack of Decision Support System (DSS) for sustainable Smart Port accessibility in port area for all existing transport nodes (smart model consists of intelligent data systems, transparency, sustainability, open innovation, big data, artificial intelligence, blockchain, non-stop service, efficiency, and automation)
OPPORTUNITIES	**THREATS**
▪ Holistic and inter-regional planning ▪ Multimodal integration where possible and single-window solutions ▪ Increasing the awareness of intermodal possibilities in lieu of sustainability ▪ Funding under Motorways of the Sea and wider maritime portfolio	▪ Medium and long-term commitment ▪ Passenger interest for provided services and modalities ▪ Implementation phases, harmonisation, and challenges of coordination

2.7. Conclusions on overall port and connections analysis

The results of the analysis with respect to the connection of maritime transportation lines and passenger flows intensity leads to the conclusion that the Italian - Croatian maritime passenger

transportation system consists of these successive four entities: 1) Transportation hubs (passenger terminals); 2) Transportation units (passenger liner ships); 3) Transportation infrastructure (waterways, piers, berths) and; 4) Transported units (passengers).

In order for the Italian – Croatian maritime passenger transportation system to become sustainable, the aforementioned four entities have to create synergy by cooperating without compromising economic, social and ecological sustainability criteria. The following SWOT analysis presents the strategic evaluation of the possibilities for promoting sustainable maritime passenger transportation options for Italian and Croatian passenger terminal ports.

Table 11 SWOT analysis of overall maritime passenger transport for Italian and Croatian passenger terminal ports

STRENGTHS	**WEAKNESSES**
▪ Substantially developed and interconnected passenger transportation system ▪ Presence of different complementary transportation modes eases the facilitation of sustainable solutions (ship, bicycle) ▪ Potential for shared mobility options ▪ Good location and interconnectedness of ports on a national and international level ▪ Favorable weather conditions during peak passenger /tourist season (summer)	▪ Insufficient sustainability strategic dimensions ▪ Slow adaptation of sustainable business models by private and public stakeholders ▪ Lack of capital intensity for promoting sustainable multimodal infrastructure in smaller ports ▪ Underdeveloped offer of dynamic passenger/ tourist ICT ▪ Strong focus on transport unimodality (particularly the utilization of private vehicles)
OPPORTUNITIES	**THREATS**
▪ Promotion of multimodal passenger transport options can lead to infrastructure utilization flexibility and optimization ▪ Growing trend of information – communication technologies can increase port organizational capacity ▪ The willingness of the European Union to provide financial support for sustainable transitions	▪ Inability to decouple economic growth from social and ecological costs ▪ High investment rates in technological innovations (greener fuels and retrofitting) can lead to higher transportation prices,

▪ Positive trends in tourism demand side – the rise of ecotourism ▪ Potential value changes of younger passenger/ tourist generations (decrease of the utilization and ownership of private vehicles)	which can result with the lowering of passenger demand ▪ Lack of community engagement due to lack of awareness of sustainability benefits ▪ Increase in tourism demand side (overtourism) can lead to negative ecological impacts which will reflect on economic and social aspects ▪ Overtourism can lead to destruction of historical sites via accelerated pollution due to inadequate waste management

3. The vision for Italy-Croatia transport sustainability improvement

In the previous deliverable D.3.3.1 (Methodology for elaborating a cross-border model of transport sustainability action plan) the basis for the MIMOSA project vision have been presented. This section summarises and explains the vision of the project according to main vision at the European level, briefly outlining the documentary and substantive foundations of that vision.

The *Vision* adopted in the MIMOSA project foe the definition of the Action Plan of the Sustainable Transport Plan Model is embedded into the current state of the strategic priorities defined by the European Union, insofar as they are applicable or enforceable in transport between Italy and Croatia. Our vision stems both from the general development strategies dictated by the European Commission and European Parliament in a series of documents (see later) and from the strategies of the EUSAIR pillars, declined at local level in the territorial cooperation programmes (such as the Italy-Croatia programme) and implemented through the strategic programmes, of which MIMOSA is a part.

Within the frame of the EUSAIR strategy, the vision of the MIMOSA project for a cross-border transport sustainability action plan consists in creating the basis for a shared strategy in the pursuit of the environmental, social and economic sustainability of maritime and coastal transport in the programme area. The operational priorities for sustainability-oriented transport plan consist in reducing maritime transport-related emissions, reducing the car use, improving the connection to the hinterlands, islands and coastal areas.

Such vision is framed within the cornerstone strategies of the EUSAIR pillars 1 and 2 (respectively: Blue Growth and Connecting the Regions). More specifically the overall vision underlying EUSAIR strategies to which this project contributes are defined as follows: a) to improve sea basin governance, by enhancing administrative and institutional capacities in the area of maritime governance and services (pillar 1, specific objective 3); b) to strengthen maritime safety and security and develop a competitive regional intermodal port system (pillar 2, specific objective 2);

c) to develop reliable transport networks and intermodal connections with the hinterland, both for freight and passengers (pillar 2, specific objective 3).

From a more general perspective, the vision above is fully coherent with the overall context of the EU strategic long-term vision, expressed by a series of documents, among which the more significative are the following:

- The 2011 White Paper from the European Commission "Roadmap to a Single European Transport Area"[13], where the general premises are set. Among these, are mentioned: the reduction of 40% of maritime transport emissions by 2050 compared to 2005, the simplification of procedures for travellers within the "European Blue Belt", and the enhancement of safety, security, and environmental protection through the SafeSeaNet – EMSA (European Maritime Safety Agency).
- The Communication 2009-8 of the EC[14], which highlights, among the rest: the need to improve the environmental performance also through incentives & taxation measures, to support actions specifically aimed at greener shipping, technological innovation, the enhancement of short-sea transport services, the promotion of a European Environmental Management System for Maritime Transport (EMS-MT).
- The "European Green Deal" and its annex[15], which defines the agenda and the roadmap for a set of "deeply transformative policies".

[13] EC-European Commission. (2011). Roadmap to a Single European Transport Area-Towards a competitive and resource efficient transport system. *White Paper,* COM (2011 - 144 final), Brussels, 28.3.2011

[14] Strategic goals and recommendations for the EU's maritime transport policy until 2018, COM(2009-8 final), Brussels, 21.01.2009.

[15] The European Green Deal, COM(2019 - 640 final), Brussels, 11.12.2019.

- "Maritime Transport Strategic Approach of the European Union"16, and by the "Integrated Maritime Policy of the European Union" (IMP)[17]
- The strategy EC Communication 2013-295 - environmental performance improve that require long-term interventions to be implemented according to a series of strategic indications.
- Regulation (EU) 2017/352 of the European Parliament and Council of Ministers establishing a framework for port service provision and common rules on port financial transparency.

The overall framework of EU policy indications, together with the strength, opportunities, weaknesses, and threats identified in the analysis, should be considered as the ground for the operationalisation of the above stated vision into priorities.

Furthermore, the framework is also coherent with the context of the EU strategic Interreg project FORTIS which is served as an excellent example for long-term vision planning and also to promote institutional dialogue by facilitating the knowledge and exchange of good practices concerning the different legislations in the field of private and public transport, which is expressed by a series of documents among which the more significative are the following:

- Strengthening Institutional Cooperation in Cross-Border Areas through Innovative Solutions in Public Transport and Civil Motorization Procedures[18]
- Action plan for streamlining Public Transport Connections in Cross-border areas[19]

[16] https://www.europarl.europa.eu/factsheets/en/sheet/124/maritime-transport-strategic-approach (last checked: November 21st, 2020)

[17] For details about legal basis, background, objectives and achievements of the IMP see: https://www.europarl.europa.eu/factsheets/en/sheet/121/integrated-maritime-policy-of-the-european-union (last checked: November 21st, 2020)

[18] Strengthening Institutional Cooperation in Cross-Border Areas through Innovative Solutions in Public Transport and Civil Motorization Procedures, FORTIS - EU Interreg PROJECT (Italy - Slovenia), Central Initiative – Executive Secretariat, 2021

[19] Action plan for streamlining Public Transport Connections in Cross-border areas, FORTIS - EU Interreg PROJECT (Italy - Slovenia), Central Initiative – Executive Secretariat, 2020

Meanwhile, maritime transportation is made up of maritime shipping and port dimensions. Focus areas include developing a vision for the future of maritime transportation, identifying the innovative technologies, business models, and policies that will drive change, overcoming barriers to innovation, and establishing governance structures at the global and national levels to foster the innovations that our societies will require for a more sustainable and efficient future transportation system. Policy, demography & society, energy & environment, technology, economics, and finance are the six major drivers of change for the transportation system. Each has a role to play, both individually and collectively. Functional transportation system plays an important role in population mobility and creates a prerequisite for economic development among individual regions. The rise in population mobility in recent decades has also raised concerns about the long-term development of various world economies. However, the growing need to travel has negative environmental consequences, emphasizing the importance of environmental protection. Technological premise establishes the conditions for organizing, operating, and managing traffic and transportation with as little negative environmental impact as possible, thereby contributing to the development of a system of sustainable mobility. Implementing innovative technological solutions within passenger transportation processes is one option for developing transportation systems.

The proper coupling of developing the multimodal solutions and the environmental preservation must be achieved through joint actions and efforts of all related stakeholders, being General public, Local, regional and national public authorities, Enterprises, transport and multimodal logistics hubs operators, Infrastructure providers, and Transport associations. As for the environmental perseverance, several procedures and initiatives are defined in order to achieve desired effects of environmental impacts identification, mitigation and control, always in the function of the sound and stable transport sustainability action plan. The involvement of passengers as central stakeholders can be described as common actions towards meeting their needs and demands, while at the same time engaging them in the whole green transportation process, in terms of raising awareness and mitigation of their travel self-organising; In terms of

achievement of the environmental-friendly multimodal transport, the sustainability transport plan should comprise of already mentioned identification of passengers' needs, transport demands, identification of bottlenecks and low levels of connectivity between ports/terminals and countries, and the provision of wider and diverse mobility solutions.

The activities and implementation of pollution reduction procedures as well as the mitigation of potential environmental impact are present in all abovementioned action plan phases. As previously defined and elaborated, from the ports' stakeholders point of view, these activities refer to alternative energy production and alternative fuels/low sulfur bunkering, circular economies, climate initiatives, cold ironing, efficient vessel handling, emissions inventories, emissions monitoring, energy management system, environmental plan, environmental report, environmental risk management, footprint assessment, key environmental performance indicators, life cycle assessment, vessel impact-related incentives and vessel impact-related port dues/penalties. These activities are defined within the vision of activities' establishment at passenger terminals during their services and operations. However, in a certain extent, all related target groups must be involved purposefully and appropriately.

4. Priorities and gap analysis for ports and vessels

4.1. Analysis of main priorities

In this paragraph we provide a description of the divergences existing between the existing situation and the desired situation, expressed by the shared vision and its operationalisation provided by the goals for maritime transport sustainability briefly presented in the previous section of this deliverable.

