CROSS-BORDER STRATEGY

Activity 5.2

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Table of Contents

1. ABSTRACT

1.1. The Project in a Nutshell

Maritime transport is the most sustainable way of transporting goods from the environmental and energy point of view. Also, the commercial ports, located near cities, play an essential role in the transport logistics system, as they allow the connection between the maritime and land routes, and represent an important factor for the growth of the economy and employment. It should be noted, however, that while maritime transport is the most sustainable way of transporting goods, port operations have an impact on air quality and greenhouse gas emissions.

The improvement of environmental sustainability and energy efficiency in port areas is a very challenging objective, due to the geographical and economical complexity of these areas and the large number of stakeholders and entities contributing to the pollutants' emissions. They include port authorities, private companies, dealers, shippers, service providers, shipping companies, etc. In the last decades, increasing attention has been paid to these topics, especially in the European context. This led to a large number of actions devoted to reducing the emissions of pollutants and developing new tools and policies to reduce the environmental impact of navigation and port operations. In this context, the SUSPORT project aims to provide its contribution.

SUSPORT (Sustainable Ports) Project, co-funded by the Interreg Italy-Croatia Cross-Border Cooperation Programme, has the main objective of improving the environmental sustainability and energy efficiency in ports in the Program Area by improving cooperation of key stakeholders – institutions and long-term management activities in this area of work on both sides of the Adriatic Sea.

The project involves all the main ports from Italy and Croatia, thus, offering a very useful channel to share past experiences and best practices dealing with port environmental sustainability and the improvement of energy efficiency in port areas. Furthermore, since all relevant ports in terms of traffic and volumes of goods/passengers are engaged, the project enables to analyse globally the environmental impacts of port activities on the whole area: the Adriatic Sea.

Ports of the Programme area do not have a common model of environmental planning and energy efficiency, and adopt mitigation measures in a non-coordinated way, with a non-homogeneous result in terms of environmental protection. SUSPORT intends to strengthen the institutional capacity and cross-border governance of the ports of the Programme Area in this sector, enhancing the environmental sustainability and energy efficiency.

Through SUSPORT, all ports involved in the project, will be able to share best practices, analyze the situation and develop common methodologies for environmental sustainability and energy efficiency, to be tested in concrete pilot actions significantly improving the environmental performance of maritime transport in the whole Programme Area.

Thus SUSPORT has developed a consistent package of studies and pilot actions on the main ports of Adriatic area, that – especially in the peculiar last years – helped to develop and keep an active network in the cross-border area Italy-Croatia, improved the cooperation among the involved and related subjects and stimulated the research and application of winning solutions in terms of coordination measures, governance and supporting tools to sustain environmental sustainability and energy efficiency in ports.

The main result of SUSPORT is the enhancement of institutional capacity of the ports of the Programme Area in the key issue of environmental sustainability and energy efficiency, in a perspective long-term cooperation. In particular, SUSPORT aims to achieve the following specific results:

1. **New planning documents of Italian and Croatian ports setting priorities and time frame** for enhancing environmental sustainability and energy efficiency of maritime transport. In particular, a fruitful exchange of experiences and analysis of best practices will provide staff from all ports in the area with a solid knowledge base to improve their planning skills.

2. **Reduction and monitoring of environmental impact of maritime transport.** In order to assess the effectiveness of different alternative measures, a comprehensive picture of the existing emissions for the area is required. To this end, all the ports involved in the SUSPORT project have been required to provide data to assess the emissions of Green House Gasses (GHG) according to a common methodology which considers both terrestrial and maritime sources.

3. **Creation of a permanent cross-border cooperation structure** on environmental sustainability and energy efficiency of maritime transport. Based on the results achieved, SUSPORT will develop a cross-border strategy to strengthen port environmental sustainability and energy efficiency, which the project partners will commit to applying in the medium and long term by signing of a joint protocol, which will lead to institutionalization of a permanent cross-border cooperation network.

Given the articulated governance of a system, compounded by transport stakeholders of different nature in the private (enterprises, operators, logistic hubs, infrastructure providers, transport associations, education and training organizations) and public (local, regional and national public authorities) sectors, an important focus has been put within the set-up of an omni-comprehensive framework, able to reach and involve these broaden groups of stakeholders and to communicate effectively the key messages identified with several communication means.

2. SUSPORT FRAMEWORK

2.1. Project Approach

SUSPORT intends to address the challenges in the Programme Area, jointly strengthening institutional and operational capacity building related to the key issue of port environmental sustainability and energy efficiency.

This wants to be achieved by increasing the skills of the ports, stocktaking existing studies and solutions under a new approach.

This phase of increasing skills leads to the drafting of a cross-border environmental sustainability and port energy efficiency model, which will be developed by the project partners in all ports of the Programme Area.

In these plans, each port is listed tailor-made actions, including the potential use of alternative fuels such as LNG and OPS, to be implemented in the near future.

Furthermore, these plans have been tested in each port with concrete pilot actions complementary to each other, ensuring both a fruitful exchange of experiences between all ports and a tangible result in terms of strengthening environmental protection and decreasing greenhouse gases.

All project activities have been developed across borders, involving all ports in the Program Area – from Trieste to Bari, from Rijeka to Dubrovnik - improving institutional cooperation in environmental sustainability and energy efficiency at cross-border level, with benefits on both sides of the border.

Because of the cross-border cooperation framework and transnational nature of TEN-T corridors to which ports belong where it is tested, this approach goes well beyond the regional and national approaches, coordinating project partners with different and complementary expertise: core and comprehensive ports, regional entities and academic/competent research institutions, resulting in a cross-border multidisciplinary and institutional multilevel cooperation.

Based on the results of the work done within the technical project's work packages (WP3 and WP4), where respectively the baseline situation was delineated and feasibility studies and pilot actions were tested in the different territories, the present document is addressing the definition of **a strategy for enhancing cross-border environmental sustainability and port energy efficiency** through the creation of a long-term cross border institutional cooperation framework, by capitalizing the efforts made so far.

2.2. Cooperation Needs

Cooperation between the various institutions operating in the Program Area is a crucial factor in ensuring its competitiveness.

This is also true for collaboration between ports: the Programme Area has main ports belonging to the TEN-T network some of which have been cooperating for years in various sectors, but not all of them together in that of environmental sustainability and energy efficiency.

Furthermore, this cooperation has so far excluded minor ports: Chioggia and Monfalcone, recently passed under the authority of the ports of Venice and Trieste respectively, and Porto Nogaro is a commercial port under the competence of a local development agency.

However, all ports face common challenges: improving air quality (impact at the local level) and reducing greenhouse gases (impact at the global level), at the same time guaranteeing a fluid and fast transit of the goods to ensure the economic and social development, all the more necessary as traffic flows are common, i.e., the same ships call in all ports of the Program Area.

Therefore, the challenges cannot be addressed only at the local level, as not only do they have a cross-border character, but also their solution implies a shared approach.

The only way to enhance institutional capacity in port environmental sustainability and energy efficiency is to adopt a joint long-term approach. In fact, only by adopting a common model of planning environmental sustainability and energy efficiency as part of a coordinated and permanent governance plan, ports will be able to guarantee both environmental protection and economic development in the Programme Area, with benefits on both the sides of the border.

This cross-border approach is wanted to be applied throughout the duration of the project, by the active participation of all PPs in all WPs applying the elaborated cross-border action plan at local level, thereby combining transport and cross border territorial development.

2.3. Relevant Objectives

Considering the outcomes of the analyses conducted and much more of the interactions observed both within the project partnership and towards the institutional stakeholders interviewed, SUSPORT aims at setting relevant objectives to be pursued, so as to contribute to the topic of the improvement of environmental sustainability and port energy efficiency at cross-border level.

In this purpose, SUSPORT Project suggests to consider the following objectives as fundamental to be considered by all Institutions and Subjects that can determine the successful development of the maritime and multimodal freight transport:

- **OBJECTIVE_1: To enhance the competences of involved ports on environmental sustainability and energy efficiency.**
  SUSPORT will increase the skills of all ports in the Programme Area in improving joint planning of environmental sustainability and port energy efficiency through a constant exchange of experiences between partners and a benchmark analysis with best practices at European and international level. In particular, the common points and the differences between the ports of the Programme Area and those in which there are already advanced experiences in this sector, such as Barcelona, Antwerp, Rotterdam, the North Sea and California will be analyzed. Indications and suggestions will be drawn up that can also be replicated in the Adriatic.

