Best Practices Analysis

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Introduction

Environmental sustainability and energy efficiency is a challenging objective to be pursued in port areas. In the last decades, increasing attention has been given to these topics, especially in the European context. This led to a large number of actions devoted to reduce the emissions of pollutants and develop new tools and policies to reduce the environmental impact of the navigation and port operations. Several research and pilot projects have been financed by the European Union through different funding programs, providing a quite strong basis that shall be considered by each stakeholder which approaches the topic.

In this context, the SUSPORT project aims to provide its contribution. The project gathers all the main ports from Italy and Croatia, 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. However, as mentioned, to effectively planning the actions to be carried out in the project area, a benchmark analyses of the state of the art in the SUSPORT ports as well as at a European and international level is required. In the project, such an issue is addressed through a best practice analysis.

The present document reports the results of such an analysis. The action has been carried out according to the joint methodology provided in the deliverable D.3.2.1. Here, a collection of actions, pilot projects and/or experiences is provided dealing with the improvement of the 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 focusing on the added value that the best practices can provide to SUSPORT project to maximise the expected impact of the pilot actions to be carried out in the next project phases.

Each partner within the SUSPORT project has been requested to contribute to the best practice analysis, filling a template in order to collect homogeneous information. In detail, for each best practice, the location, description and impact on SUSPORT project have been collected. Then PP03-VIU was in charge to coordinate, analyse, integrate and complement the best practices collection.

Scope of Document

The main aim of this document is to collect the most relevant best practices regarding the enhancement of environmental sustainability and port energy efficiency. The document will contribute to improving the best practices sharing among the project partners and the public audience.

Moreover, together with the territorial need assessment carried out by each project partner, this document provides a solid basis for carrying out the action plan for enhancing the environmental sustainability and energy efficiency of the ports in the Programme Area, which provides the framework for the development of the actions carried out by each port involved in SUSPORT project.

Hence, the best practice analysis will help the joint planning of environmental sustainability and port energy efficiency by improving the exchange of experiences between partners and providing a benchmark analysis at European and international level.

Best Practices

A total of 27 best practices have been collected. Most of them deal with technologies, solutions or policies adopted in a specific port. Here, the best practices have been grouped by location in order to make easier the usability of the document. Figure 1 provides an overview of the results. It can be noticed that most of the best practices are related to European ports. Besides, also best practices dealing with wider networks have been considered. In detail, the ports involved in the Ecoports initiative and the Adrion region have been considered, since they have a direct impact on SUSPORT project area.