- Improve port infrastructures to reduce emissions, to support multimodality, vessel technology innovation, and to ensure safety and security,
- improve connections with the hinterlands and opportunity to reduce car use,
- Improve vessels technology to increase efficiency and reduce emissions.

Of course, the development of these objectives can be done by following different types of actions. Therefore, in this section we first highlight what we consider to be the priorities for what concerns:

- passenger terminals overall improvement
- passenger terminals service improvement
- passenger terminals safety and security
- environmental impact reduction
- port accessibility and intermodal connections improvement
- passenger liner ships improvement

According to the general passenger terminal analysis, sufficient number of berths and operational shore length are crucial for maritime port infrastructure development and also for transportation line determination for sustainable action plan. Regarding to the analysis, organisational aspect in the line schedule could be implemented in function of harmonization of multimodal transport options. Large hub terminal infrastructure and their operational coast basically consists of a several RO-RO ramp for acceptance RO-RO passenger ferry. A larger number of the ro-ro ramp gives the possibility for mooring the few Ferries at the same time which gives the possibility to

enlarge organisational aspect and also organise more passenger transportation lines in function of passenger demands. Also, larger operational coast gives the possibility to enlarge the number of HSC vessel which gives the possibility for increase passenger traffic flow. In the following table priorities of actions for general passenger terminal overview is presented.

Table 12 Priorities of actions for general passenger terminal

General passenger terminal gaps	Very important	Moderately important
Adequate terminal surface area with port limits determined with possibility to expand	☒	☒
Enough ro-ro ramp for RO-RO passenger vessels	☐	☒
Interconnection for multimodal transport	☒	☐
Sufficient infrastructure terminal condition	☒	☐
Avoiding conflict with urban space	☒	☐

As for the passenger service, the organisational aspects of port surface area within the cross - border passenger terminal ports need to be restructured to achieve a harmonization of multimodal transport options. According to the passenger terminals analysis, port surface area indicators are significant predictors for future port development. Also, infrastructure expansion problems sometimes lie in potential problems on a port limit with spatial planning, and potential issues with urban space. Potential problem or gap usually arises before establishment of strict port limits or due to expanding original limits or even a change in the ownership structure or institutional model.

Nevertheless, in order to fulfil passengers' needs inside the passenger terminals from a standpoint of passenger demand, passenger terminals need to ensure safety, regularity, reliability and comfort. This study shows similarities and inequalities between each passenger terminal/ports in terms of passenger needs. Taking all into account, similarity is seen through some important advantages that all ports have in common. For example, all passenger terminal areas are close to ATMs, land gas stations but around some passenger terminals are missing important facilities

infrastructure (restaurants, coffee shops, shops, souvenir sales, accommodation, etc.). These services infrastructures and activities are very important according to the passenger demands.

Table 13 Service improvement priorities

Service gaps	Very important	Moderately important
Adequate terminal infrastructure for passengers	☒	☐
Harmonization of multimodal transport options	☒	☐
Resting area (e.g., benches availability)	☒	☐
Proper equipment for boarding passengers	☐	☒
Established Luggage storage space with proper Traveller & Luggage Management Systems	☒	☐
Appropriate conditions for ticket sales inside the terminal for the passenger line service together with possibility for bus or railway ticket service	☒	☐
Adequate facilities for passenger with reduced mobility	☐	☒
Adequate facilities for passenger with children	☐	☒
Proper sanitary facilities in the passenger terminal area	☒	☐
Proximity of important facility services and infrastructures (Bars and Restaurants, Hotel or Private accommodation, ATM, Exchange office)	☒	☐
Proper ICT infrastructures in function of passenger demands	☒	☐

Making passenger terminal ports more sustainable, need to be in accordance with economic, social, and environmental criteria but there are some system boundaries which hamper this progress. For instance, passenger terminals should encourage the use of electric bicycles and vehicles to promote intermodality with raising awareness of environmental safety, but one of the boundaries is that many ports do not have proper infrastructure (e.g., chargers for electric bicycles or vehicles).

Furthermore, the knowledge gathered from conducted analysis reveals some gaps which leave passenger terminals the possibility of improvement. The group of very important improvements in

passenger terminals/ports should be ICT improvements in function of passenger demands. For example, in order to facilitate and simplify passengers in the process of buying tickets, all ports should have appropriate conditions for tickets sales and availability of buying tickets online. Only few Adriatic passenger terminals fulfil these requirements. Another examples of ICT integration regarding to the passenger demands are: Wi-Fi free of charge, real-time information systems for passengers, schedule information/itinerary of maritime transportation lines.

An important factor in the attractiveness competitiveness and sustainable development of port and passenger terminal is the proper enforcement of safety and security features. In the following table the Priorities of actions for Passenger terminal safety and security is presented.

Table 14. Priorities of actions for Passenger terminal safety and security

Safety and Security gaps	Very important	Moderately important
Proper maritime port protection due to all weather conditions	☒	☐
Proper fire-fighting equipment	☒	☐
Proper pollution prevention equipment	☒	☐
Proper first AID equipment	☐	☒
Established Custom and Security personnel	☒	☐
Check-in & boarding management systems	☐	☒
Border & port security screening	☒	☐
Video surveillance of the port area	☐	☒
Established parking space with Automated vehicle access control and Automatic license plate reader	☐	☒
Cyber security management	☐	☒

In order for the port to be safe and protected it must first of all be planned in a location that is protected from all weather conditions and must have an evaluated and implemented quality Port Safety and Security Plan defining safety and security requirements.

During the analysis of safety and security features, a dynamics' map between actions was presented in order to simultaneously reduce safety and security risks and increase passengers'

satisfaction. For example, it turned out that most ports do not have an adequate solution for automating the process of access, monitoring and surveillance of vehicles, which is one of the key factors in the multimodality of ports. In addition, the results of the analysis showed that many ports do not have a check-in or boarding management systems, technologies for counting passengers and systems for collecting and storing passenger data, which can lead to congestion, safety risks, security breaches and finally unsatisfying passengers' demands.

The ports' safety and security analysis can be used to identify synergies and conflicts between actions to adequately protect ports from security and safety risks, especially at the cross-border level. For example, with the implementation of ICT technologies, data of interest related to safety and security can be exchanged in a timely manner between all stakeholders in order to prevent any risks and enable the smooth flows of passengers and vehicles in ports and surrounding regions. However, some actions may be in conflict. One of the top priorities in each port should be investment in secured ICT systems for facilitation and automation of processes in order to make the transport more sustainable. Another priority, looking at environmental impact, should certainly be the implementation and use of sea, air and environmental pollution monitoring and surveillance systems. The Port Authorities' answers can be used for gap analysis of actions related to safety and security in passenger terminals. Looking at the broader picture of safety and security features in ports involved, it can be concluded that the actions taken are partially met. The gaps are reflected in weaknesses presented in the analysis: insufficient personnel trained to provide first aid, firefighting, pollution prevention and security protection, congestion and crowdedness due to lack of appropriate actions and safety and security measures. However, the opportunities listed in the analysis can address these gaps to make ports attractive, competitive and long-term sustainable.

Finally, as for the environmental impact, the improvement of coastal and transport services between destinations implies ports and their respective areas as an essential link in the reduction of the environmental impact of transport. Together with established intermodality the development of environmental impact procedures of a particular passenger terminal/port acts as

a key indicator of port's sustainable development in terms of reduction of pollution and raising environmental awareness. For sustainable and environmentally friendly Cross-border Transport Sustainability Action Plan, certain initiatives and procedures taken by port areas and respective stakeholders are necessary to develop and maintain the port system.

Table 15. Priorities for environmental impact reduction

Environmental Impact	Very important	Moderately important
Alternative energy production	☐	☒
Alternative fuels - LNG	☒	☐
Alternative fuels - Hybrid	☐	☒
Alternative fuels - Electric	☐	☒
Circular economies	☒	☐
Climate change initiatives	☒	☐
Efficient vessels handling	☐	☐
Emissions inventory	☐	☒
Emissions monitoring	☐	☒
Carbon footprint	☐	☒
Water footprint	☒	☐
Environmental Risk Management	☒	☐
Definition of shared key EPIs	☒	☐

Alternative energy production refers to establishment of generation and supply of energy sources other than fossil fuels[20]. The main advantages such energy are their inexhaustibility and renewability, as well as usage of techniques which, in significantly less extent, affects the environment. In terms of alternative fuels, types of alternative energy encompass wind, solar and nuclear energy, hydrogen gas, tidal energy, biomass energy, and biofuels. Examples of renewable sources can be further listed as geothermal power, wave energy, hydroelectric energy, and solar energy. The development of means of alternative energy contributes to the particular port

[20] Inspire. (2021). Available online: https://www.inspirecleanenergy.com/

competitiveness on the market, as well as its environmental sustainability during all related operations and processes.

As per Directive 2014/94, Alternative fuels are power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport, with the potential to contribute to the transport process decarbonisation, as well as enhancement of the transport sector environmental performance[21]. According to the Directive 2014/94/EU of the European Parliament and the Council, alternative fuels denote fuels or energy sources that serve at least in part as a substitute for fossil fuels, thus including: Electrical Propulsion Energy, Hydrogen Propulsion, Biofuels and biodiesel fuel, Natural Bio-gas fuel, Liquefied Natural Gas (LNG).

Hydrogen propulsion systems have the best environmental balance but the conditions for their large-scale deployment will not be in place for at least 10-15 years. In the short term, LNG and hybrid systems are the most promising solution.

According to DNV GL analyses, the Liquefied Natural Gas (LNG) system as a shipping fuel will have most probably wider application on the passenger vessel. LNG is already widely used, especially on freighter. In addition, passenger liner ships mostly will use LNG as a fuel in the future. Presently, one of the limiting factors for ships using LNG as a shipping fuel is the insufficient number of ports with fuel supply capabilities. The European Union in Directive 2014/94 /EU of the European Parliament and the Council of 22nd October 2014 on the establishment of infrastructure for alternative fuels stated that all seaports of the basic trans-European transport network (TEN-T Core Network) should be able to supply ships with LNG by the end of 2025.

In the North Adriatic, port of Rijeka has been implemented FSRU LNG terminal at the island Krk which could be served as a LNG hub in chain of supply especially for Northern Adriatic Ports. The Port of Venice is presently developing infrastructures for LNG bunkering and will be equipped with a LNG multi-modal facility within 2023.

[21] European Commission (EC). (2014). Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure. *Official Journal of the European Union*. I. 307/1.

Hybrid propulsion systems[22] achieve lower fuel consumption and consequently lower emissions. The application of existing hybrid solutions is possible on almost all passenger ships of coastal liner shipping and does not impose any additional restrictions. The technology is fully developed and applicable to all ships with diesel-electric propulsion and even the largest ones. The biggest barrier to this solution given by significant initial investment.

A possible alternative for ships sailing on a short distance and in protected area is the full-electric propulsion mode. Of course, the emissions of an electric ship are zero but this technology provides a significantly reduced range compared to a liquid fuel propulsion.

Among means of enhancements, *circular economies* are essential, entailing gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the port system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital.