- **OBJECTIVE_2: To harmonize measures and policies on port environmental sustainability and energy efficiency.**
  The knowledge learned will be transferred into a common cross-border model of port environmental sustainability and energy efficiency, which will be developed in each port and tested by project partners through complementary pilot actions, allowing ports to combine environmental protection and efficiency in the transit of goods. Experimentation in different areas related to environmental sustainability and energy efficiency and the related exchange of experiences will have a multiplier effect on the competences of the partners, who will be able to replicate the results in their own territories, thus harmonizing environmental and energy policies.

- **OBJECTIVE_3: To provide a strategic framework for port environmental sustainability and energy efficiency.**
  The results of the project will be included in a cross-border strategy to strengthen port environmental sustainability and energy efficiency, which will be applied in the medium and long term by the project partners, signatories of a joint protocol. Therefore, SUSPORT will create an institutional platform for long-term cooperation, cross-border governance of environmental sustainability and energy efficiency that will allow information, knowledge and, best practices to be shared in a long-term perspective, also contributing to EUSALP, EUSAIR and EUSDR.

3. SUSPORT RESULTS

3.1. Background and Area of Interest

Through the technical implementation activities, SUSPORT was able to foster the enhancing the environmental sustainability and energy efficiency of the ports in the Programme Area through **increased institutional cooperation to create the basis for coordinated and permanent governance in the context of port environmental sustainability and energy efficiency at cross-border level**, jointly developing action plans and a long-term strategy, increasing coordination and cooperation between ports to strengthen sustainability and competitiveness.

Since the quality of a project depends largely on an adequate composition of its partnership, able to pool all skills and competences of relevant institutions in order to achieve the set of project results and having the capacity to create strong links to target groups addressed by the project, the territorial involvement has generated the following results in terms of **entities/subjects directly touched by the project fulfillment:**

- 13 municipalities - Trieste, Monfalcone, San Giorgio di Nogaro, Venezia, Chioggia, Ravenna, Ancona, Bari, Rijeka, Zadar, Split, Ploče and Dubrovnik
- 9 regions - FVG, Veneto, Emilia-Romagna, Marche, Puglia, Primorje-Gorski, Zadar, Split-Dalmatia, and Dubrovnik-Neretva
- 12 ports - Trieste, Porto Nogaro, Venice, Ravenna, Ancona, Ortona, Bari, Rijeka, Zadar, Ploče, Dubrovnik, Split
- 2 scientific subjects - Venice International University, ITL Emilia-Romagna

Figure 1- Geographical area of interest of SUSPORT.

Furthermore, some institutional subjects have been involved into the project on a cooperation level:

- 3 European Macro-strategies - EUSAIR, EUSALP, EUSDR
- 2 national Ministries of Transport – Italy, Croatia

3.2. Methodological Assessment

In the SUSPORT project, the preliminary phase is devoted to creating the basis for the development of the specific pilot actions planned for the next steps. Two are the main activities carried out in this context: the **Best Practices Analysis (BPA)** and the **Territorial Needs Assessment (TNA)**.

The BPA is carried out by all the partners of the project. Here, a collection of actions, pilot projects and/or experiences is provided dealing with the improvement of environmental sustainability and energy efficiency within the port areas. The collection encompasses all the port operations as well as the environmental policies already put in place by port authorities worldwide.

Moreover, the selection has been carried out by focusing on the added value that the best practices can provide to the SUSPORT project to maximise the expected impacts of the pilot actions which will be performed subsequently.

Therefore, the main aim of the collection is to select the most relevant best practices regarding the enhancement of environmental sustainability and port energy efficiency to improve the information sharing among the project partners and the public audience. The contributions have been collected by means of a template file requesting a description of the selected best practices and the added value for the project area and activities. No geographical limitations were imposed.

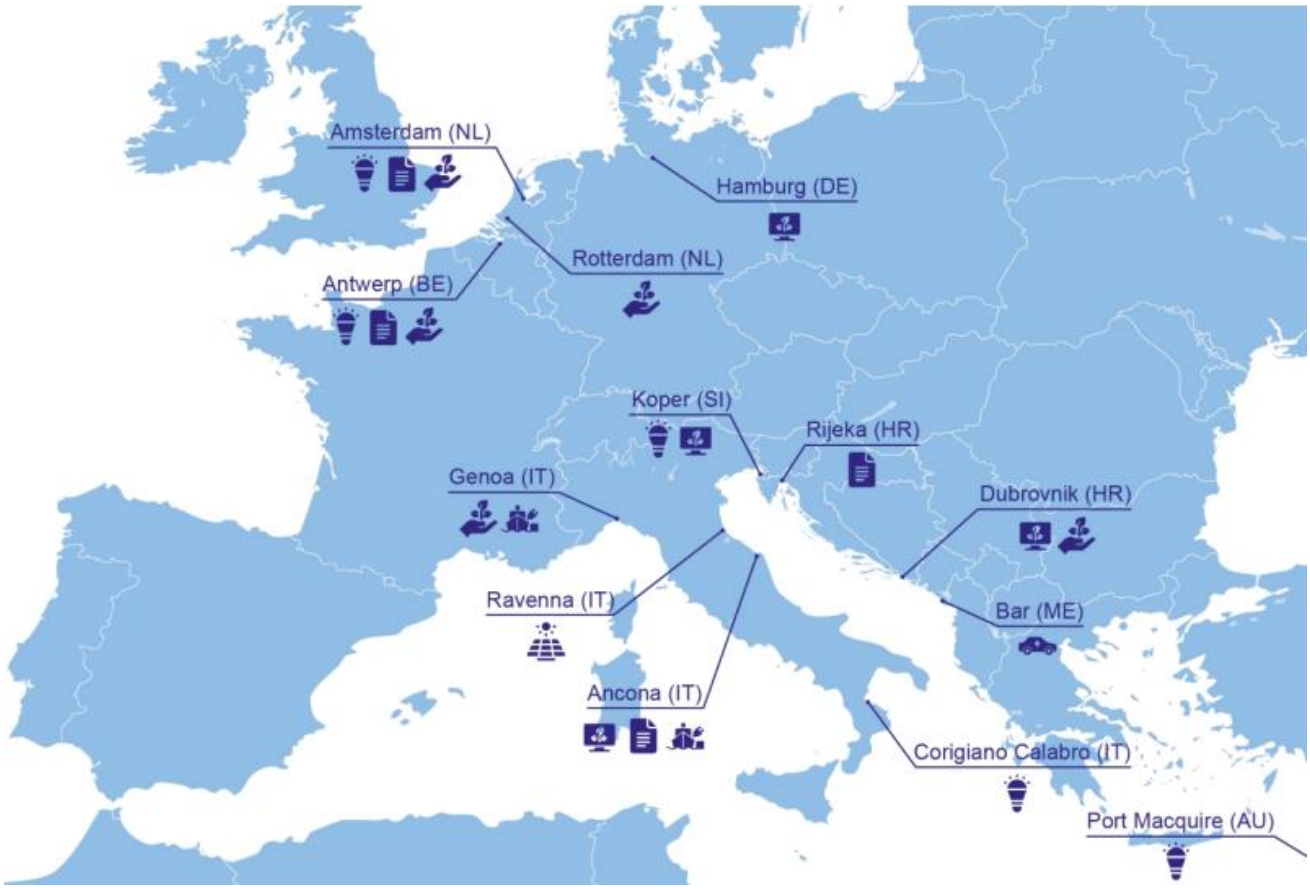

Figure 2- Selected best practices location.

A total of 27 best practices have been collected. Most of them deal with technologies, solutions or policies adopted in a specific port. Figure 2 and Table 1 provide an overview of the results.

Best Practice	Location
Port of Amsterdam smart public lighting on DC	Amsterdam (NL)
ECO-solutions deployment in the Ports of Amsterdam	Amsterdam (NL)
Overall sustainability strategy	Amsterdam (NL)
Port Authority-CNR agreement to reuse the former Fincantieri building	Ancona (IT)
PIA – Progetto Inquinamento Ancona	Ancona (IT)
Ancona Blue Agreement	Ancona (IT)
Onshore power supply	Ancona (IT)
Analysis of energy consumption	Ancona (IT)
Interact City in the Port of Antwerp	Antwerp (BE)
ECO-solutions deployment in the Ports of Antwerp	Antwerp (BE)
Overall sustainability strategy	Antwerp (BE)
Electric vehicles for Port of Bar	Bar (ME)
Public lighting in the port of Corigliano Calabro	Corigliano Calabro (IT)
ECO measuring station by Dubrovnik Port Authority	Dubrovnik (HR)
Alterenergy project	Dubrovnik-Neretva Region (HR)
Green initiatives	Genoa (IT)
Cold ironing in the port of Genoa	Genoa (IT)
Advanced technology solutions for the port operations and management	Hamburg (DE)
Introducing high-efficiency lighting technologies	Koper (SI)
Monitoring can bring savings	Koper (SI)
LED Street Upgrade	Port Macquire-Hastings (AU)
Photovoltaic system on the roof of the Port of Ravenna Authority headquarters	Ravenna (IT)
Low Carbon Transport Plan	Rijeka (HR)
Carbon footprint and sustainable initiatives	Rotterdam (NL)
Ecoports network - UE	
Ports in Adrion Region - UE	

Table 1. Complete List of the Best Practices Collected and Analysed During SUSPORT Project.