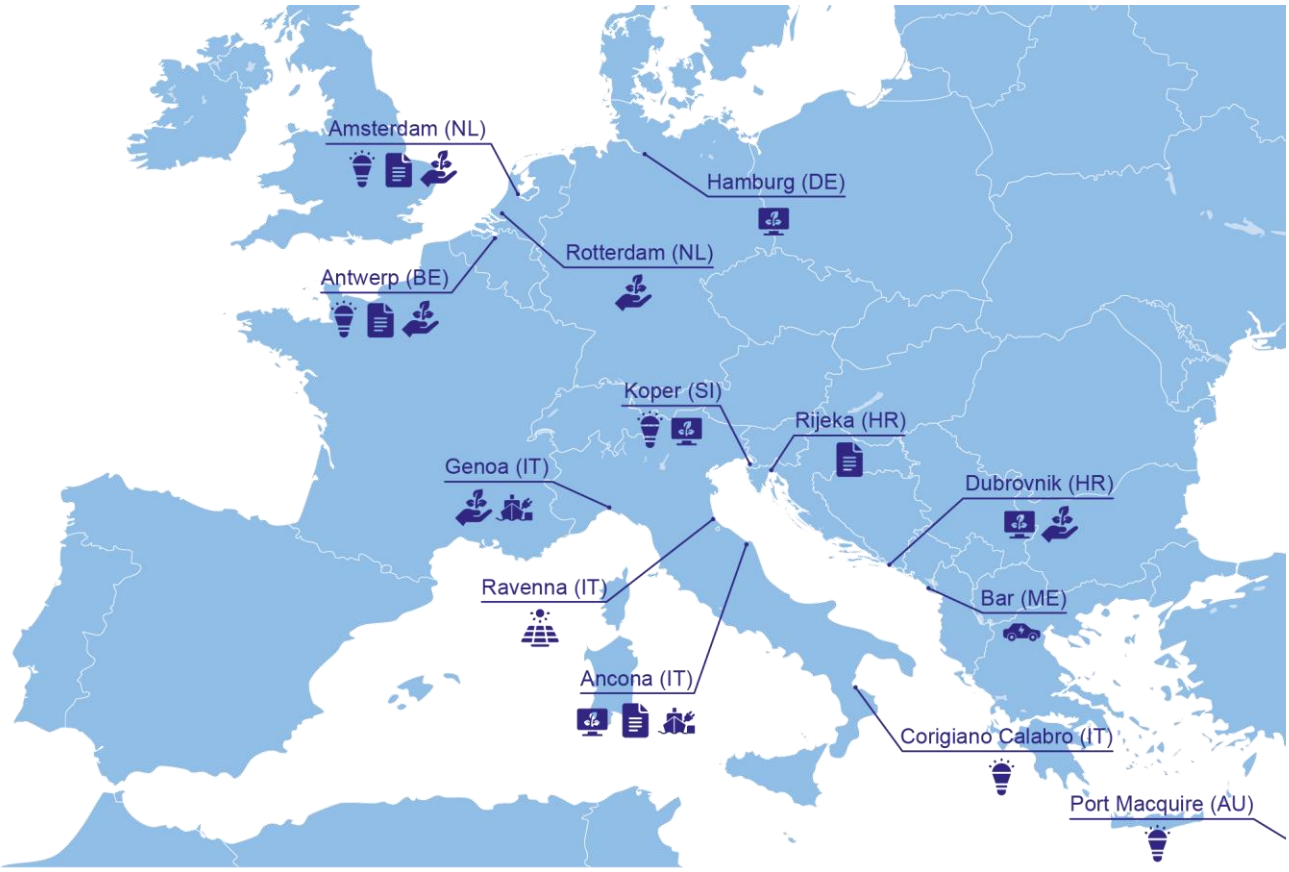

Figure 1 - Selected best practices location

In the following, the selected best practices are described and analysed, focusing on their impact on the SUSPORT project.

Port of Amsterdam - The Netherlands

Three best practices related to the port of Amsterdam[1] have been analysed. The first deals with the application of Direct Current (DC) in public lighting. Since the port of Amsterdam put in place multiple actions dealing with environmental protection and energy-saving, an overview of the most interesting in terms of added value for SUSPORT project has been analysed. Moreover, the port of

[1] Link to Port of Amsterdam: https://www.portofamsterdam.com/

Amsterdam elaborated an overall sustainability strategy encompassing all the port operations and development in a consistent environmental framework.

Port of Amsterdam smart public lighting on DC

Port of Amsterdam initiated a pilot project with smart public lighting on bicycle paths powered by DC (Figure 2). The smart public lighting adjusts to a comfortable light level when there are users of the paths. The installation of the DC grid instead of the regular AC grid and energy sourced fully from nearby floating solar panels and a miniature wind turbine it, makes the street lighting system sustainable and energy and cost-efficient.

Figure 2 - DC powered lighting system in the port of Amsterdam

Added value for SUSPORT / link to pilot actions

Many activities that will be developed in the SUSPORT project will focus on the replacement of existing lighting in the port areas. The learning experience and idea applied in Amsterdam can be used to make SUSPORT’s ports more sustainable and energy and cost-efficient.

ECO-solutions deployment in the Ports of Amsterdam

The Port of Amsterdam is the second largest in the Netherlands in terms of transhipment. It is ranked fourth among European ports and it is considered to be one of the world’s most advanced and committed ports in terms of energy efficiency solutions, sustainable energy generation and storage.

In this framework, from the most valuable solutions to be taken as best practice examples, the following solutions have been selected:

1. Energy Port Policy: Adoption of a dedicated Programme for the transformation of the port to a sustainable 'Energy Port'
2. Installation of solar panels: With the 100,000 m^2 (17 MW) of solar panels installed on port's buildings, the port area is the largest solar farm in the region
3. "Sustainable energy means business": The Port seeks to become an innovative hub for start-ups and companies working in the field of energy efficiency and circular and bio-based maritime economy
4. Cold ironing

Implementing Cold Ironing solutions lessens the environmental impact on areas surrounding ports, particularly in densely populated areas. The Ports of Amsterdam is a great example where cold ironing has been successfully implemented using the locally generated electricity

Added value for SUSPORT / link to pilot actions

The most promising solutions described above in the framework of energy efficiency at the Port of Amsterdam represent valuable references for all SUSPORT project partners as well as for the Italian and Croatian stakeholders.