It is based on three principles:

i) Design out waste and pollution,

ii) Keep products and materials in use, and

iii) Regenerate natural systems[23].

These principles contribute to development and realisation of *climate change initiatives*, which can act on international, national, regional and local basis. In terms of ports, they refer to respective jurisdiction areas and sub-areas. Climate initiatives are defined within the Climate Action Plan[24].

Provision of *cold ironing*, i.e. supplying vessels, boats and crafts with shore-side electrical power, nowadays represents the must-have port's ability, in order to provide a comprehensive service,

[22] For example, the hybrid system is installed on the RO-RO vessels: Prinsesse Benedikte, Deutchland, Texelstroom and *Prins Richard.*

[23] Ellen Macarthur Foundation (EMF) (2019). What is a circular economy? Available online: https://www.ellenmacarthurfoundation.org/circular-economy/concept (12 Jun 2021)

[24] Bierbaum, R., Stults, M. (2013). Adaptation to Climate Change: Context Matters. *Michigan Journal of Sustainability*, 1: 15-30. doi: http://dx.doi.org/10.3998/mjs.12333712.0001.004

while at the same time maintaining control on energy consumption. Cold ironing acts as a segment of *efficient vessels handling* in a whole, thus controlling emissions from vessels in terms of *emissions inventories* and *emissions monitoring*, i.e., controlling and accounting the amount of emissions of one or more greenhouse gases and/or air pollutants into the atmosphere[25].

In pace with emissions monitoring, emerging necessary procedure represents the assessment and evaluation of the *carbon footprint*, i.e. total greenhouse gases emissions caused by the port system in a whole. Further, each port should develop and improve an *energy management system* (EMS) to monitor, control, and optimize the performance of the generation or transmission system. In terms of ports, which are mainly characterised by microgrids, the EMS utilisation is oriented on a particular, limited area, and therefore it is considered as highly feasible.

Environmental component of port's master plan simultaneously encompasses the *environmental plan*, *environmental reports* and *environmental risk management* (ERM). All these initiatives, desirably prepared interconnectedly, serve as a means of control and precautionary actions on mitigation of external impacts of the ports' surrounding areas.

Another key element is quantification and mapping of green, blue and grey water footprints in a particular port area. The water footprint of a port system can be defined as the total volume of freshwater that is used to produce the goods and services consumed by the individual or community[26]. In these terms, the corresponsive port sets both the achievement of sustainable water management within their operations, as well as raises awareness on water sustainability towards all customers and stakeholders in the transportation process.

Among variety of determination means of the *key environmental performance indicators* (EPI), several categories can be distinguished: i) emissions to air, ii) emissions to land, iii) emissions to

[25] United Nations Climate Change (UNCC). (2008). National Inventory Submissions 2008. Available online: https://unfccc.int/ (12 Jun 2021)

[26] Hoekstra, A. Y. et al. (2012). The Water Footprint Assessment Manual: Setting the Global Standard. London: Earthscan.

water, and iv) resource use[27]. EPIs represent means and ways of assessment of environmental outcomes and/or impacts emerging from port operation. This approach can be further supplemented and enhanced with additional *life cycle assessment* (LCA) methodology[28], assessing cumulative potential environmental impacts of port services, operations, and the consequent effects of all processes to the environment.

The assessment of environmental impact procedures provided insights into identifying synergies and conflicts between actions. Although possible, the coordination and cooperation between stakeholders (particularly port authorities) is not present, at least not in this phase and in a desired extent. However, it represents sound opportunity for further actions.

4.2. Gap analyses in function of ports' improvement

This section is dedicated for synthetizing the main outcomes of the SWOT analysis carried out for each of the drivers analysed with reference to the main highlighted weaknesses.

Furthermore, general indications in the comparison between the existing overall situation according to Survey analysis and the desired level of the passenger terminal port improvement are visible in the following tables. The comparison is based on three gap levels: low, medium, and high gap.

Table 16 Gap analysis for the passenger terminals in general

Gap analysis for the passenger terminals in general	Gap level
Not reacting to trends quick enough (slow in decision making) due to limited cooperation between relevant government (public sector) and numerous business (private sector) port stakeholders	Medium gap
Insufficient length of operational shore and number of ro-ro ramps for increasing of traffic demand	Medium gap

[27] Department for Environment Food and Rural Affairs (DEFRA). (2006). Environmental Key Performance Indicators. London: DEFRA.

[28] Vujičić, A., Zrnić, N., Jerman, B. (2013). Ports Sustainability: A life cycle assessment of Zero Emission Cargo Handling Equipment. Journal of Mechanical Engineering, 59(9): 547-555.

Conflict with urban place risking that development might be hindered together with low possibility for terminal infrastructure area expands	High gap

The highest gap between existing stage and desired improvement level for the Cross-border area lies in conflict with urban place which leads directly to the low possibility for terminal infrastructure area expands. Due to the territory conflict, the extend of operational shore and number of ro-ro ramps for increasing of traffic demand are limited. In smaller ports without increasing of the passenger flow, the existing operational shore length and capacity are sufficient and marked with medium gap. Furthermore, in most passenger terminal ports are limited cooperation between relevant government (public sector) and numerous business (private sector) port stakeholders. Also, without proper established communication between these sectors/stakeholders, potential problem or high gap usually arises before establishment of strict port limits or due to expanding original limits or even a change in the ownership structure or institutional model.

Table 17 Gap analysis for service improvement of sustainable and multimodal/cross-border passenger terminal ports in function of passenger demands

Gap analysis for service improvement of sustainable and multimodal/cross-border passenger terminal ports in function of passenger demands	**Gap level**
Deficiency of specific port infrastructure and equipment in function of passenger demands and comfort (proper boarding equipment, passenger short-stay accommodation facilities, luggage management system, sanitary facilities, etc.)	Medium gap
Lack of adequate service activities/infrastructure inside the Port area or in vicinity	Low gap
Lack of facilities/services for passengers with reduced mobility and children	High gap
Lack of communication services through ICT integration which support interoperability	High gap

The highest gap between existing stage and desired level in the Cross-border area for service improvement of sustainable and multimodal/cross-border passenger terminal ports in function of passenger demand lies in lack of communication services through ICT integration which support interoperability. According to the Survey analysis, the ICT improvement is based on very important passenger demands, e.g., Wi-Fi availability, ICT tools for providing adequate real-time information for the passenger, on-line ticket purchasing, etc.). Furthermore, the passenger terminals and their infrastructure are not prepared for the passengers with reduced mobility and children, consequently marked with high gap.

The medium gap between existing stage and desired level lies in deficiency of specific port infrastructure and equipment in function of passenger demands and comfort. Only a few large terminals have proper boarding equipment, passenger short-stay accommodation facilities, luggage management system, sanitary facilities, etc., but smaller ports can be improved. Furthermore, due to the city area in vicinity, most of the international passenger terminal ports have minimum but adequate service activities/infrastructure (e.g., passenger long-stay accommodation facilities, food facilities, rent a car/bike, etc.), consequently marked with low gap.

Table 18 Gap analysis for safety and security of passenger terminal ports

Gap analysis for safety and security of passenger terminal ports	Gap level
Lack of sufficient firefighting, pollution prevention and medical infrastructure/equipment with trained personnel in the port infrastructure	Medium gap
Lack of Port safety and security plan implementation including Cyber security plan according to the latest EU Directive	Medium gap
Lack of communication services through ICT integration which support mobility and interoperability	High gap
Lack of appropriate custom facility inside the passenger terminal under Custom's Administration legislative with adequate equipment	Medium gap

The highest gap between existing stage and desired level in the Cross-border area for safety and security of passenger terminal ports lies in communication services through ICT integration which

support mobility and interoperability. For the safety and security improvement, highest gap is visible in lack of automated vehicle access, traffic/parking monitoring system, ICT tools for providing adequate traffic information, ICT security management system, etc.

The medium gap lies in lack of sufficient firefighting, pollution prevention and medical infrastructure/equipment with trained personnel in the port infrastructure. Nevertheless, few smaller passenger terminal ports completely rely on the outsources government or private services outside the port limit area without needs for proper trained personnel in this sector. Furthermore, mostly passenger terminal ports have adequate Port safety and security plan, but limited number of ports have implemented Cyber security plan according to the latest EU Directive, consequently marked with medium gap.

According to safety and security inside passenger terminal ports lack of appropriate custom personnel and facility inside the passenger terminal under Custom's Administration legislative with adequate equipment are missing (e.g., check-in system and boarding process with passenger/luggage screening and inspection possibility). Most of the smaller passenger ports completely rely on outsource government personnel (Police and Custom's Administration) for checking and inspection when the passenger liner ship is arriving according to the itinerary, consequently marked with medium gap.

Table 19 Gap analysis in implementation of initiatives to reduce the environmental impact

Gap analysis in implementation of initiatives to reduce the environmental impact	**Gap level**
Lack of environmental procedures and initiatives towards pollution reduction, and the mitigation of potential environmental impact which appears in function of the transport process and all related services inability of particular procedures	High gap
Lack of environmental' s infrastructure facilities and/or organisational reception aspect for ship waste (Garbage Management), waste oils and oily water, ballast water sediments, air pollution, etc.)	High gap
Unprepared for implement of alternative energy production and alternative fuel deliverable (e.g., LNG fuel. cold ironing implementation, wind/solar/hydrogen/tidal/biomass energy, etc.)	High gap

According to the Survey analysis and significant change in future environmental legislation, all stages of implementation initiatives to reduce the environmental impact have a high gap in the Cross-border area for the passenger terminals.

Table 20 Gap analysis on technological solutions for the improvement of cross-border passenger liner ships

Gap analysis on technological solutions for the improvement of cross-border passenger liner ships	Gap level
Very old passenger liner ships together with very old fleet in the Cross-border area	High gap
Passenger liner ships as a strong pollutant according to the propulsion system, fuel in use and ship construction (unpreparedness of particular shipowners due to environment legislation)	High gap
Limited passenger liner service (low connections) in Cross-border area according to passenger demand	Medium gap
Lack of decision process systems with data storage and technical analyses in digitalization and automation	High gap

According to the significant change in future environmental legislation, passenger liner ships also have a significant high gap between existing stage and desired development level in technology, construction, fuel in use, etc.

Furthermore, due to the Survey analysis, the existing passenger liner service in the Cross-border area are limited according to the passenger demands. Nevertheless, in Survey analysis a constant increase of passenger traffic flow is visible, consequently marked with medium gap.

Table 21 Gap analysis on port accessibility and intermodal connections

Gap analysis on port accessibility and intermodal connections	Gap level
Limited connections between sea and land transportation (road and rail connection improvement in each passenger terminal environment)	Medium gap
Main transportation connecting nodes without proper intermodality and environmentally awareness	Medium gap

Low or non-use of e-sharing mobility service with appropriate infrastructure	High gap
First-last-mile, rental and sharing service diversity approach	High gap
Lack of DSS for sustainable Smart Port accessibility in port area for all existing transport nodes	High gap

The highest gap between existing stage and desired level in the Cross-border area for port accessibility and intermodal connections lies in low or non-use of e-sharing mobility service with appropriate infrastructure for environmental protection, *First-last-mile* rental and sharing service diversity approach due to passenger demands, and Lack of DSS systems for sustainable Smart Port accessibility in port area for all existing transport nodes. The DSS smart model system consists of intelligent data systems, transparency, sustainability, open innovation, big data analysis, artificial intelligence, blockchain, non-stop service, efficiency, and automation.