Besides, the current performance of Adriatic ports had to be assessed in order to gauge the impact of the measures that will be implemented by the port authorities in the next phases of the project.

In this context, Venice International University elaborated the common methodology to carry out the territorial needs assessment (TNA), with particular attention to the evaluation of the carbon footprint related to onshore and maritime operations in the port areas.

In more detail, the scope of TNA is to assess the state-of-the-art situation in terms of the carbon footprint of the port area. Data related to 2019 was employed, including both terrestrial and maritime emissions. Terrestrial emissions comprise electric energy, heating, port service vehicles, port operational vehicles, heavy-duty vehicles, railway tractors. Maritime emissions were decomposed into the ones related to anchored, manoeuvring and moored ships. This initial status was the base for the development of the next steps and the evaluation of project impacts. Besides, to support overall assessment, the involvement of key stakeholders is essential. Hence, TNA elaborated a complete mapping of the local stakeholders in terms of their relevance. Moreover, actions for their active involvement were considered and defined.

Finally, a Strengths Weaknesses Opportunities and Threats (SWOT) analysis was carried out to key internal and external factors perceived as important to achieving project objectives.

According to the common methodology, each port prepared a document including the peculiarities of each port area, the mapping of stakeholders, the current carbon footprint, and a SWOT analysis to deliver the factors involved in reaching the main project goals. Following, each Port applies the common, cross-border model at local level by drafting a local action plan for enhancing port environmental sustainability and energy efficiency, identifying measures to be realised in the short, medium and long term to tackle the challenges assessed in the TNAs, as well as funding needs and opportunities.

Furthermore, the methodology for the territorial needs assessment and the **cross-border model action plan** for enhancing port environmental sustainability and energy efficiency is replicable to any other port since these issues affect all ports in and outside the Programme Area.

3.3. Identification of Territorial Needs

PORTS OF TRIESTE AND MONFALCONE

The "carbon footprint" for the ports of Trieste and Monfalcone has been analysed based on the common methodology developed by WP Leader. In order to determine the greenhouse gas emissions in the port area, a data collection system was used for all port users through the implementation of a specific online questionnaire developed on the Open-Source platform called "Limesurvey". This system allowed each participant to access a personalized private area, within which the different types of plant, vehicle or equipment possessed, potentially capable of releasing greenhouse gases, in addition, of course, to the consumption of fuels and energy carriers related to them.

On the basis of the analyses carried out, the first consideration concerns the importance of the most impacting activity in terms of greenhouse gas emissions, which is that deriving from the stationing of ships on the quay, representing 66.1% of the total emissions of CO2eq in the port area.

The study as a whole confirms that the activities that generate the greatest emissions in absolute value are precisely the ships at mooring and, “Land side”, the traffic of heavy port operating vehicles.

Furthermore, the present “criticalities” are in fact common and similar to those of the other ports in which the electrical connection systems for the ships on the quay have not yet been implemented and made operational.

From TNA analysis (including SWOT) emerged some possible future activities related to SUSPORT project:

- it is necessary to invest in new technologies able to reduce the impact of the port on air pollution and greenhouse gas emissions;
- it is necessary to overcome the shortcomings in the process of adopting internationally recognized and validated standards.

PORT OF PORTO NOGARO

The Aussa - Corno industrial area has a port known as 'Porto Nogaro' which is composed of the two public structures of Porto Nogaro 'Vecchio' (located near the town of Porto Nogaro), the Porto Margreth structure and the private quay of the former Industrie Chimiche Caffaro, which is reached by the Banduzzi artificial canal.

The "carbon footprint" has been analysed with the aim of defining the emission status in terms of CO2 equivalent of the Porto Margreth, according to the methodology described in the UNI EN ISO 14064 standard, which identifies carbon dioxide equivalent (CO2eq) as the unit of measurement for assessing GHG emissions, as established by the Convention on Climate Change (UNFCCC).

The analysis shows that in the port area the activities that generate the most emissions are those related to the hotelling of ships at the quay (90%). However, emissions from ships manoeuvring (4%) and those from operational vehicles involved in the handling of goods (4%) are also significant.

Furthermore, the final energy consumption referred to 2019 and related to thermal and electric vectors and to the traffic of ships and vehicles of the subjects have been considered, as they are the most relevant from an energy and environmental point of view.

In particular, it has been highlighted that the most energy-consuming and impacting activities are closely related to the quayside vehicles used for the handling of goods and the parking and manoeuvring of ships on the quay.

Main takeaways from TNA:

- it is necessary to define more effective and timely measures aimed at reducing polluting emissions in the port;
- it is fundamental to invest in new and most environmentally friendly technologies with the aim of improving energy efficiency and produce energy from renewable sources;
- it is important to promoting the use of renewable energy in the port area through the introduction of rules, priorities, facilitations, incentive mechanisms etc.

PORTS OF VENICE AND CHIOGGIA

As one of the partners of SUSPORT, NASPA (North Adriatic Sea Port Authority) is an independent public body according to the Port Italian Law in force. Its task is to guide, plan, promote and monitor port activities in the European Core port of Venice and European Comprehensive port of Chioggia, which was recently merged in 2017. It is also in charge of maintaining infrastructures and dredging, overseeing the supply of services of general interest (Nautical services among them, waste management and others), managing the State Maritime Property and planning the development of the port.

Strategically located at the top end of the Adriatic Sea, at the intersection of the main European transport corridors and of the Motorways of the Sea (MoS), the Port of Venice is in a position to act as the European gateway for trade flows to and from Asia. The Port of Venice's position means it can act as the main entry point to a vast area of central Europe - including amongst others North-Eastern Italy, Austria and Bayern - in addition to Eastern Europe and some of the European Union's most dynamic markets.

The Port of Venice is also the northernmost terminal of the Motorways of the Sea that cross the Eastern Mediterranean and connect Central Europe with North Africa and the Middle East. Along with other North Adriatic ports, it is in the right place at the right time to exploit its geographical advantage of being the closest point to the heart of manufacturing Europe, saving 5 sailing days on a typical trip from Shanghai to Munich, saving also 135 kg/TEU of Co2. It is one of the major European ports for project and general cargo, and one of the main port in the Adriatic for the number of containers handled.

A leader in many traffic segments, it is the only port in Italy with access to inland waterways trough the Po Valley (Mantua and Cremona), benefitting from a river port providing freight transport by barge along the Po River, helping decarbonizing transport. Its aim is to build a "Model Port" that respects the environment, is safe, open and ethical.

Considering the results of the "carbon footprint" of both the Port of Venice and the Port of Chioggia and therefore, more specifically, the summary of the overall emissions associated with the various functions rearranged by incidence of the total CO2 value, the two areas of activity that have the

greatest impact are those relating to "Naval traffic (Mooring phase)" and "Naval traffic (Manoeuvring phase)".

If considered in relation to the four typical categorizations of the SWOT analysis, this can be seen as a “weakness” for NASPA (North Adriatic Sea Port Authority), since any impacts of the naval sector on the port system do not derive from management and environmental aspects directly manageable and verifiable by NASPA. On such management and environmental aspects, NASPA can only exercise an influence, however significant, by carrying out orientation and coordination functions towards the various stakeholders involved in these activities.

In this context, NASPA expressed some solutions as a possible direct implementing subject from TNA:

- it is important to implementing of preparatory studies on new technologies and fuels with low or zero "carbon footprint" for the energy transition;
- it is necessary to invest in actions related energy efficiency such as the replacement of diesel/petrol powered cars with electric ones, the replacement of traditional lighting systems with LED lighting systems, or the construction of photovoltaic systems on state-owned buildings, etc.

PORT OF RAVENNA

The Port of Ravenna, which is administered by the Port System Authority of the central-northern Adriatic Sea (AdSP), handles about 5.3% of the goods of the Italian Port Systems and is distinguished by the traffic of solid bulk and packaged goods, for which it holds the greatest handling in absolute terms of tons and in relative terms among all Italian ports: 16.3% of solid bulk and 30.1% of various goods in 2017.