More specifically, the above described best practices could be taken into consideration while exploring eco-solutions and energy efficiency measures, such as:

- Energy Policy
- Solar panels installation and smart grids
- Sustainable energy and innovation start-ups

On-shore power supply (link to one of the pilot actions of the LP) and generation of electricity from renewables.

Overall sustainability strategy

The port of Amsterdam put in place an overall sustainability strategy which considers all together several sustainability issues affecting shipping, onshore mobility, employment, economic activities, local ecosystem, energy and climate, research and innovation, society, circular economy and safety/security. The overall strategy is focused on the following main topics:

1. Energy transition and circular economy: the port is committed to improving the energy share coming from renewable sources. Besides the interaction between port and city enables better waste management fostering the recycling process. Finally, the port promotes innovation in this field supporting knowledge-based incubators in the port area.
2. Environment and surrounding areas: the port monitors the emissions (including noise, air quality, water quality) and their effect in its neighbourhoods.
3. Clean and safe shipping: the port is improving operations' safety to face increased traffic and reduce accidents occurrence, which could also comprise accidental pollution. Moreover, the port through monitoring of ship emissions and waste produced by ships is fostering the development of clean shipping.
4. Work and knowledge: the port fosters and monitors the new innovative companies in the port area. In particular, companies adopting new technologies and methods based on knowledge or high skills. Besides, employment is also monitored.
5. Chain responsibility: the port promotes and develop a constant dialogue with all the stakeholders.

Added value for SUSPORT / link to pilot actions

The organic approach to environmental issues put in place by Amsterdam port is a good example for the SUSPORT partners, helping in developing an overall sustainability strategy capable to better pursue the SUSPORT project objectives.

Port of Ancona – Italy

The Port of Ancona[2] put in place several environmental actions, agreements and policies in the latest years. These best practices involve a large set of stakeholders including public bodies, shipping companies and the local shipyard. Here several examples are provided and discussed.

Port Authority-CNR agreement to reuse the former Fincantieri building

A place where beauty, science, history and a part of the future of the port of Ancona meet. It is the building located in the Porto Antico, adjacent to Fincantieri, and which will become the new headquarters of the Institute for Biological Resources and Marine Biotechnologies of the National Research Council (CNR) of Ancona[3]. The signing of the agreement between the president of the Port System Authority, Rodolfo Giampieri, and the director of the Cnr Irbim Institute, Gian Marco Luna, represents an important moment for the start of the path that will lead to the redevelopment of the building where the Institute of research, once the intervention which will be carried out with funds from the CNR itself and with the contribution of the Marche Region has been completed, it will transfer its operational headquarters which is now located in Mandracchio, near the former Fishing Fair, by 31 December 2022 .

Present for the signature were the Secretary-General of the Port System Authority, Matteo Paroli, and, for the CNR Irbim, Andrea Belardinelli, head of the Ancona office, and the engineer Emilio Notti. The redevelopment works said the director of Cnr Irbim Luna, "will aim to enhance the beauty of this place and make it available both for scientific research and for the city, with spaces that can be used by the community as well as from the schools with which we have an intense exchange and training program ".

The president Adsp Giampieri underlined how "this is a recovery of a unique place, linked to the economic history of the port and the city, with quality architecture, to be dedicated to the study and research activities of an institute recognized at European and international level. Rebirth of an empty container that is filled with new meaning, of a place that fits well into the general enhancement path of the Porto Antico and the improvement of the port-city relationship with a qualified use of spaces. Furthermore, when fully operational, as the Port System Authority, we could

[2] Link to the port of Ancona: https://porto.ancona.it/

[3] https://www.porto.ancona.it/it/news/1389-porto-di-ancona-firma-convenzione-autorita-portuale-cnr-per-nuova-sede-ex-palazzina-fincantieri

reuse the area where the CNR is now based, a space of over 2,000 square meters, which is very important for port activities ".