Furthermore, according to the Survey analysis, limited connections between sea and land transportation inside the port area are visible, consequently marked with medium gap. Majority of the international passenger terminal ports have a problem in the central area between sea and land transportation connection (road and rail connection inside the terminal). Port conflict with urban place and limited infrastructure directly lead to the bottleneck especially during summer season with passenger traffic flow increase.

The medium gap between existing stage and desired level in the Cross-border area for port accessibility and intermodal connections lies in main transportation connecting nodes without proper intermodality and environmentally awareness. Nevertheless, the Italy side have developed electric railway as a main intermodal connection, but Croatian part of the Cross-border area still have a significant task to improve.

In order to mitigate such high gaps, it is important that the public and private stakeholders of the Italy – Croatia cross – border area create a typology of actions which will slowly adopt the sustainable transport planning paradigm, while at the same time gradually remove the business –

as – usual transport planning paradigm. The business – as – usual transport planning paradigm emphasizes on mobility and quantity (more, faster), and is planned for only one transportation mode (unimodality) by being unrelated to environmental, social or other sustainability planning areas. This leads to a lack of quality connections and congestions at transport hubs that connect multiple different transport modes (ports). Both public and private stakeholders should replace the aforementioned models by emphasizing accessibility and quality (closer, beter) via fostering of transport interrelationships (intermodality).

The adoption of efficient, responsible and resilient technological and organizational approaches for future business conduct of passenger terminal ports in terms of passenger – centric approaches can be utilized to map dynamics between actions. In order to enhance the accessibility and connectivity to passengers, each public and private transport stakeholder has to be flexible and integrated within the transport system. This will result with flexibility in a plethora of organizational and operational dimensions, such as allowing the passenger to have the freedom of choosing the wanted route, time, mode of transport, service provider, payment system, and also target integration with other modes of transport to meet his own requirements.

In order to pre-emptively reduce the negative aforementioned gaps of system maturity, it is important to identify synergies and conflicts between actions of public and private stakeholders that cooperate with the port authority. This must be done by accounting direct benefits of each particular stakeholder action, such as: employment, contribution to GDP, direct tax rates, trade facilitation, potential to access new markets, port revenue generation, local and regional development of the port community, lower transport costs for passengers/ tourists, promotion of social inclusivity, greener technical solutions (retrofitting of equipment with alternative fuel options) etc. The aforementioned stakeholder actions can be utilized as viable indicators for decision making purposes of the port authority in order to carry out efficient coordination and cooperation administrative activities for the interests of the port community and the passengers as well.

The Port Authority is therefore obliged to take into account public and private stakeholder objectives in the sustainable maritime passenger transport planning process by the following two criteria:

1) Identification of the critical stakeholders who can better contribute to achieving the sustainability mission and strategic objectives of the port community (realization of passenger centric transport planning approach) and,
2) The specific strategies implementation to provide an adequate coverage of different aspect

Thus, it is important that the stakeholders under the guidance of the port authority participate in knowledge transfer or knowledge sharing activities in order to conduct a gap analysis of actions of each particular stakeholder in the port community. This will aid the Port Authority in setting up in the port community a hierarchy of priorities for the facilitation of sustainable transitions in the maritime passenger transport planning process. The multidimensional and diverse nature of the priorities and actions of the private and public stakeholders in the port community can lead to conflicting interests. Thus, it is important for the port authority to recognize the internal (crucial for the port community) and external (less crucial for the port community) private and public stakeholders and determine the societal (passenger/tourist centric) outcomes of their actions. The development of the port community in terms of sustainable transitions is characterized by slowness and inertia because changes in the maritime industry require substantial capital investments.

Nevertheless, in order to concretely address the goals and proper action plan, a set of specific strategies and actions together with the Roadmap and Policy approach are defined and elaborated in the next chapter.

5. Action plan with Roadmap and Policy approach

The Cross-border Transport Sustainability Action Plan is based on the additional document the *Survey analysis for Cross-border Transport Sustainability Action Plan* and the previously elaborated chapters in this deliverable: In-depth Analysis of the PRESENT SITUATION with SWOT analysis, the VISION for sustainability improvement, analysis of main PRIORITIES and, GAP analysis in function of ports' improvement. In order to concretely address the mentioned goals, a set of specific each Strategies with stakeholders involved are proposed.

5.1. Proposed actions

The sustainable integration of cross – border area transport systems is categorized with substantial systems complexity due to the fact that observed stakeholder behavioural patterns and business interests cannot be easily inferred from their properties. The composition of the cross – border area constitutes of a multitude of different stakeholder interactions and relationships which demands the observation of the entire transport system from different aspects of sustainability to achieve insight into system usefulness and accuracy.
The general overview of the proposed actions for developing visible positive technological and organizational outcomes in the selected areas of interest with regard to passenger terminal ports and ships must have a result – oriented approach. This can only be achieved with proper conduct in cross – border cooperation with the aim of creating better passenger flows connections between passenger terminal ports via low – carbon maritime and multimodal transport solutions along with raising passenger accessibility, safety and security by innovative smart tools and technologies. Leading stakeholders in the cross – border area must be constituted of national, governmental, municipal and maritime authorities who will administer guidelines for sustainable transitions. Supportive stakeholders belong to both the private and public sectors, implying they must be constituted on the specific economic activity they are engaged in ranging from ICT,

passenger transport organization, passenger services offer, tourism promotion, safety insurance, security surveillance, waste management disposal and environmental monitoring.

5.1.1. Description of ACTIONS implementing for passenger terminal in general

The increased pressure for sustainable transitions in the cross – border area maritime industry results in the emerging of new challenges that are changing the passenger terminal port infrastructure operations and landscape. This is mainly reflected on newly identified infrastructural barriers in the passenger terminal ports waterfront in terms of operational shore length and pier arrangement due to the multiplicity of passenger flows divided into domestic and international. Passenger terminal ports that do not have a sufficient length and number of piers are prompted to exchange pier utilization in terms of passenger flows type in order to conduct correct Customs formalities, which create further organizational and congestion challenges. Operational shore length and pier scarcity is mainly reflected in smaller passenger terminal ports, while bigger passenger terminal ports face challenges of territorial scope expansion due to close proximity with their respective cities. The resolving of port and city territorial disputes creates further zoning and planning problems in terms of relocation of port passenger transport services in the hinterland. Even though such activities can reduce traffic congestion, they can cause negative spillover effects on port economic activity concession grants regarding passenger service facilities because relocation converts ports into quick passenger transfer points, instead of passenger – centric transport nodes. This requires the creation of actions on holistic passenger transport planning approaches due to fact that passenger terminal ports are transport nodes characterized by complex and multi – faceted external and internal business factors that influence the operations of the entire port ecosystem. The initial starting point for mitigating the aforementioned infrastructural, organizational, and territorial barriers is gathering intelligence on passenger flows intensity in cross – border area passenger terminal ports. Adequate knowledge on the actual number and forecasted future number of passenger flows influx will help better

systemize planning of port economic activities concessions and port territorial area limit determination. This will open opportunities for reducing difficulties with ownership in the port area, spatial planning documentation, urban space allocation, and safety of future financial investments.

Furthermore, the following implementation strategies for passenger terminal in general have been developed.

- S1 – Establishing an integrated governance framework for administration and organisation aspects
- S2 – General Improving of sustainable and multimodal/cross-border passenger terminal port's infrastructure

Going more in detailed and mowing towards, specific strategies with their actions for passenger terminal in general are elaborated in the following table.

Table 22 Specific strategies and actions for passenger terminal in general

Strategy	Action ID	Proposed measures for the Action Plan
S1 – Establishing an integrated governance framework for administration and organisation aspects	1	Fostering institutional dialog between relevant government (public sector) and numerous business (private sector) port stakeholders for each local passenger port terminal
	2	Fostering dialog between Italy - Croatia Cross border passenger terminals/Port Authorities (defining organisational and administrational responsibilities for the planning, operation, and management)
	3	Establishment of a responsible Cross border coordination centre for harmonizing, uniform planning rule according to EU and other legislative
S2 – General Improving of sustainable and multimodal/cross-border passenger terminal port's infrastructure	1	Port's infrastructure complex developing and necessary increasing of operational berth length/number with an appropriate depth section and other safe maritime aspects due to adverse environmental conditions (maritime safety aspect, meteorological and hydrological criteria)
	2	Fostering for extending port capacities with port quality service improvement

Stabilization of port infrastructural, territorial, and organizational planning via passenger flows forecast continuity requires boosting awareness of *crucial stakeholders* such as port authorities, municipal and urban authorities by collaborating with demographics research institutions, travelling agencies and municipal cadastral institutions.

5.1.2. Description of ACTIONS implementing on terminal services for passenger

Adequate sustainable passenger services planning strategies can significantly shift competitiveness towards maritime passenger ports considering the conditions are created for better journey information provision via ICT and other crucial service requirements for ensuring passenger comfort. The sustainable passenger services provision status of cross – border area passenger terminal ports is characterized by a lack of ICT journey information provision and a lack of essential passenger comfort services ranging from accessibility, refreshment areas, sanitary facilities, passenger short-stay accommodation facilities (resting centres), money exchange areas, parking areas and additional entertainment programs.

Every sustainable cross – border area passenger terminal port must implement the utilization of integrated ICT technologies for developing intelligent passenger journey planning solutions coupled with essential passenger comfort facilities. This will boost passenger terminal port competitiveness by creating attractive and seamless utilization of different passenger services under a single platform. Ports thus must undertake a certain set of actions for achieving sustainable passenger services by creating conditions for enhanced ticket integration, reception and waiting facilities along with luggage storage and handling facilities. Further actions include creating boarding equipment facilities for vulnerable passenger groups of reduced mobility, play areas for children and resting areas such as catering, medical and sanitary facilities for all passenger groups. The ICT substructure needed for the proper functioning of the complex passenger terminal port facility environment requires actions such as app – based and QR code

based real – time information systems supported by free WiFi. The aforementioned actions have to be introduced via information boards and displays with multilingual information. The most important journey travel planning factors of the stated information systems must include bus and railway timetables itineraries, maps of origins and destinations with relevant tourist attraction sites, and elementary country of origin information such as rules of engagement and emergency numbers, locations of and charging points for electric vehicles.

Furthermore, the following main implementation strategy for covering this subject area is:

- S3 – Fostering the passenger terminal services development in function of passenger demands

Going more in detailed and mowing towards, specific abovementioned strategy with the actions is elaborated in the following table.