Thanks to its strategic position in the Adriatic Sea, and above all to one of the most dynamic economic areas in Italy, the port of Ravenna is one of the hubs of reference for national and international ports; the airport is a leader in Italy for trade with the markets of the eastern Mediterranean and the Black Sea and plays an important role for those with the Middle and Far East.

The methodology to assess the port emissions for the Port of Ravenna refers to the UNI EN ISO 14064 standard, which identifies the equivalent carbon dioxide (CO2eq) as a unit of measurement for the assessment of greenhouse gas emissions, as established by the Convention on Climate Change (UNFCCC).
According to the results of the carbon footprint of the Port of Ravenna, the main CO2 emissions are attributable to the maneuvering and mooring phase of the ships entering the port.

Port authorities and other port stakeholders have a small margin of impact in deciding how to reduce these emissions. Actions for the reduction of these emissions must involve authorities and subjects

at the highest level (e.g. as European and International bodies). However, communication policies at the local level can be considered as a first step towards reducing maritime emissions.

Other imported emissions concern operational port vehicles since most of them are powered by diesel. According to the SWOT Analysis, these machines have a long useful life and high costs, therefore their replacement with machines with reduced emissions could be not very effective, especially at an economic level. Therefore, one might think of starting to replace some with more efficient ones as they reach the end of their life.

From TNA, it has been concluded that the implementation of some improvement actions as follows could give immediate and significant results for the overall emissions of the port area:

- the replacement of diesel vehicles with other hybrids or electric ones;
- the implementation of some initiative in the docks that allows to reduce the consumption of electricity, such as cold ironing that could provide shoreside electrical power to a ship at berth while its main and auxiliary engines are turned off.

PORT OF ANCONA

The Port of Ancona is located in the middle of the Italian Adriatic coast. The port is spread out over an area of 1.4 million square meters and consists of passenger and ferry terminals, container and general cargo facilities. The port has a key function in the Adriatic-Ionian Macro-Region as a terminal of the international ferry routes to Greece, Croatia and Albania.

Container traffic has developed in recent years, exceeding 150,000 TEUs per year of traffic and attracting major carriers of container transport worldwide. Also, in this sector, the port of Ancona reveals its vocation as a "Gateway to the East" at the service of the market basin of central Italy, as in the ferry traffic and bulk carriers of the port.

According to the results of “carbon footprint” analyses related to the Port of Ancona, the overall emissions are mainly due to ships at berth, responsible for almost 83% of the total amount, and, generally, maritime emissions represent more than 95% of total emissions. Road traffic in the port area is responsible for less than 3% of total emissions while direct and indirect emissions related to buildings and public lighting plants represent almost 2% of total emissions.

As discussed in the Port Environmental Energy Plan published in 2019 (DPEASP – Documento di Pianificazione Energetico Ambientale del Sistema Portuale), one of the possible solutions that could reduce the amount of emissions of ships at berth is the electrification of the docks dedicated to the mooring of ships (the so called “cold ironing”).

Auxiliary diesel generators that power cargo handling equipment and other ship's services while in port are the primary source of air emissions from ships at berth; cold ironing mitigates harmful emissions from diesel engines by connecting a ship's load to a shore-based source of electrical power, such as cogeneration systems or renewable energy plants (e.g. photovoltaic systems), that could drastically reduce the indirect emissions due to electricity consumption.

This solution could lead to a significant reduction of the atmospheric pollutants emission, of GHGs emission, if partially covered with renewables, and finally also of acoustic impact.

PORT OF BARI

The Port of Bari is included in Port System Authority of the Southern Adriatic Sea (AdSP MAM) which also includes the ports of Brindisi, Manfredonia, Barletta and Monopoli.

The Port of Bari is located in the north-west of the old city, its boundaries are included to the west by the San Cataldo pier and to the east by the new Foraneo pier. The initial construction of the Bourbon pier (1853), thanks to its functionality, made it become the reference point for maritime and land trade in the province of "Terra di Bari" in the second half of the nineteenth century.

From the analysis of the equivalent CO2 emissions emitted within the AdSP areas it is pointed out that the greatest contribution in the overall GHG emissions comes from moored ships and heavy vehicles (respectively 67% and 26%).

From TNA analysis (including SWOT) emerged some possible future activities related to SUSPORT project:

- it is necessary to experiment with the latest detection technologies and the attached mass storage digital ecosystems that aim to reduce emissions and pollutants;
- it is fundamental to increase the productivity of the port without neglecting the safeguard of the environment, exploiting renewable resources with low environmental impact.

PORT OF RIJEKA

The Port of Rijeka Authority is responsible for the port of Rijeka, which is a development-oriented port with port basins specialized in types of cargo. The port includes a number of port basins: Rijeka, Sušak, Bakar and Omišalj (island of Krk) and Raša in Istria, which makes it the largest and most important national port.

The results of the "carbon footprint" analyses related to the Port of Rijeka were used to determine emission sources, track emission trends, and provide the information needed to determine where ports can focus efforts to reduce their greenhouse gas (GHG) emissions.

Based on the collected and analysed data, an analysis of ecological sustainability and energy efficiency was made through the production of a carbon footprint of the observed area related to terrestrial and marine greenhouse emissions. Greenhouse gases retain heat in the atmosphere and heat the planet, and the most responsible for the greenhouse effect include carbon dioxide, which is also the most important gas, methane, nitrous oxide, and water vapor and fluorinated gases.

According to the IPCC methodology followed it has been obtained that total greenhouse gas emissions for the port area amount to 24,128.66 t, of which the dominant part of as much as 84% refers to marine emissions, while the remaining part of 16% refers to land emissions. Within maritime emissions, the largest share or 72% refers to moored ships, followed by 18.43% to anchored ships, while manoeuvring ships account for 5.03% of total emissions. Regarding terrestrial emissions, the largest share of 51.31% refers to cargo handling equipment, followed by electricity 26.10%. The lowest share of emissions refers to vehicles (work and cargo) with 10.36% and 12.21%.

The port of Rijeka is the most important intermodal center and is the main cargo entry-exit port for Central and Eastern Europe in the Republic of Croatia, which can have its opportunity in the development of the port as sustainable and green.

Sustainable development can be implemented through a variety of measures to reduce greenhouse gas emissions, increase energy efficiency, etc. In the decision-making process on the appropriate set of measures, account must be taken of the specificities of the port area concerned (location features, existing infrastructure, organisational arrangements with respective competences, services/products/activities carried out, national/regional/local regulatory framework, etc.), as well as to the needs and objectives and financial opportunities. Cooperation from all stakeholders is also important for successful implementation of measures.

Therefore, based on the SWOT analysis and the good practice examples 12 potential and advisable measures have been identified, with them having a positive impact on climate change, air quality, waste, noise and/or light pollution, and focused on the opportunities from the port side. Proposed measures and their possible implementation dynamics were agreed with the Port of Rijeka Authority.

The proposed measures include the following:

- Modernisation of lighting at the pier
- Construction of connection for electrical charging stations
- Purchase of electric vehicle
- Energy consumption monitoring system
- Onshore power system
- Installation of onshore photovoltaic panels
- Limitation of speed for ships in the port vicinity at a level of voluntary participation
- Energy renovation of buildings

- Use of alternative energy sources in land transport and machinery operation
- Education for employees in the field of sustainability and energy efficiency
- Application of noise reduction technologies and principles
- Preparation of a Waste Management Plan for the whole area of Port of Rijeka Authority

The possible timeline for the implementation of the proposed measures refers to the period 2021-2030 following the vision of Port of Rijeka Authority until 2030.

PORT OF ZADAR

Zadar plays an important role as a transport center of Croatia, where the northern continental transport routes meet the Adriatic Sea and connect to the sea routes, the motorway (A1), the railway and airports. It is classified as a port on the comprehensive TEN-T network. Port of Zadar is located in one of the largest Croatian counties- Zadar County in the very center of the Croatian side of the Adriatic coast. The City of Zadar is an economic, administrative and cultural center of the county and fifth largest city in Croatia.

Port of Zadar meets all traffic and transportation conditions and requirements at international, national and local levels. It is also an important connection between ferry terminals located along Croatian coast and along the Adriatic and Mediterranean coast.

According to the results of "carbon footprint" analyses related to the Port of Zadar, the overall GHG emissions in the Port of Zadar for the year 2019 were found as 4351.6 tons CO2 equivalent which is minor when compared to the EU statistic.