The building was built in 1956, inspired by post-war luxury architecture. For years it was the prestigious headquarters of the shipyard, overlooking the port basin and the most important historical presences of the port, the Arch of Trajan, the Clementine Arch, the harbour walls.

It is included in the Iti-Waterfront 3.0 project of the Municipality of Ancona, of which the Port System Authority and Cnr are partners. Funded with a European tender through the Marche Region, the initiative was created to redevelop the waterfront of the Doric airport, also from an energy and sustainable point of view. For the building, an intervention to improve the energy-environmental efficiency is planned to achieve a reduction in the energy consumption of the building and create a building according to the canons of sustainable construction.

Added value for SUSPORT / link to pilot actions

One of the goals of the signed agreement between the port authority and CNR is to achieve the energy independence of the buildings in the port area. This can provide an useful example for the activities that will be developed within the SUSPORT project.

PIA – Progetto Inquinamento Ancona

The Central Adriatic Ports Authority with the Municipality of Ancona and the Marche Region have joined the "Progetto Inquinamento Ancona" (PIA), aimed at improving knowledge on the exposure of the population to allergenic pollens and their potential interaction with pollutants atmospheric agents such as fine dust (PM 10 and PM 2.5).

Further actions foreseen by the project are aimed at increasing the awareness of institutions and citizens on the subject through integrated information, as well as communication and education activities to encourage the adoption of correct lifestyles, especially for the most sensitive population groups.

The PIA develops around four issues of strategic interest, which contributes to achieving the project objectives:

1. Health;
2. Environmental monitoring of inorganic pollutants with particular regard to PM 2.5;
3. Role of urban green as a pollutant of a biological nature or as a factor for mitigating damage from pollution;
4. Communication strategy;

Specifically, the activities realized by Central Adriatic Ports Authority concern the realization of a deep analysis of the local emission framework linked to port emissions through a scientific methodology which, by putting other regional data into the system, allowed to reconstruct the quality of the air of the city of Ancona, as well as the related future scenarios also linked to the demolition of silos, used for the storage of cereals and no longer significant for the production cycle of the port of Ancona.

Added value for SUSPORT / link to pilot actions

The project represents a good practise for the analysis of the quality of the air in port areas and to better plan future environmental activities.

Ancona Blue Agreement

The voluntary "Ancona blue agreement", dedicated to the issue of air quality in the port reality, was promoted by Central Adriatic Ports Authority and by the Harbour Master of the port of Ancona as a bridge towards the application of the new Imo-International maritime organization 2020 worldwide regulation on ship emissions, which came into force on January 1, 2020.

The “Ancona Blue Agreement” was signed on November 30, 2018, by the representatives of four companies, Adria Ferries, Jadrolinija, Superfast Ferries-Blue Star Ferries, Snav, and it was valid until 31 December 2019.

According to the agreement, the shipowners and ferry companies, in collaboration with the shipping agencies, committed to operating the main and auxiliary engines of the ships using fuel for marine use with a sulfur content not exceeding 0.1%, from the completion of the mooring manoeuvre in port and up to departure and exit from the port, compared to the 1.5% required by law at that time.

The "Ancona blue agreement" thus anticipated, improving it, the 2020 European directive which provides that all ships, from 1 January 2020, are required to use, when navigating in the open sea, in manoeuvring and inside ports, fuels with a sulfur content of less than 0.5%. If the stop in the port, according to the times previously disclosed to the public, should exceed two hours, once the mooring manoeuvres have been completed, they must use fuels with a sulfur content not exceeding 0.1%.

Added value for SUSPORT / link to pilot actions

Ancona Blue Agreement represents a best practice as an example local cooperation framework between the public bodies and the maritime operators to cooperate for the achievement of important results in the field of environmental sustainability of port operations.

Onshore power supply

Fincantieri shipyard at the port of Ancona realized an investment to introduce electrification at the quay to power all the ship plants and the plants used for the ship construction and outfitting. This will allow to keep the engines off during the whole productive process thus reducing pollutant emissions.

Added value for SUSPORT / link to pilot actions

The electrification of Fincantieri shipyard quay is in line with the pilot action that will be realized by Central Adriatic Ports Authority, concerning the realization of technical studies for the onshore power supply of operative quays at the port of Ancona. Moreover, it is a best practice as a sustainability action for large productive companies in the maritime sector.