Table 23 Specific strategy and actions for terminal services for passenger

Strategy	Action ID	Proposed measures for the Action Plan
S3 – Fostering the passenger terminal services development in function of passenger demands	1	Fostering for improving and developing a specific port infrastructure and equipment in function of passenger demands and comfort (boarding equipment, passenger short-stay accommodation facilities, luggage management system, sanitary facilities, etc.)
	2	Fostering to provide adequate service activities/infrastructure inside each Port area or in vicinity (passenger long-stay accommodation facilities, food facilities, land gas station, Rent a car/bike, etc.)
	3	Providing adequate facilities/services for passengers with reduced mobility and children
	4	Providing adequate activities and preserving its tourist attractions by promoting sustainable tourism and intermodality
	5	Developing new communication services through ICT integration which support interoperability (Free Wi-Fi availability, ICT tools for providing adequate information, on-line ticket purchasing, etc.)

	6	Developing new and innovative communication services through ICT integration which support Cross border integration and interoperability (single on-line ticket in Cross-border area for different transportation nodes)
	7	Supporting the decision process systems with data storage and technical analyses in function of collecting passenger data

To pursue and develop the goal of passenger – centric services, passenger terminal ports must cooperate with their respective city and municipal authorities along with other crucial private stakeholders (catering companies, tourist agencies, ICT companies) and public stakeholders (governmental institutions).

5.1.3. Description of ACTIONS implementing on safety and security of passenger terminal ports

The notion of organizing an environment for safe and sustainable transport of passengers in multimodal transport systems leads to the conclusion that safety and security belong to the primary concerns for every cross – border area passenger terminal port. Current safety and security research endeavors on cross – border area passenger terminal ports indicate results of vehicle congestion coupled with passenger crowding, inappropriate environmental protection conducts from multimodal transport modes intersecting in ports, and an insufficient number of personnel qualified for providing elementary security services such as first aid, fire – fighting, pollution prevention and passenger screening activities.

Present dissatisfactory safety and security measures create unnecessary risks for the entire passenger terminal port system. The aforementioned unnecessary risks manifest themselves as threats such as natural hazards in terms of adverse weather events, environmental loading factors such as air and noise pollution which cause health risks to passengers, criminal activities, cyber security attacks, and equipment and service failure. Ports are obliged to mitigate unnecessary safety risks by creating actions that will provide passenger protection from adverse weather conditions of strong winds, high waves, heavy rain, wildfires, pollutant particles, and high UV

radiation. This will be achieved by upgrading current superstructure and infrastructure capabilities from the aspect of firefighting and pollution prevention along with acquiring passenger first aid and rescue equipment such as ladders and lifebelts in case of an accident. Port security activities must encompass a set of actions beginning by establishing customs services with border security screening equipment and procedures. They can serve as initial cyber security surveillance sites for conducting passenger check – in via boarding management systems, and health monitoring and disease prevention via procedures with appropriate equipment. Meanwhile, security actions development depends on new communication services through ICT integration which support mobility and interoperability together with decision process systems with data storage and technical analyses in function of collecting data regarding to port safety and security. In other words, confronting risks on safety and security must be undertaken by port staff training in terms of firefighting, medical assistance, custom's administration, and cyber security.

Furthermore, the following main implementation strategy for covering this subject area is:

- S4 – Supporting the passenger terminal's safety and security development

Going more in detailed and mowing towards, specific abovementioned strategy with the actions is elaborated in the following table.

Table 24 Specific strategy and actions for safety and security of passenger terminal ports

Strategy	Action ID	Proposed measures for the Action Plan
S4 – Supporting the passenger terminal's safety and security development	1	Fostering to improve appropriate and sufficient firefighting, pollution prevention and medical infrastructure/equipment with trained personnel
	2	Port safety and security plan implementation including Cyber security plan according to the latest EU Directive
	3	Fostering to improve the appropriate custom facility inside the passenger terminal under Custom's Administration legislative with adequate equipment (e.g., check-in system and boarding process with passenger/luggage screening and inspection possibility)
	4	Developing new communication services through ICT integration which support mobility and interoperability (automated vehicle

		access, traffic/parking monitoring system, ICT tools for providing adequate traffic information, ICT security management system, etc.)
	5	Supporting the decision process systems with data storage and technical analyses in function of collecting data regarding to port safety and security

Transport safety and security are sensitive concerns that require continuous stakeholder cooperation and experience exchange from port authorities with private and public entities that conduct business in the safety and security domain (public firefighting and medical assistance, public or private company for environment/pollution protection, custom administration, private ICT company, etc.).

5.1.4. Description of ACTIONS for implementing of initiatives to reduce the environmental impact

According to the *Survey analysis for Cross-border Transport Sustainability Action Plan,* the current status of passenger terminal ports preparedness on environmental preservation initiatives is characterized with substandard performance and low representation of initiatives. Also, in the Survey analysis all conducting initiatives are elaborated and presented. The conducted analysis results indicate a successful implementation of 26% of initiatives while 74% of initiatives is not implemented.

The general lines of action focus on the following implementation objectives (initiatives to be launched and implemented):

- Alternative energy production
- Alternative fuels – Electric engines (short distance and manoeuvring)
- Alternative fuels – LNG
- Circular economies
- Climate initiatives
- Cold ironing
- Efficient vessel handling
- Emissions inventories
- Emissions monitoring

- Energy management system
- Environmental plan
- Environmental report
- Environmental risk management
- Footprint assessment
- Improving coordination/connection with air, rail and road transport
- Key environmental performance indicators
- Life cycle assessment
- Vessel impact-related incentives
- Vessel impact-related port dues / penalties

Furthermore, the following main implementation strategy for covering this subject area is:

- S5 – Fostering the development and raising awareness on environmental impact implementation

Going more in detailed and mowing towards, specific abovementioned strategy with the actions is elaborated in the following table.

Table 25 Specific strategy and actions for implementing of initiatives to reduce the environmental impact

Strategy	Action ID	Proposed measures for the Action Plan
S5 – Fostering the development and raising awareness on environmental impact implementation	1	Developing environmental impact procedures and initiatives in passenger port terminals towards pollution reduction, and the mitigation of potential environmental impact which appears in function of the transport process and all related services
	2	Fostering to improve environmental' s infrastructure facilities and/or organisational reception aspect for ship waste (Garbage Management), waste oils and oily water, ballast water sediments, air pollution, etc.)
	3	Fostering to implement alternative energy production and alternative fuel deliverable (e.g., LNG fuel. cold ironing implementation, wind/solar/hydrogen/tidal/biomass energy)
	4	Supporting the decision process systems with data storage and technical analyses in function of collecting environment data
	5	Supporting and developing port environmental infrastructure in road transportation (eCar or eBike rent together with adequate chargers)

Passenger terminal ports must collaborate by adherence to national, international and global environmental regulations and legislation in order to avert the possibilities of unfavourable and even detrimental environmental effects of ships on passengers, coastal communities, and marine ecosystems. For example, MARPOL 1978 international convention provides the elementary guidelines on harmful ship substances and waste regulation at open sea while Directives (EU) 2019/883 and (EU) 2005/33 provide guidelines for port reception facilities for ship waste delivery and the allowed European sulfur content of marine fuels at inland waterways and ships at berth respectively.

Better management of the negative ship externalities in port areas must be achieved by constructing systemic collaboration of port authorities with environmental monitoring agencies, waste management companies, tourist (passenger) agencies and regulatory authorities. Furthermore, the proper coupling of developing the multimodal solutions and the environmental preservation must be achieved through joint actions and efforts of all related stakeholders, being General public, Local, regional and national public authorities, Enterprises, transport and multimodal logistics hubs operators, Infrastructure providers, and Transport associations.

5.1.5. Description of ACTIONS for implementing technological solutions for the improvement of cross-border passenger liner ships

Modern ship technology plays a pivotal role in achieving a smarter, safer, more secure, and more competitive Italy – Croatia cross border area in terms of maritime passenger economic, social, and environmental sustainability criteria. The aspect of sustainability indicates that the current status of the Italy – Croatia cross – border area maritime passenger fleet is characterized by obsolete technical – technological ship capabilities. The fact that the HSC and RO – RO fleet age averages in the value of 27 and 39 years respectively leads to the conclusion for prioritizing the adoption of transformative and innovative green technologies in ship hull types, power generation systems, fuels, propulsion systems, and information – communication systems.

The International Maritime Organization contemporary environmental regulatory restrictions are fostering innovation – led change and pressure in the shipping industry on a global and cross – border area level. This requires adaptive action from the cross – border area ship owners to implement new and transformative ship technologies. Such technologies will enable superior energy efficiency via the adoption of lightweight materials that will improve ship hydrodynamics, advanced hybrid – power generation systems supported by alternative fuels and renewable energy storage systems, with the intent of optimizing ship sailing and maneuvering performance. The ousting of current ship fuels with high sulfur content will be achieved with the utilization of alternative fuels and renewable energy sources. Further reductions in GHG environmental impacts of cross – border area ships will be fostered by the integration of advanced alternative fuels distribution systems with the ships' main and auxiliary power sources. Crucial ship innovative technological actions must be undertaken under the domain of digitalization and automation by implementing ship integrated control systems. This will enable processes of enhanced ship operations by advancing engine monitoring activities, remote fuel usage maintenance, passenger journey safety by real – time weather data and digital routing management, and smart propulsion systems that enable the propeller angle, pitch, and speed to be adjusted to enhance ship maneuvering capabilities at ports and fairway channels.
Furthermore, the following main implementation strategy for covering this subject area is:

- S6 – Improving and fostering the development of cross-border passenger liner ships

Going more in detailed and mowing towards, specific abovementioned strategy with the actions is elaborated in the following table.

Table 26 Specific strategy and actions for implementing technological solutions for the improvement of cross-border passenger liner ships

Strategy	Action ID	Proposed measures for the Action Plan

S6 – Improving and fostering the development of cross-border passenger liner ships	1	Developing new or yearly improved passenger liner service in Cross-border area according to passenger demand
	2	Fostering to realize new cross-border passenger liner ships in Cross-border area for achievement lower average fleet age
	3	Fostering to realize new cross-border passenger liner ships in Cross-border area with the adoption of transformative and innovative green technologies in ship hull types, power generation systems, fuels, propulsion systems, and information – communication systems
	4	Fostering to improve existing or new cross-border passenger liner ships due to passenger demands in function of raising awareness about multimodality and environment protection
	5	Supporting the decision process systems with data storage and technical analyses in digitalization and automation by implementing Ship Integrated Control Systems

The application of innovative green ship technologies requires shipowners and governmental authorities as the most important stakeholders to investigate the commercial benefits of ship technological sustainability transitions because they require a data – centric mode of operation which is in most cases characterized by substantial capital intensity.

5.1.6. Description of ACTIONS for implementing sustainable port accessibility and intermodal connections

Designing sustainable cross border transportation system with accessible and optimally utilized land infrastructure is a complex subject. To successfully reach desired goals the solution must incorporate both the stakeholder and the passenger perspectives. The approach must be sequential thus incorporating improvements of existing assets, alongside implementation of forthcoming technologies. The focus is undoubtably on reduction of road transport with its shortcomings and negative impacts towards sustainability and environmental footprint goals. However, the inevitability of road transport in the near-term and mid-term solutions, must be accounted for in the transport mix. The planned transport solutions should further minimize individualistic usage of road vehicles and promote moving from individuality to more pronounced

usage of shared road and public transport possibilities. This is possible with further utilization of bus transport, for which designated, priority lanes and parking spaces should be provided. Such sustainable solutions and goals are reachable with policies and measures aligned with passenger expectations and satisfaction.