GHG emissions in the Port of Zadar are very specific and there are no significant terrestrial GHG emissions. Shore-side emissions are produced indirectly by electrical energy consumption or directly from road vehicle traffic inside the port area and from the natural gas boilers used for heating. Terrestrial emissions make only 7.6% of overall GHG emissions in Port of Zadar, maritime emissions account up to 92.4%. Largest terrestrial GHG producer is road transport, partially due to the relatively long ferry approach inside the port area of almost 1 km, however expected emission from this category will undoubtedly decrease in the coming years due to the increasing share of electric vehicles.

Largest part of the emissions is attributed to the large cruise ships, which is very important considering their small numbers. Enormous 85.6% of all emissions are caused only by cruisers mooring, making them an ideal candidate for any measures towards reduction of GHG emissions.Therefore, main takeaways from TNA as follows:

- it is necessary to implement different activities to decrease emissions, among which shore-to-ship power supply could provide most benefit. Such systems could be installed only for cruise ship arrivals, as ferries produce relatively small mooring emissions;

- it is important to ensure enough electric capacity for future growth. This electric capacity is ultimately aimed for expected cruisers staying for more than one day but also for all other types of e-vehicles: e-taxi boats and e-ferries. Great perspective is shown for installing Photovoltaic (PV) panels in order to ensure green electricity in the port area. PV power generation systems are plants with solar modules mounted on fixed metal supports at an optimal angle to the horizontal surface and oriented to the south and they represent environmentally friendly energy source.

PORT OF PLOČE

The strategy of the development of the Port of Ploče is still aimed mainly at meeting the needs of the economy of Bosnia and Herzegovina, and by building modern infrastructure inland, the port will be able to offer its services to the markets of central European countries that it has already served before.

The Port of Ploče is a universal purpose port which means that it serves to transship almost all types of cargo that appear in international shipping. Within the port itself there are areas specializing in the service of certain types of cargo.

16,5 million tons of CO2 were emitted from the territory of the Republic of Croatia in 2020, accounting for 0,06% of global CO2 emissions.

Additionally, according to the results of “carbon footprint” analyses, the total amount of CO2 emissions in the Port of Ploče in 2020 was 2,586.99 tons, therefore allowing Port of Ploče to be classified as an area with low CO2 emissions. However, also based on the CO2 release calculation carried out, it is evident that there are possibilities to further improve, i.e., reduce CO2 emissions in both terrestrial and maritime part of the port activities.

From TNA analysis (including SWOT) emerged some possible future activities related to SUSPORT project:

- it is important to optimize inbound cargo operations by introducing new technologies such as "Cold Ironing", or "Shore-2-Ship" whereby the need for the operation of auxiliary vessel engines would disappear, i.e., CO2 emissions would be eliminated during the vessel's anchoring/hoteling phase in the port.
- it is fundamental to implement activities (e.g. the introduction of LEDs instead of metal-halide public lighting replacement, replacement of inadequate air conditioning systems in the administrative building, etc.) aiming at reducing electricity consumption, which will also directly affect in reduction of CO2 emissions, as well as other greenhouse gases.

PORT OF DUBROVNIK

The port of Dubrovnik - Gruž is an important transport hub for local, regional and international maritime passenger traffic of the southern part of the Adriatic. In terms of number of arrivals, the most significant is the traffic of scheduled passenger vessels, while the total number of passengers is dominated by the segment of passengers from cruise ships.

According to the results of "carbon footprint" analyses related to the Port of Dubrovnik, the overall CO2 emissions for the Port of Dubrovnik-Gruža were found as 36.850 tons in which most of the emissions are related to cruise ships manoeuvring and mooring in the port, and terrestrial emission count only for the 1,4% of the total emissions.

Considering that Port authority Dubrovnik already started to prepare High voltage shore connection project and maximizing usage of renewable energy sources inside operational area of the port gives as a clear footage of wat are main concerns and target areas. Tackling with maritime emissions in ports is a crucial element of making ports sustainable and friendly to the nearby surrounding.

PORT OF SPLIT

The City of Split is located in Split-Dalmatia County, is the second most populated city in Croatia. The city lies on the eastern shore of the Adriatic Sea and is an integral transport hub as well as a popular tourist destination. Due to its favorable geographical positioning, the port of Split has been able to focus on both passenger and freight transport. The port of Split, according to its purpose is a port open for international traffic, and according to its size and importance, it's ranked as the port of special (international) economic interest for the Republic of Croatia. The port of Split ranks as the first port in Croatia in terms of passenger traffic.

Being a passenger port, most of the GHG emissions in the port of Split are directly related to ship traffic, specifically manoeuvring and mooring. Other sources of GHG emissions are negligible with only significant amounts produced indirectly by electrical energy consumption or directly from road vehicles traffic inside the port area.

Taking into consideration statistics which indicates that an EU citizen on average produces around 7t of CO2 per year (source: EUROSTAT, 2018) it can be calculated that specific emission per passenger and hour represents only 0,00427 tCO2/passenger. This is a very good result because with assumption that an average stay of each of 5 607 789 passengers (total number of passengers in the port of Split for 2019) is approximately 3 hours, the result indicates 7,61 tCO2 per passenger on yearly level. In comparison to an average 7t per EU citizen it is a very good result especially when considering that ports are very intensive areas related to emissions.

However, it is evident that there are possibilities to further improve, i.e., reduce CO2 emissions of the port activities.

From TNA analysis (including SWOT) emerged some possible future activities related to SUSPORT project:

- it is necessary to improve electric lighting through the introduction of LED lighting technology in public port areas used by citizens;
- it is fundamental to catch the trend happening worldwide rapidly about the electrification of ferries and vehicles with the aim of reducing emissions and pollutants. Today's leading technologies are now making it possible for ocean-going vessels to go electric, meaning that entirely battery-powered solutions are being made for ferries and vessels travelling shorter distances, while for longer routes, creating a hybrid solution is more suitable due to higher capacity needs.
- it is important to ensure power supply of ships (cold ironing) that are moored in the port for more than one day. This will open up the problem of connected power for EE in the Port of Split area.

3.4. Methodology Towards the Action Phase

As anticipated the main objective of SUSPORT was to improve planning capacities of the identified stakeholders – e.g., terminal and logistic operators, policy makers, local municipalities – using delivered territorial needs assessment and action plan for overcoming them for the respective region.

Based on the outputs and results of the territorial needs assessments and the best practice analysis, the goal of the subsequent activities was the implementation of concrete pilot actions related to environmental sustainability and energy efficiency of all ports generating freight transport in the Programme Area, as a powerful tool to enhance the ports' overall environmental performance at cross-border level, improving their role as green gateways and corridor roots for the transport of goods.

Although ports focus on similar and complementary aspects of the port operations, from lighting of common port areas, to emobility, from energy efficiency of port building to onshore power supply for moored ships, pilot actions are not identical.

This combination of similar and different pilot activities gives PPs the possibility to learn from each other and transfer the lessons learned by other PPs in the respective territory, with an ensuing **added value at cross-border level**, with competing ports on both shores of the Adriatic having the same traffic flows, the same challenges (impacts of port operations on air quality, greenhouse gases and noise) working together towards the same goal, i.e. improving the environmental performance of ports both in Italy and Croatia in a coordinated way.

Pilot actions are assessed based on a common methodology, commonly evaluating their impact at cross-border level.

Pilot actions will feed the cross-border strategy, the MoU for enhancing environmental sustainability and energy efficiency of port operations, thereby creating a **long-term cross-border cooperation network** and recommendations to Macroregional strategies.

3.5. From Territorial Needs to Pilot Actions

SUSPORT has foreseen the implementation of **13 pilot actions** on environmental sustainability and energy efficiency of port operations, testing the cross-border action plan and the local implementations in order to improve the overall environmental performance of all activities related to port and land-interface maritime transport in the Programme Area and support the role of ports as green gateways.