Analysis of energy consumption

Central Adriatic Ports Authority realized the analysis of the energy consumption for the year 2016 of owned facilities at the Port of Ancona, with particular reference to three main energy sectors:

1. public lighting
2. own buildings
3. equipment (quay cranes)

The diagnosis has identified interventions to improve efficiency of energy use that will be implemented according to a schedule ranging from short term and long term actions, on the basis of the guidelines of the forthcoming Central Adriatic Ports System Masterplan and of the port of Ancona Masterplan.

Added value for SUSPORT / link to pilot actions

The knowledge of the trend in energy consumption and of the most "energy-consuming" sector is a key baseline activity to implement targeted actions aimed at reducing the energy consumption and improve energy efficiency. It is coherent with the strategy of Central Adriatic Ports Authority to pursue sustainability actions aimed at improving the resiliency and the environmental quality of the Central Adriatic ports.

Port of Antwerp - Belgium

Three best practices related to the port of Antwerp[4] have been analysed. The first deals with the innovative lighting system based on connected led luminaries. Since the port of Antwerp put in place multiple actions dealing with environmental protection and energy saving, an overview of the most interesting in terms of added value for SUSPORT project has been analysed. Moreover, the port of Antwerp elaborated an overall sustainability strategy encompassing all the port operations and development in a consistent environmental framework.

Interact City in the Port of Antwerp

Port of Antwerp implemented Interact City connected LED lighting system and management software which is used to reduce energy costs and increases efficiency so the savings can be reinvested in new projects. The operation for making a safer and more sustainable port of Antwerp began in 2018. Old gas discharge lamps were replaced by an energy-saving Interact City system comprising 1,300 connected LED luminaires. The network was completed in 2019, and configurations were made together with the Port of Antwerp. The new system is now fully integrated with the port's existing monitoring system in order to help site managers achieve their

[4] Link to Port of Antwerp: https://www.portofantwerp.com/

sustainability goals while improving operational efficiency. The results have shown that combination of connected LED lighting and Interact City software delivers considerable savings on energy costs. The Port of Antwerp has equipped its luminaires with a double set of connectors and by connecting plug-ins, some environmental conditions (such as traffic and noise) can be measured anywhere. The Port of Antwerp also wants to maintain an energy-efficient working environment for its users in accordance with ISO 50001, and this action helps to meet this goal. Luminaire performance can also be measured online by port management. Problems are prevented or detected in a short notice so that action and solutions can be provided and undertaken. The Port of Antwerp also opted for LED to ensure safe traffic signals since under gas discharge lighting, signalling colours such as red, orange or green can appear different, whereas they retain their colour under LED lighting. Besides, various dimming profiles ensure that the lighting in each port area is on at the right time and with the right intensity of the lumen.

Added value for SUSPORT / link to pilot actions

The case of Port of Antwerp that is considered worldwide as one of the most advanced in energy efficiency and has successfully implemented energy-optimization related measures in past years is a clear added value to the SUSPORT project and its pilot activities. This best practice shows that the efficacy and benefits of introducing LED lighting and management software contribute directly to energy savings. Specifically, it is presented that LED lighting combined with software can facilitate savings of up to 60%

ECO-solutions deployment in the Ports of Antwerp

The port of Antwerp houses Europe’s largest integrated fuel and chemicals cluster. This is associated with high energy intensity and emissions of greenhouse gases. Despite these characteristics, the port community is considered worldwide as one of the most advanced in energy efficiency and has taken successfully energy optimization related measures in past years while investing in renewable energy.

From the most relevant solutions implemented in this framework, the following measures have been selected:

1. Energy Plans and “The Blue Gate Antwerp project”: The Port promoted a specific framework for energy plans dedicated to businesses operating in the port area. Furthermore, the Port of Antwerp itself is reinvesting its share of the income yielded by the generation of energy from renewables via dedicated fund for energy named “The Blue Gate Antwerp project”.
2. ECLUSE: Ecluse (Figure 3) is a steam network created by the Port that supplies the heat from six incinerator facilities in the form of steam to the nearby port companies.
3. PortXL and start-up Enervalis – smarter decisions about energy management: With this project, the Port of Antwerp aims to introduce and support innovative technologies on to the port sustainability platform, such as the case of Enervalis, a start-up offering software that allows making smarter decisions about energy management.
4. Mobility: The promotion of sustainable transport methods within the port is one of the priorities in which the Port is committed, including the promotion of a dedicated policy of promoting the use of sustainable transport methods and the reduction in the number of home/work trips by private cars.