To improve stated connecting land connection services, several preconditions and priorities must be set. Firstly, the planned upgrades of connecting roads must be carried out alongside with mitigation measures for ports where congestion appears. Since the road transport will still be a part of transport mix, hopefully as least as possible, adequate parking spaces should be provided, both for short and long stay. Long stay parking spaces are of importance for ports, and possibly for other hubs or nodes in the land transport system. Fraction of the negative impact of road vehicles can be reduced with multimodality, for example with motorail trains carrying cars and other vehicles. Such options are already present in both Italy and Croatia, although very modestly, however they should be implemented further, at least in the near-term solutions. Utilisation of such multimodal approaches and limited contribution in transport mix does not require extensive planning and adaptation in available transport networks. Furthermore, more shared and rental electric services in function of environment protection should be at disposal, both in port and in other transport nodes. This will facilitate the *clean* movement in the first-and-last mile legs of the voyage. Since numerous ports depend on road transport for passenger arrivals and departures from/to the ports, plans should be devised for further utilisation of more favourable means of road transport such as shuttle or bus services.

Furthermore, projected traffic increase should align with measures and goals of sustainable and smart transport initiatives. In such perspective, more detailed assessment of land infrastructure and utilisation in terms of current and expected traffic should be carried out. For the road traffic, besides technological advances reducing negative environmental impacts, infrastructure should be evaluated in terms of travel time, speed, congestion indices and other objective measurable values. For railway, similar measures would be of interest as a basis for increased utilisation, alongside with goal of tighter integration with other means of transport. Also, in a longer-term

planning should be focussed to improve and develop railway electrification system with appropriate infrastructure as a main transportation nodes promoting intermodality and environmentally awareness.

Furthermore, the following main implementation strategy for covering this subject area is:

- S7 – Fostering the development of sustainable port accessibility and intermodal connections

Going more in detailed and mowing towards, specific abovementioned strategy with the actions is elaborated in the following table.

Table 27 Specific strategy and actions for implementing sustainable port accessibility and intermodal connections

Strategy	Action ID	Proposed measures for the Action Plan
S7 – Fostering the development of sustainable port accessibility and intermodal connections	1	Fostering to improve sustainable Smart Port accessibility in port area for all existing transport nodes (smart model consists of intelligent data systems, transparency, sustainability, open innovation, big data, artificial intelligence, blockchain, non-stop service, efficiency, and automation
	2	Fostering to improve existing or new development of intermodal connections between sea and land transportation (road and rail connection improvement in each passenger terminal environment)
	3	Fostering to improve and develop main transportation nodes promoting intermodality and environmentally awareness (Railway electrification system with appropriate infrastructure or electrified road transportation with charging infrastructure)
	4	Developing inter-connecting rail services between Italy and Croatia by promoting intermobility, environmentally awareness and fulfil passenger demands (single CB railway)
	5	Integrate e-sharing mobility service in each passenger terminal environment with appropriate infrastructure and charging infrastructure

The application of innovative sustainable port accessibility and intermodal connections requires port authorities and state government to investigate the commercial benefits of intermodal sustainability connections between Italy and Croatia due to substantial capital intensity (e.g., railway electrification system with appropriate infrastructure). Furthermore, accessibility distances

to next transport modes should be minimized as possible or resolved with adequate direct connections, thus facilitating the movement to next transport mode as much as possible. Consequently, all stakeholders involved in land transportation (road and rail) have significant role in transport connection improvements.

5.2. Overall policy approach

A number of possible policy actions to guide the future development of investment in maritime and coastal transport, within the overall framework of the analyses outlined in this section are proposed.

The overall policy approaches are presented (e.g., going beyond specific measures or action) through a synthetic framework based on a simple and intuitive logic that can summarise the feasibility of alternatives at a glance, and which consider different possible actions on the basis of the investment and coordination effort they require.

The policy instruments that can be envisaged in a context as broad and complex as maritime and coastal transport planning are, of course, very numerous. In terms of approach, however, the various instruments can be traced back to a few general lines which basically use regulatory instruments combined with incentives and sanctions.

Based on the authors' knowledge, those initiatives/actions are classified according to the dimensions of the presented matrix, a tool, already described in the previous deliverables D.3.2.1. The classification matrix has been reduced to the first three categories of investment effort compared to its theoretical formulation (streamlining at minimum cost, improving investment, innovative investment), since none of the initiatives/actions considered are "pioneering" in nature (see D.3.2.1. for details).

The criteria used to plot the above matrix are of various kind, but essentially related to the following parameters. For the investment effort: a) diffusion and/or level of development of innovation in the area of reference, b) cost of implementing infrastructure (if required) and of

organisational adaptation. For the organisation and coordination effort: a) level of reference legislation (if relevant), b) level of (political) decision-making process involved in the implementation of the investment; c) number and level of bodies / institutions involved for the realisation of the initiative.

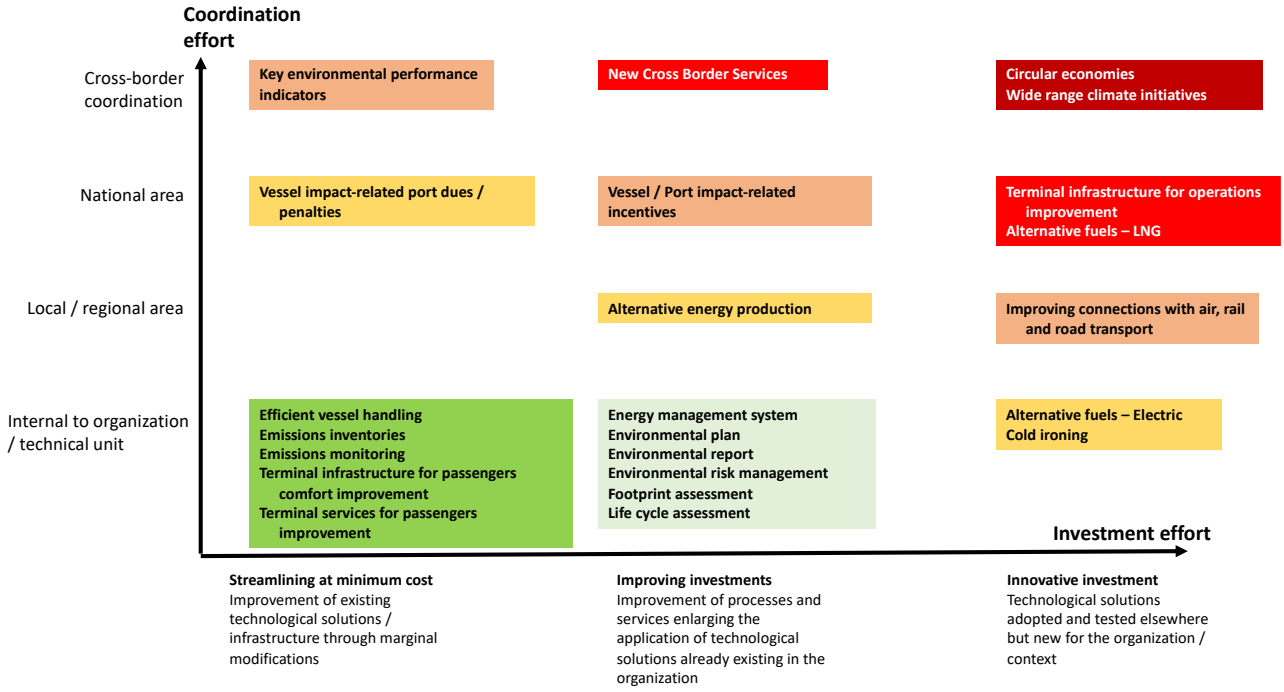

Figure 5 Assessment of investment/coordination effort of possible initiatives

The matrix merely identifies, in an approximate way, the complexity of the actions (costs and effort increase from bottom-left towards top-right). The decision of how to set up the action plan is instead linked to political and financial evaluations by the single subjects and stakeholders involved in the actions. However, considering the objectives of the European strategy and the programme objectives, it is possible to hypothesise a dual line of action that combines the possibility of exploiting synergies triggered by a top-down logic with the competitive advantages pursued by maritime and port operators (from now on, “operators”) in ordinary management.

More precisely, the rationale is to prioritise top-down policy actions that are less complex and at the same time can trigger virtuous mechanisms that drive operators and stakeholders to bottom-up virtuous actions.

Regarding the primary goal of reducing the carbon footprint, we think that there are at least two possible lines of action, both triggered by policy initiatives based on the definition of key environmental performance indicators, and related target, to be agreed.

The first line of action is a typical short/medium-term incentive-based initiative aiming at creating favourable conditions to investments, as shown in the figure below. The definition of environmental targets is the premise (step 1), but this is the basis for the allocation of incentives or the definition of programmes (step 2) to which both large and small operators would respond, along investment lines and incentives differentiated according to the type of action.

The implementation of targeted incentives (expressed in various forms, e.g., subsidised loans, tax credits, etc.) would have the effect of triggering virtuous phenomena, with the distinction of effects of greater or lesser importance depending on the size and investment capacity of the operators involved. Depending on the method and extent of the incentives, there would therefore be more widespread effects with a lesser impact, rather than more sporadic and more complex effects. This type of action is typically national in nature, but if carried out in a cross-border context it would certainly be more effective and would avoid increasing disparities between the two sides of the Adriatic.