In this context, ports tested several kinds of pilot actions, ensuring a consistent exchange of experiences and expertise:

- replacement of the existing lightning system with LED light bulbs
- installation of photovoltaic and solar thermal systems
- implementation of e-mobility measures
- improvement of the environmental performance of port buildings
- installations of sensors and stations to monitor noise, air and water quality
- pre-investment studies for on-shore power supply

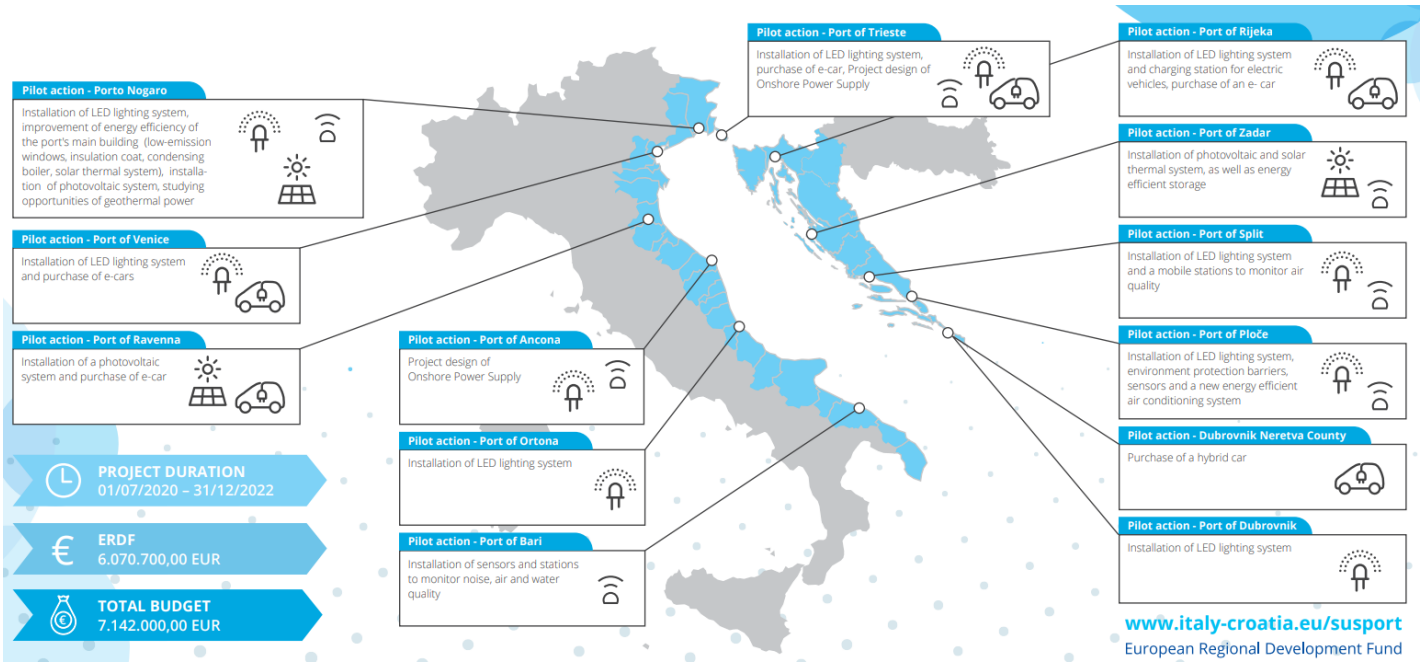

Figure 3- Overview of the pilot actions of SUSPORT project.

Partner	Location	Pilot Action description
LP- Port Network Authority of the Eastern Adriatic Sea (AdSP MAO)	Trieste	**1.** Replacement of the existing lighting system of the public areas, including the port of Monfalcone, composed of indicatively 979 lamps, with LEDs. The estimated energy saving amounts to almost 50%. **2.** Monitoring of the environmental effects resulting from the plan or programme implementation included in the Strategic Environmental Assessment (SEA). **3.** Pre-investment study for the application of on-shore power supply (OPS) in the Port of Trieste. **4.** Purchase two electric vehicles and installation of charging stations
PP1- Consorzio di Sviluppo Economico del Friuli (COSEF)	Porto Nogaro	**1.** Replacement of existing 108 lamps with 200W LEDs. **2.** Improvement of the energy efficiency of the port's main building which hosts the Harbour Master's office, Customs, ONG "Stella Maris", etc. by the use of: a) low-emission windows b) insulation coat of the whole building surface, c) condensing boiler, d) solar thermal system for the production of how water and heating. **3.** Pre-investment study assessing the use of geothermal power.
PP2- North Adriatic Sea Port Authority - Ports of Venice and Chioggia (ADSPMAS)	Venice	**1.** Replacement of existing lighting in the public areas with LEDs. More specifically, the Port of Venice will replace 84 light sources. **2.** Purchase of two electric vehicles. **3.** Purchase of a hybrid plug-in vehicles.
PP5- Port of Ravenna Authority (ADSPMACS)	Ravenna	**1.** Installation of a photovoltaic system whose nominal power will be equal to 130 KWp. The system will be realised on a Platform roof in the yard of the Port of Ravenna Authority. **2.** Purchase of an electric vehicle **3.** Purchase of a hybrid plug-in vehicle.
PP6- Central Adriatic Ports Authority (ADSPMAC)	Ancona	**1.** Technical and economic feasibility study to test the application of innovative technologies for the supply of electric power to the ferries while at port. **2.** Replacement of the existing four high mast lights of the commercial dock with LEDs. **3.** Purchase of 2 hybrid plug-in vehicles.
PP7- Special Agency of the Chamber of Commerce Chieti Pescara (ASVI)	Ortona	**1.** Following an agreement with the Central Adriatic Ports Authority (PP6), PP7 replaces the existing lighting systems in the public areas with LEDs.
PP8- Southern Adriatic Ports Authority (ADSPMAM)	Bari	**1.** Installation of sensors and stations to monitor noise, air (concentrations of PM, pollutant gases) and water quality (turbidity produced by excavations and ship traffic, solid and hydrodynamic transport to the port mouths) and development of a new module in the port' PCS GAIA for its manangement. **2.** Purchase of 2 electric vehicles.

Table 2. Implementation Actions within SUSPORT project (1).

PP9- Port of Rijeka Authority	Rijeka	**1.** Replacement of existing lighting and installation of LED lights port public areas. **2.** Purchase of an electric vehicle. **3.** Installation of charging station for electric vehicles.
PP11- Port of Zadar Authority	Zadar	**1.** Installation of canopies with photovoltaic system for port lightening including charging station for an electric vehicle. **2.** Installation of energy storage system for night consumption. **3.** Purchase of an electric vehicle, including the installation of a charging station.
PP12- Port of Split Authority	Split	**1.** Acquisition of mobile environmental laboratory (MEL), a display showing the measures and development of an IT platform to support data exchange between measuring equipment, port operational centre and display. **2.** Replacement of existing port lightning. **3.** Purchase of one hybrid vehicle.
PP13- Port of Ploče Authority	Ploče	**1.** Replacement of the existing port lightning system with energy-efficient technology. **2.** Purchase and implementation of environment protection barriers. **3.** Installation of sensors and stations for monitoring noise, air and water quality, display to show measurements with related development of IT platform to support data exchange. **4.** Replacement of the existing air condition system in Port of Ploče Authority data center with energy-efficient technology. **5.** Installation of sensors for monitoring dust, energy consumption and air quality, related display for measurements and IT platform to support data exchange. Procurement includes server rack installation and changes, smart Power distribution Units and server equipment. **6.** Micro Data Center solution for Data Recovery site with efficient cooling system and intelligent electrical power distribution. **7.** Digital Green Incident Management.
PP14- Port of Dubrovnik Authority	Dubrovnik	**1.** Replacing of existing port lightning.
PP15- Dubrovnik Neretva County	Dubrovnik	**1.** Purchase of a hybrid vehicle.

Table 2. Implementation Actions within SUSPORT project (2).

4. CROSS-BORDER STRATEGY

4.1. Key Pilot Action Guidelines for Cross-Border Strategy

Considering all gathered and described prerequisites, TNAs, best practices analysis and outlined methodology aligned with the project as a whole, it is possible to derive and outline the following key pilot action guidelines, as a part of the cross-border strategy:

1. Best practices dealing with port environmental sustainability and the improvement of energy efficiency in port areas can be directly applied in the Programme Area as well as in other geographical contexts by considering the needs and objectives, and financial opportunities.
2. The use of monitoring devices that are allowing to the control of the air/water quality and the main sources of pollution (e.g. maritime and road traffic inside the port) play a key role as well as applying a mix of new technologies (e.g. the replacement of public lighting system, electric cars, cold ironing), renewable energy sources (e.g. photovoltaic panels) and IT systems.
3. The culture of collaboration should be sustained with the consistent objective of the institutionalization of a permanent cross-border cooperation network, aiming at better communication and coordination with stakeholders at a cross-border level to share their experiences and expertise, and work together to identify common challenges and solutions.
4. Ports and PPs are advised to propose key pilot actions as a part of cross-border cooperation planning and strategy that rely on this cooperation network, and that will further enhance connectivity and interoperability within scope of the SUSPORT project.
5. The goal of the key pilot actions is aligned with the primary project goal, which is improving the environmental sustainability and energy efficiency in ports in the Adriatic Sea.
6. The results of the key pilot actions should be compared for mutual learning and further future development at the cross-border level.
7. A pilot project plan will be created for implementing a range of pilot actions in different ports throughout the program area, with a focus on promoting energy efficiency and sustainability. This will be done through the preparation of a plan of environmental sustainability and energy efficiency for each port based on a common model, the implementation of concrete pilot actions with a tangible effect, and the harmonization of these policies and measures at cross-border level thanks to the drafting of a joint strategy, applied in the medium and long term even after the end of the project.
8. The impacts of the pilot project plan should be regularly measured on both sides of the Adriatic Sea through a common methodology and established metrics, and the progress toward achieving project goals should be evaluated.