Figure 3 - ECLUSE network in the port of Antwerp

Added value for SUSPORT / link to pilot actions

The most promising solutions described above in the framework of energy efficiency at the Port of Antwerp represent valuable references for all SUSPORT project partners as well as for the Italian and Croatian stakeholders.

More specifically, these best practices experiences could be taken into consideration while exploring available eco-solutions and energy efficiency measures, such as:

- Energy Plans assessment
- Network of heating systems serving the port area
- Decision support systems for energy management

Mobility (link to one of the pilot actions of the LP)

Overall sustainability strategy

The port of Antwerp put in place an overall sustainability strategy which considers all together several sustainability issues affecting shipping, onshore mobility, employment, economic activities, local ecosystem, energy and climate, research and innovation, society, circular economy and safety/security. The overall strategy is focused on the following main topics:

1. Shipping emissions: the port categorised the vessels due to their compliance with international standard recording also their Environmental Ship Index (ESI) and the amount of waste (ballast water, chemical waste, sewage, garbage, air-polluting waste).
2. Traffic emissions: The ports monitors the traffic emissions and the environmental performances of the trucks accessing the port area. Moreover, polices have been put in place to cut up to 43% of road traffic from/to the port by 2030. Traffic information is collected by the port and shared with stakeholders to enable better trip planning.
3. Local environment: the port is committed to assuring the environmental quality of the local ecosystem. Antwerp port adopted a Cleanness Index to measure the cleaness of its public spaces and use specialised barge systems to clean up its waters. Besides, water quality, air quality and noise levels are constantly monitored. Finally, actions are put in place to assure long-term biodiversity preservation.
4. Energy sources: the port of Antwerp is expected to double the energy share coming from renewable energy in the next years. Besides, the application of energy saving means enables the port to reduce the CO_2 emissions that are declining since 2012.
5. Research and Development: R&D investments introduced several new technologies dealing with digitalization, automation, etc. fostering port sustainability. The port also promotes R&D investments by the companies present in its area (e.g. the petrochemical industry) to reduce their environmental impact.

6. Port and local community: being the most important employer in the region the port of Antwerp is also perceived positively by the local community. This result is pursued by carrying out an annual survey among the citizens to collect their perception of port activities also including port sustainability. Moreover, “open-port” events also improve the interaction between the port and the community.
7. Circular economy: the port monitors the employment and the added value produced by recicing activities in the port area. Moreover, the total amount of produced and processed waste is also recorded.

Added value for SUSPORT / link to pilot actions

The organic approach to environmental issues put in place by Antwerp port is a good example for the SUSPORT partners, helping in developing an overall sustainability strategy capable to better pursue the SUSPORT project objectives.

Port of Bar - Montenegro

The port of bar recently experimented the vehicle electrification. An overview of the results of this action is here provided.

Electric vehicles for Port of Bar

With the aim of promoting and testing electromobility, Luka Bar d.d. purchased electric vehicle Nissan Leaf (Figure 4) and prepared a call for tender which includes a purchasing electric car charging station which will be the first charge point in the city for tourists and citizens. Port of Bar is a significant and only freight port in Montenegro and as such, it is dedicated to environmental protection and sustainable business models which would support the society and inhabitants of the Bar. Therefore it aims to support sustainable transport and IT systems, reductions of greenhouse emissions and improvements of living standards of Bar citizens. Therefore, testing of the electric vehicle and availability of the electric charging stations is of utmost importance in supporting energy efficiency in Montenegro which strives to become an EU members state.

Figure 4 - Nissan Leaf Connect in the port of Bar

Added value for SUSPORT / link to pilot actions

Purchase of electric vehicle and a charger by Port of Bar is a direct added value to the project SUSPORT since Port of Zadar Authority together with several other ports as partners on the project, also aims to purchase an electric vehicle together with a charger. Described activities are in line with SUSPORT objectives within the scope of e-mobility measures which are already listed in the AF as project activities. Furthermore, this best practice is a good example of using EU projects for the purposes of improving energy efficiency in port areas within Europe.