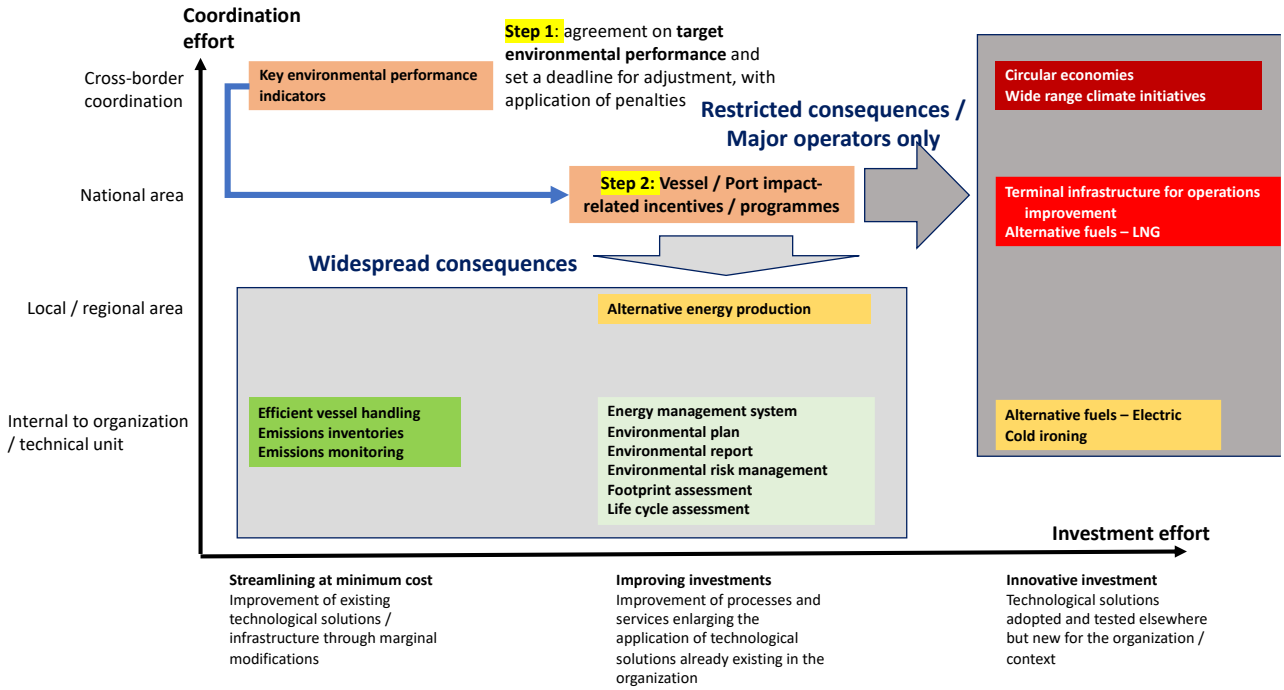

Figure 6 Overall scheme for incentive/programme - based policy

To be effective, the implementation of such an action requires significant co-financing by operators and the setting of adaptation targets, e.g., emission standards, carbon footprint reduction targets. In the absence of a) operator co-financing, b) elements that make improvement investments necessary, the competitive forces that are at the basis of an effective implementation of strategies by operators would be missing. The aim, in fact, cannot only be that of a reduction in the carbon footprint, but must necessarily include an increase in competitiveness.

The second possible line of action is a long-term initiative and involves, as the previous one, a cross-border agreement on KPI and significant emission reduction measures, but includes defined targets and penalties at a given deadline. Such an agreement can be made at the level of national governments, but in this case, it could be at the origin of competitive asymmetries between operators that would emerge if the regulations were different for Italy and Croatia (and of course the effect in terms of carbon footprint would also be smaller). In a similar case, concerning the

regulation of emissions in the automotive sector, the agreements emerged from extensive stakeholder consultation and were initially established as self-regulatory codes, before becoming binding regulations over time. This is, therefore, a long-term policy line, but with the advantage of having a solid basis for sharing objectives between institutions and stakeholders. To be effective, the agreement should foresee the application of concrete consequences within a given deadline, such as financial or port access penalties for those not meeting the set targets. The assumption is that the adoption of emission target measures (step 1) will result in the adaptation of the operators involved, with various types of investments (step 2), from the simplest (inventory and emission monitoring) to the most ambitious (LCA, cold ironing, etc.). When the target agreement expires, the application of penalties (step 3) will have an impact on the competitiveness of the operators, pushing them further towards even higher investments, thus reinforcing the initial effect (step 4).

According to this line, the sequence of actions should be as depicted in the following figure.

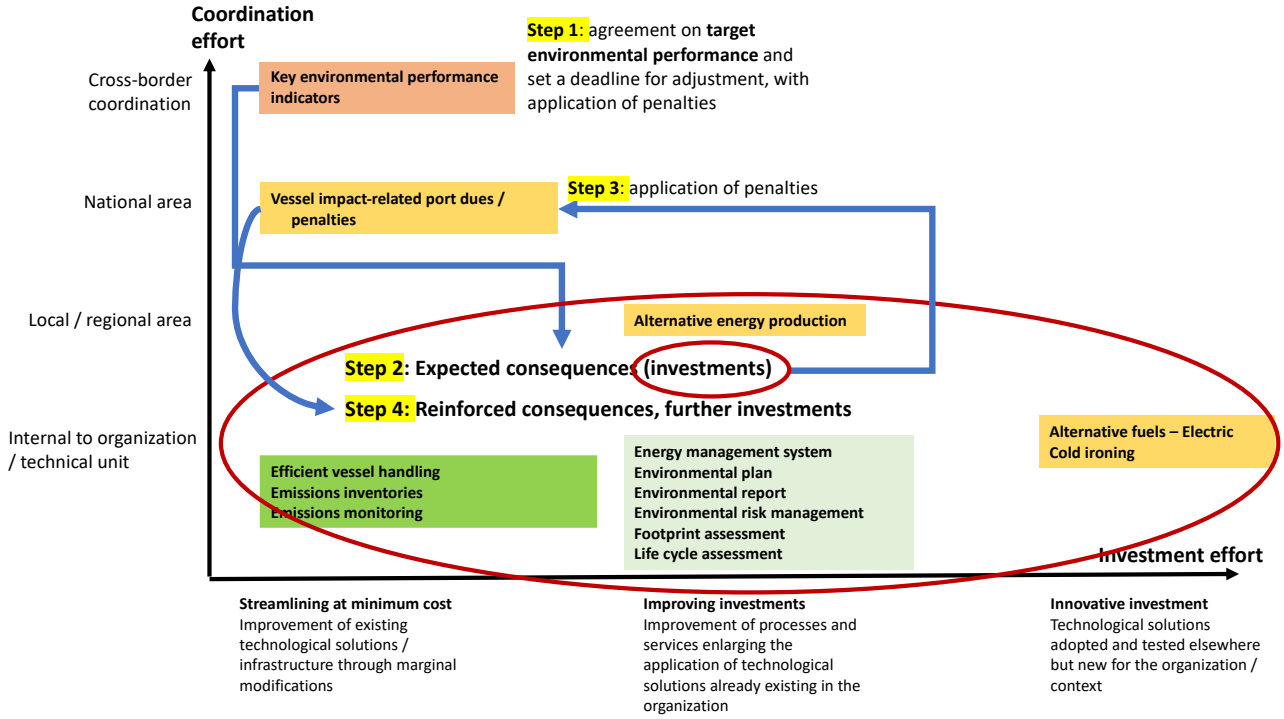

Figure 7 Overall scheme for regulation introducing sanctions

The two lines of action mentioned above can be partially overlapped, so as to try to optimise the results especially as regards the different investment capacity, and the different gaps to be bridged, between large operators and small and medium-sized operators.
Moreover, both these action lines include measures and actions which, in the light of the analysis set out in this document, can be considered realistic for most operators. They are bot focused on emissions from shipping and port activities, which are currently a priority according to most previous studies as well as statements from operators and travellers interviewed for the segmentation survey. However, there is also a need/opportunity to take action on reducing the number of travellers using private cars as a means of travel. In principle (and leaving aside restrictions) this can be achieved by: a) improving connections between ports and hubs and hinterlands, b) improving the comfort of travelling by ship so as to incentivise changes in behaviour.
Both these two topics are currently under investigation and results will be presented in next deliverables. In particular, at the moment we do not yet have the definitive results of the analysis of the carbon footprint per traveller between Italy and Croatia by travel mode, which is still under study (early results will be reported in deliverable 3.1.4). Such information is relevant in order to understand whether the modal shift would be an opportunity. For this reason, this aspect is not considered at the moment and will be further developed later and included in the deliverables of the cross-border transport plan (O.4.5 and D.4.5.1).

5.3. Roadmap and timeline

In this section, we propose a roadmap in which the set of strategies are carried out together with related described actions. Also, each action is associated with an indicative timeline interval expressed according to an ordinary scale, whose values are associated with the following meanings:

- 1 – 3 years - short term,

- 3 – 5 years - medium term,
- 5 – 7 years - long term.

Furthermore, each described action have been rated additionally according to the three-level of priority, whose values/colours are associated with the following meanings:

- High priority (red),
- medium priority (orange),
- low priority (green)

The roadmap is carried out for each strategy separate together with priority level in the following tables. Also, along with the following roadmap, additional remarks and comments are made relating to the complexity and financial aspect.

<table>
<tr><th>Strategy / Period</th><th>Short - term</th><th>Medium - term</th><th>Long - term</th></tr>
<tr><td rowspan="3">S1 - Establishing an integrated governance framework for administration and organisation aspects</td><td>Fostering institutional dialog between relevant government (public sector) and numerous business (private sector) port stakeholders for each local passenger port terminal improvement</td><td></td><td></td></tr>
<tr><td colspan="2">Fostering dialog between Italy - Croatia Cross border passenger terminals/Port Authorities (defining organisational and administrational responsibilities for the planning, operation, and management)</td><td></td></tr>
<tr><td colspan="3">Establishment of a responsible Cross border coordination centre for harmonizing, uniform planning rule according to EU and other legislative</td></tr>
<tr><td rowspan="2">S2 – General Improving of sustainable and multimodal/cross-border passenger terminal port’s infrastructure</td><td colspan="3">Port’s infrastructure complex developing and necessary increasing of operational berth length/number with an appropriate depth section and other safe maritime aspects due to adverse environmental conditions (maritime safety aspect, meteorological and hydrological criteria)</td></tr>
<tr><td colspan="3">Fostering for extending port capacities with port quality service improvement</td></tr>
</table>

Figure 8 Roadmap for passenger terminal in general strategy

The first strategy (S1) represents one of the less costly typologies due to institutional and administration aspect in Cross border area. Besides, it could be achievable also from the transportation legislative point of view through an extension within the scope foreseen by the EU regulation. However, the establishment of an integrated governance framework for administration and organisation aspects with Cross border coordination centre establishment between Italy and Croatia, imply a higher deal of complexity.

The second (S2) strategy represents one of the high costly typologies due to port infrastructure investment for both actions. Furthermore, the general improving of sustainable and multimodal/cross-border passenger terminal port's infrastructure implies medium complexity. Obviously, smaller infrastructure demands from the sea side could represents low complexity, however, larger infrastructure demands have larger complexity due to major construction change, especially in environmental infrastructure improvement, and due to port area restrictions. Hence, it is even more important choosing the best fitting options in port infrastructure changes due to flexibility and cost effectiveness, having in mind the contributions in function of better organisation, environmental protection, and technical improvement.

Strategy / Period	Short - term	Medium - term	Long - term
S3 – Fostering the passenger terminal services development in function of passenger demands	Fostering for improving and developing a specific port infrastructure and equipment in function of passenger demands and comfort (boarding equipment, passenger short-stay accommodation facilities, luggage management system, sanitary facilities, etc.)		
	Fostering to provide adequate service activities/infrastructure inside the Port area or in vicinity (passenger long-stay accommodation facilities, food facilities, land gas station, Rent a car/bike, etc.)		
	Providing adequate facilities/services for passengers with reduced mobility and children		
	Providing adequate activities and preserving its tourist attractions by promoting sustainable tourism and intermodality		
	Developing new communication services through ICT integration which support interoperability (Free Wi-Fi availability, ICT tools for providing adequate information, on-line ticket purchasing, etc.)		
	Developing new and innovative communication services through ICT integration which support Cross border integration and interoperability (single on-line ticket in Cross-border area for different transportation nodes)		
	Supporting the decision process systems with data storage and technical analyses in function of collecting passenger data		

Figure 9 Roadmap for passenger terminal services development in function of passenger demands

The third strategy (S3) represents one of the high costly typologies for actions relating to the specific port infrastructure investment due to the passenger demands. However, these improvements imply medium complexity for realisation.