9. In Addition to the key pilot actions and the project plan, policy alignment should be promoted through engaging with national and regional policymakers to encourage the adoption of policies and regulations that support the project's goals, and advocate for the allocation of resources to support its implementation.
10. Some other ways that may be supporting the project goals should be promoted on both sides of the Adriatic Sea through providing training and support to port staff, local communities, and other stakeholders to build their capacity to implement sustainable practices and technologies.

4.2. Key Performance Indicators

Some relevant KPIs have been identified within the framework of the SUSPORT Project and some of them can be considered as general. This can be useful for any further replication or initiatives that aim at fostering port environmental sustainability and energy efficiency, or in order to measure the impact of the key pilot actions and evaluate the progress toward achieving project goals.

N° Indicator	Indicator	Description
1	CO2 emissions reduction (tons per year) in port area	Inclusion of this KPI entices involved PPs (ports) to apply for those key pilot actions that will lower GHG emissions
2	Energy consumption kWh in port area	Inclusion of this KPI entices involved PPs (ports) to apply for those key pilot actions that will allow to efficient energy consumption
3	Percentage of renewable energy sources used at the port	This KPI measures the proportion of energy used at the port that comes from renewable sources, such as solar or hydroelectric power that will allow energy saving
4	Number of the electric/ hybrid plug-in vehicles purchased as a consequence of project involvement	All PPs (ports) should strive to apply for those key pilot actions which are enhancing the sustainability of the ports through the usage of electric vehicles.
5	Number of the existing outdoor lighting fixtures replaced with LEDs as a consequence of the key pilot action execution	All PPs (ports) should strive to apply for those key pilot actions which are enhancing energy saving through the transition to LED lighting fixtures
6	Noise pollution reduction in decibels	Inclusion of this KPI entices involved PPs (ports) to apply for those key pilot actions like the usage o electric vehicles which are working without noise and thereby will allow improving the state of the environment.
7	Number of ports using the sensors and stations to monitor air and water quality	Inclusion of this KPI entices involved PPs (ports) to apply for those key pilot actions that will allow controlling of the air/water quality and the main sources of pollution.
8	Amount of funds leveraged based on project achievements	Maximum available fund utilization within the project scope enables the best possible envisaged project outcome

Table 3. Key Performance Indicators for SUSPORT project.

In addition to these sustainable development actions of the project, there are several external elements that are giving additional support to the primary project goal, thanks to the other strategies and interventions at the national and EU levels, with the shared aim of reducing energy consumption and increasing environmental sustainability, also using renewable energy. In order to have a better understanding of the pillars of the cross-border strategy that will be explored in the next chapter, having a look at the other strategies and interventions external to the project could be helpful.

4.3. External Elements Aimed at Environmental Sustainability of Ports

Environmental sustainability has been the subject of several European projects in the last decades, with the increasing attention to these topics and this led to a large number of actions devoted to reducing the emissions of pollutants and developing new tools and policies to reduce the environmental impact of port operations.

With its Climate Law, the EU has set itself the target of reducing its greenhouse gas (GHG) emissions by at least 55 % by 2030 and aims for climate neutrality by 2050. Of the maritime sector's CO2 emissions, between and 6 and 7 % are generated at berth in ports in the European Economic Area. This calls for a strong focus on the greening of shipping, making port services sustainable and infrastructure for alternative fuels available.

In July 2021, to align the EU economy with the European Green Deal and the sustainable and smart mobility strategy, the European Commission put forward a first set of legislative proposals, the fit for 55 package. The proposals are interlinked and several have implications for ports. These concern maritime fuels, fuels infrastructure, emissions trading, and energy taxation.

The proposed FuelEU Maritime regulation aims to boost the production and uptake of sustainable, low-carbon fuels in maritime transport, and obliges ships to use on-shore power supply (OPS); ports are expected to facilitate both. The rules apply to ships of more than 5000 gross tonnes (GT), regardless of their flag. From 2025, limits would be introduced on the carbon intensity of the energy used by vessels, covering around 90 % of the emissions generated. The supply of electricity from the shore to the ships during the mooring phase allows for minimizing the use of the auxiliary onboard engines for the self-production of the necessary electricity, significantly reducing emissions of CO2, nitrogen oxides, and fine dust, as well as the acoustic impact. From January 2030, ships staying for more than two hours in a port would have to connect to OPS, unless they used another zero-emission technology. Responsibility would lie with the shipping companies. Non-compliance would lead to penalties, which would feed into an innovation fund to finance the production of renewable maritime fuels and other greening actions in the sector. With containerships, cruise ships and passenger ferries using OPS, both greenhouse gas emissions and air pollution in and near ports should decrease.

The proposed regulation on the deployment of alternative fuels infrastructure seeks to ensure the availability of a dense alternative fuels network, including liquefied natural gas (LNG) at EU ports. It

requires that, by the beginning of 2030, at least 90 % of demand for OPS be met in TEN-T maritime ports, and sets requirements for OPS for inland waterway vessels at berth. With containerships, cruise ships and passenger ferries using OPS, both greenhouse gas emissions and air pollution in and near ports should decrease. Furthermore, EU Member States would have to install LNG refuelling points in maritime TEN-T ports, and jointly ensure LNG coverage for seagoing ships to circulate throughout the TEN-T network by 2025.

The EU emissions trading system (ETS) is the cornerstone of the EU's policy to combat climate change and reduce GHG emissions cost-effectively. The proposed ETS review seeks to align the ETS with the EU Climate Law. While requirements for the current ETS sectors will be strengthened, the Commission is proposing to further reduce emission allowances and extend the ETS to the maritime sector by including ships of 5000 GT and more. The system would cover all energy used in European ports and consumed during voyages between them, and 50 % of the energy used during journeys between EU ports and those in a third country. Penalties from the ETS would feed into an innovation fund targeting climate action.

With the revision of the Energy Taxation Directive, the Commission has proposed to tax fuels according to their energy content and environmental performance instead of their volume. Fossil fuels, such as those used as bunker fuels in vessels, will no longer be exempt from taxation in EU ports, but will remain untaxed in ports outside of the EU. From 2023, taxes would be introduced over a 10-year period, requiring sufficient market uptake of alternative fuels.

Hereby, the European Commission welcomes the initiatives taken by the port sector to promote excellence in environmental management and performance. A number of ports have already adopted plans to better manage their footprint on the environment and such initiatives should be encouraged.

In parallel, key maritime and inland ports on the trans-European transport network (TEN-T) need to adapt to the role of strategic multimodal nodes and clean energy hubs.

4.4. Pillars of the Cross-Border Strategy

The whole experience conducted within SUSPORT Project highlighted some pillars of the cross-border strategy and important needs, coming both from the implementation phases of the project and some other strategies and actions that are external to the project but still share the same aim of reducing energy consumption and increasing environmental sustainability.

These pillars of the cross-border strategy can be considered as points of reference in the strategic definition process within national and transnational organizations and also as hints for the development of future Projects in the field of port environmental sustainability and energy efficiency.

For the further steps, it must be agreed to pursue cooperation in the domain of environmental sustainability and energy efficiency considering the following pillars, also through future EU-funded projects and initiatives:

PILLAR 1: DECARBONISATION:

- Enlarge the on-shore power supply also known as “cold ironing” action to improve air quality in the ports.
- Analyse possible carbon pricing mechanisms, such as carbon taxes or emissions trading schemes, to incentivize port users and operators to reduce their greenhouse gas emissions.
- Assess the energy production through renewable energy sources.
- Encourage the use of low-carbon transportation modes, such as electric and hybrid plug-in vehicles, by port employees and visitors.
- Encourage the use of alternative fuels in port operations and transportation.
- Develop a green port certification programme that recognizes ports for their achievements in reducing greenhouse gas emissions and promoting environmental sustainability, being coherent with the EU strategies.

PILLAR 2: ENVIRONMENTAL MANAGEMENT SYSTEM:

- Implement an efficient Environmental Management System, including the so-called carbon management.
- Implement carbon management programmes, to measure, report, and verify their greenhouse gas emissions.
- Report environmental and carbon performance of the ports through sustainability reports, environmental impact assessments, and carbon footprint reports.

PILLAR 3: HARMONIZATION OF POLICIES AND ACTIONS:

- Promote the adoption of common standards and guidelines, and advocate for the integration of environmental sustainability and energy efficiency into relevant policies and regulations at the national and EU levels.
- Develop a common framework for environmental sustainability and energy efficiency that is agreed upon by all participating ports and provide the basis for the standardisation of environmental protection measures.
- Enhance the alliance between the ports to promote collaboration and knowledge sharing on environmental sustainability and energy efficiency.

- Conduct a comparative analysis of the environmental sustainability and energy efficiency policies and actions of different ports in the same region or across borders.

Figure 4 provides an overview of these 3 pillars of the cross-border strategy.

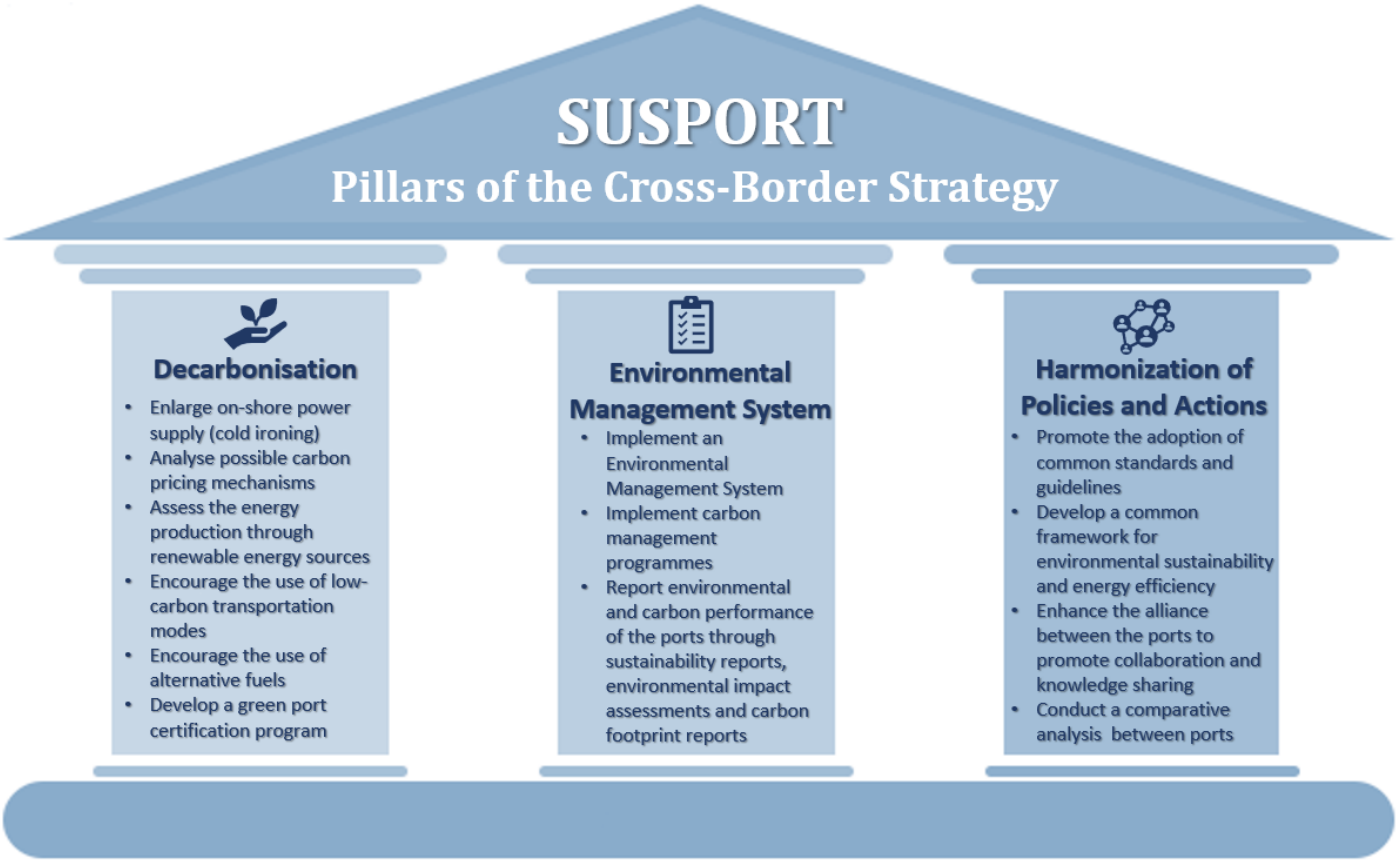

Figure 4- Overview of the pillars of the cross-border strategy of SUSPORT project.

5. CONCLUSIONS AND FINAL REMARKS

Generally speaking, the definition of reliable timing when such complex processes and subjects are involved is hardly estimable.

SUSPORT has tried to implement concrete upgrade actions on the port environmental sustainability of ports and improvement of port energy efficiency, but especially to sustain the idea that every single initiative is important and is empowered by cooperation if a coherent framework has been assessed beneath.

The achievement of significant results in environmental sustainability and energy efficiency cannot be thought only in the short-medium term.

Therefore, it is requested to have a common and continuative effort, promoted by all relevant institutional subjects, sustained by high-level strategies and implemented through cooperative networks.

Besides, all pilot actions have been already finalised with the following results coherent with the main objective of improving the environmental sustainability and energy efficiency in ports of the program area.

For instance, North Adriatic Sea Port Authority purchased two electric cars that are available now to support the operational and institutional activities of the ports of Venice and Chioggia, 100 percent electric with zero emissions. The purchase of these cars will allow them to further reduce the C02 emissions and to travel in a more sustainable and comfortable way also with the complete absence of noise.

Thanks to electric vehicle usage, the Port of Zadar Authority has reduced GHG emissions by 300 kg so far and will continue to do so. Since the vehicle is now charged exclusively from a charger powered by solar panels, it could be said that the vehicle footprint is 0 as energy used is renewable and clean. That means GHG reduction of between 600 and 1300 kg per year.

So far, solar plants have produced 2135 kWh of electricity which is energy equivalent to 643 liters of gasoline or 760 kg of coal and a reduction of 354 kg of CO2.

Another pilot action was purchasing a plug-in electric vehicle (PHEV) to reduce the carbon footprint of DNR (Dubrovnik-Neretva Region) since it can be considered as the most suitable solution for daily use. It is expected that, thanks to the use of the PHEV, DNR will be able to reduce CO2eq emissions by 10 tons/year.

Furthermore, by replacing the existing solutions used in public lighting, the Dubrovnik port Authority will reduce energy consumption, improve light technical parameters and traffic safety conditions, and reduce potential risks of environmental pollution due to the use of environmentally unacceptable lighting fixtures and the occurrence of light pollution.

By replacing the existing lighting fixtures with LED lighting fixtures, the installed power will be reduced by approx. 51%. The projected consumption of old lighting for 4,100 operating hours per year is 310,288 kWh. New lighting should consume 151,130 kWh for the same time period. This saves electricity consumption for the period of one year: 159,158 kWh. Additional savings will also be achieved by installing a public lighting management system.

Moreover, thanks to the SUSPORT project, the Southern Adriatic Sea Port System Authority has strengthened its environmental protection action in its port through the acquisition and installation of sensors and stations to monitor noise, air (concentrations of PM, pollutant gases) and water quality (turbidity produced by excavations and ship traffic, solid and hydrodynamic transport to the port mouths), connected to the VEGA system. Through the functions of the multi-parametric probes and VEGA system, the ports belonging to the Southern Adriatic Sea Port System Authority will become "smarter".

As a result, sustainable development offers many opportunities, such as reducing operating costs (in particular considering reduced energy consumption), increasing the quality of supply, and modern equipment of the entire port (machinery, infrastructure, etc.), promoting and developing the port as a sustainable and green one that advocates public interest and the common good, improving the state of the environment at site level and beyond (reducing noise, pollutant emissions and greenhouse gas emissions to air, light pollution, waste, etc.) which contributes to the satisfaction of local authorities and all citizens with a healthier environment.