The action related to the providing adequate facilities/services for passengers with reduced mobility and children implies medium complexity and cost. These additional improvements definitely will fulfil higher passenger demands and create higher passenger terminal competitiveness.

The action related to the providing adequate activities and preserving its tourist attractions by promoting sustainable tourism and intermodality is based on adequately communication services. However, these improvements imply lower cost typologies and medium complexity for realisation due to advocated synergy between sustainable mobility and tourism between Italy and Croatia.

The actions related to the ICT implementation in function of passenger demands deals with communication interoperability (Free Wi-Fi availability, ICT tools for providing adequate information, on-line ticket purchasing, etc.), Cross border interoperability (single on-line ticket in Cross-border area for different transportation nodes) and DSS with data storage interoperability. These actions imply medium complexity and cost, but also highlight a great improvement for passenger demands and flexibility approach. The aforementioned priorities can be considered crucial because they are medium capital intensive (than port expansion programs); and consequently information exchange between port communities will generate knowledge transfer.

<table>
<tr><th>Strategy / Period</th><th>Short - term</th><th>Medium - term</th><th>Long - term</th></tr>
<tr><td rowspan="5">S4 – Supporting the passenger terminal's safety and security development</td><td colspan="3">Fostering to improve appropriate and sufficient firefighting, pollution prevention and medical infrastructure/equipment with trained personnel</td></tr>
<tr><td colspan="2">Port safety and security plan implementation including Cyber security plan according to the latest EU Directive</td><td rowspan="3"></td></tr>
<tr><td colspan="2">Fostering to improve the appropriate custom facility inside the passenger terminal under Custom's Administration legislative with adequate equipment (e.g., check-in system and boarding process with passenger/luggage screening and inspection possibility)</td></tr>
<tr><td colspan="2">Developing new communication services through ICT integration which support mobility and interoperability (automated vehicle access, traffic/parking monitoring system, ICT tools for providing adequate traffic information, ICT security management system, etc.)</td></tr>
<tr><td>Supporting the decision process systems with data storage and technical analyses in function of collecting data regarding to port safety and security</td><td colspan="2"></td></tr>
</table>

Figure 10 Roadmap for passenger terminal's safety and security development

The fourth strategy (S4) mostly represents less costly typologies, besides infrastructure/equipment development related to the custom administration and environmental protection equipment, consequently marked with medium necessary cost and complexity.
The actions related to the ICT implementation which support mobility and interoperability (automated vehicle access, traffic/parking monitoring system, ICT tools for providing adequate traffic information, ICT security management system, etc.) and DSS with data storage interoperability imply medium complexity and cost, but also highlight a great improvement for safety and security international port development.

<table>
<tr><th>Strategy / Period</th><th>Short - term</th><th>Medium - term</th><th>Long - term</th></tr>
<tr><td rowspan="5">S5 – Fostering the development and raising awareness on environmental impact implementation</td><td colspan="2">Developing environmental impact procedures and initiatives in passenger port terminals towards pollution reduction, and the mitigation of potential environmental impact which appears in function of the transport process and all related services</td><td></td></tr>
<tr><td colspan="3">Fostering to improve environmental' s infrastructure facilities and/or organisational reception aspect for ship waste (Garbage Management), waste oils and oily water, ballast water sediments, air pollution, etc.)</td></tr>
<tr><td colspan="3">Fostering to implement alternative energy production and alternative fuel deliverable (e.g., LNG fuel. cold ironing implementation, wind/solar/hydrogen/tidal/biomass energy)</td></tr>
<tr><td>Supporting the decision process systems with data storage and technical analyses in function of collecting environment dana and emmision monitoring</td><td colspan="2"></td></tr>
<tr><td colspan="2">Supporting and developing port environmental infrastructure in road transportation (eCar or eBike rent together with adequate chargers)</td><td></td></tr>
</table>

Figure 11 Roadmap for raising awareness on environmental impact implementation

The complexity and cost related to the strategy for raising awareness on environmental impact implementation, due to the importance, is set and elaborated separately in the previously chapter 5.2 Overall policy approach (Figure 5,6 and 7).

Strategy / Period	Short - term	Medium - term	Long - term
S6 – Improving and fostering the development of cross-border passenger liner ships	Developing new or yearly improved passenger liner service in Cross-border area according to passenger demand		
	Fostering to realize new cross-border passenger liner ships in Cross-border area for achievement lower average fleet age		
	Fostering to realize new cross-border passenger liner ships in Cross-border area with the adoption of transformative and innovative green technologies in ship hull types, power generation systems, fuels, propulsion systems, and information – communication systems		
	Fostering to improve existing or new cross-border passenger liner ships due to passenger demands in function of raising awareness about multimodality and environment protection		
	Supporting the decision process systems with data storage and technical analyses in digitalization and automation by implementing Ship Integrated Control Systems		

Figure 12 Roadmap for raising awareness on environmental impact implementation

The sixth strategy (S6) represents one of the high costly typologies due to new development of cross-border passenger liner ships which will fulfil all above mentioned technical and innovative green technologies. Besides high cost, nowadays new passenger liner ships represent low complexity for realisation. The highest complexity is more related to the necessary port infrastructure improvement for handling these passenger liner ships with new technology (S2). Passenger liner ships are considered as the backbone transportation entities of the Italy – Croatia cross – border area because they are the direct means for shaping passenger flows intensity. Hence, according to the Survey analysis, and the visible highest gap between existing stage and desired for the passenger liner ships, their improvement is necessary. Furthermore, in spite of the relatively low number passenger liner service, a positive trend and new improvements must be underlined due to passenger demands.

<table>
<tr><th>Strategy / Period</th><th>Short - term</th><th>Medium - term</th><th>Long - term</th></tr>
<tr><td rowspan="5">S7 – Fostering the development of sustainable port accessibility and intermodal connections</td><td>Fostering to improve sustainable Smart Port accessibility in port area for all existing transport nodes (smart model consists of intelligent data systems, transparency, sustainability, open innovation, big data, artificial intelligence, blockchain, non-stop service, efficiency, and automation</td><td></td><td></td></tr>
<tr><td colspan="3">Fostering to improve existing or new development of intermodal connections between sea and land transportation (road and rail connection improvement in each passenger terminal environment)</td></tr>
<tr><td colspan="3">Fostering to improve and develop main transportation nodes promoting intermodality and environmentally awareness (Railway electrification system with appropriate infrastructure or electrified road transportation with charging infrastructure)</td></tr>
<tr><td colspan="3">Developing inter-connecting rail services between Italy and Croatia by promoting intermobility, environmentally awareness and fulfil passenger demands (single CB railway)</td></tr>
<tr><td colspan="2">Integrate e-sharing mobility service in each passenger terminal environment with appropriate infrastructure and charging infrastructure</td><td></td></tr>
</table>

Figure 13 Roadmap for sustainable port accessibility and intermodal connections

The seventh (S7) strategy represents one of the high costly typologies and high complexity due to infrastructure development for port accessibility and development intermodal connections in Cross-border area. Hence, it is even more important choosing the best fitting options in port accessibility and intermodal connections development due to flexibility and cost effectiveness, having in mind the contributions in function of better organisation, environmental protection, and technical improvement. Also, the expanding of port accessibility is necessary due to the passenger flow increasing and large bottleneck appearance especially during the summer period. Furthermore, developing inter-connecting rail services between Italy and Croatia by promoting intermobility, environmentally awareness and fulfil passenger demands are not directly connected to the MIMOSA project, but these aspects are highly connected to promote intermodality with the overall vision concerning improvement connectivity between Italy and Croatia.

6. Conclusion

Cross-border Transport Sustainability Action Plan for the Cross-border area between Italy and Croatia has been elaborated. This deliverable defines all the necessary measures to improve the port infrastructure, port services, safety and security improvements, passenger liner ships, port accessibility and intermodal connections, together with passenger demands in order to make the port system of maritime passenger traffic in the Adriatic safer, environmentally friendly, technical developed and attractive to the potential passengers.

The Cross-border Transport Sustainability Action Plan lies on the previously elaborated additional document *Survey analysis for Cross-border Transport Sustainability Action Plan* which is based on a deep survey from the relevant Port Authorities for the international passenger terminal ports in Italy and Croatia. After detail presented actual situation in the passenger terminal port environment, in depth SWOT analysis is presented in this deliverable. By using the main outcomes, this action plan provides the VISION for port sustainability improvement. These are representing main addressee to be pursued in the long run as main results to obtain for the improvement of overall ports sustainability in general and at European level as well. Furthermore, by synthetizing the main outcomes from the SWOT analysis carried out for each of the drivers analysed with reference to the Threats and Weaknesses highlighted, the GAP analysis in function of the port improvement has been elaborated. Furthermore, gap analysis is based on comparison between the existing overall situation according to Survey analysis with previously elaborated chapters, and the desired level of the passenger terminal port improvement by pointing three gap levels: low, medium, and high gap. By using in-depth SWOT analysis, shared vision and its operationalisation provided by the goals for maritime transport main, established PRIORITIES with their importance (very important and moderately important) are structured as follows.

- Improve port infrastructures to reduce emissions, to support multimodality, vessel technology innovation, and to ensure safety and security.
- Improve connections with the hinterlands and opportunity to reduce car use.

- Improve vessels technology to increase efficiency and reduce emissions.

In order to concretely address the identified goals for Cross-border Transport Sustainability Action Plan, the following set of specific Strategies with responsible stakeholders has been outlined.

- **S1** – Establishing an integrated governance framework for administration and organisation aspects
- **S2** – General Improving of sustainable and multimodal/cross-border passenger terminal port's infrastructure
- **S3** – Fostering the passenger terminal services development in function of passenger demands
- **S4** – Supporting the passenger terminal's safety and security development
- **S5** – Fostering the development and raising awareness on environmental impact implementation
- **S6** – Improving and fostering the development of cross-border passenger liner ships
- **S7** – Fostering the development of sustainable port accessibility and intermodal connections

Inside each strategy, the necessary measures (actions) have been elaborated together with the ROADMAP integration. The roadmap is carried out for each strategy separate together with priority level (low, medium and high priority) and general time horizon for implementation (short term, medium term and long term) along with the following additional remarks and comments relating to the complexity (low, medium or high complexity) and financial aspect level (low, medium and high-cost typologies). Finally, the Cross-border Transport Sustainability Action Plan represents a first step towards looking at the problem of sustainable transport in the North Adriatic as a whole, rather than as the sum of several separate measures. A tool helping to prioritise is adopted that underlies a logic not only based on available resources or emergencies, but on the overall picture of possible actions assessed according to their actual feasibility.

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