Port of Corigliano Calabro - Italy

In the energy efficiency in the port of Corigliano Calabro[5] will be improved through the improvement of the public lighting system. An overview of the project is here provided.

[5] Link Port Authority of Gioia Tauro: http://www.portodigioiatauro.it/

Public lighting in the port of Corigliano Calabro

The project involves the replacement of all the luminaires of the lighting towers with new types of lighting, based on LED technology. The interventions affect the entire port area, with particular attention to the lighting placed along the fishing quay and in the operational yards.

For an economic value of approximately 641 thousand euros, the Port Authority of Gioia Tauro[6] has included this measure in its three-year operational plan (POT 2020 - 2022) with a view to developing sustainability policies.

The goal is, in fact, to reduce electricity consumption and to adapt the port of Corigliano Calabro to new commercial needs.

Added value for SUSPORT / link to pilot actions

The goal is a gradual replacement, in port facilities, of all the old type projectors with new generation LED projectors with low consumption. This is one of the main goals of SUSPORT project.

Port of Dubrovnik - Croatia

Monitoring the air quality can provide data to control the emissions coming from a port area as well has to plan future actions to reduce pollution and check their results. As an example, the experience carried out by Dubrovnik Port Authority[7] is here provided. Moreover, in Dubrovnik-Neretva region the european project “Alterenergy” was also developed dealing with the installation of solar panels and the replacement of public lighting system.

ECO measuring station by Dubrovnik Port Authority

Dubrovnik Port Authority has installed an ECO measuring station, with the aim of monitoring air quality, relative humidity, atmospheric air, air temperature, concentration of nitrogen oxide and monoxide, sulfur dioxide, carbon monoxide, UV index with display results and atmospheric

[6] http://www.portodigioiatauro.it/news/comunicati-stampa/2020/03/05/illuminazione-pubblica-e-nuova-categoria-di-merce-da-movimentare-nel-porto-di-corigliano-calabro--51/

[7] Link to the Port Authority of Dubrovnik: http://www.portdubrovnik.hr/

conditions in the port. The device was installed at the beginning of 2019 in the port area of the Port of Dubrovnik, by Hrvatski Telekom d.d. and the results are currently visible on the integrated information and communication system located in the Našička facility / Terminal for homeport operations.

The plan is to also have visibility of data on the website of the Port of Dubrovnik, where it will be possible to see indicators of the current situation and long-term monitoring of air quality in the port, given the increasing application and control of environmental standards. Preservation of the quality of the environment, along with the rational use of natural resources, is one of the most current problems of further technological and economic development of the country. The main objectives can be qualified as the prevention of pollution of the sea, coast and more protected stay of citizens and visitors. Dubrovnik Port Authority has harmonized its regulations and plans with all regulations related to environmental standards and norms and is in line with the world's leading countries in terms of measures and principles on environmental protection.

Added value for SUSPORT / link to pilot actions

This activity can be identified as an added value to SUSPORT project as it contributes to energy efficiency in ports and serves as a good example of how installing measuring stations can be used in ports and port areas for this purpose. Measuring stations will also be purchased and installed within the project SUSPORT therefore this best practice can be used by the partners for the implementation of their activities.

Alterenergy project

EU project “Alterenergy”: The overall project was aimed to set up an Adriatic community of the renewable energies, by sharing knowledge initiatives, technologies, and financial instruments, regional energy planning, production and use of renewable energies.

Demonstrative investment action concerning renewable energy sources and energy efficiency measures was realized on Elementary school Ston: installation of a photovoltaic power plants with dual-axis tracking system (tracker) to 10 kW, a thermal solar system of plate collectors and vacuum tubes for hot water, and LED lighting in the school building.

Development of maritime passenger terminal Vela Luka: replacement of standard lighting and installation of LED light bulbs in the port area.

Added value for SUSPORT / link to pilot actions

Through the implementation of the Alterenergy pilot action, valuable conclusions were achieved in terms of the possibility of replication of such pilot action to other similar public buildings in the jurisdiction of Dubrovnik Neretva region. In terms of the legal framework, DNR is ready to share its know-how in terms of usage of such pilot action. The elementary school is completely independent in terms of energy use for its local needs. Currently, the school is undergoing changes of project documentation and expansion of its facilities and upon finalisation all generated energy (produced throughout the system installed in this project) will be allowed to be used in the common public electricity network.

Port of Genoa - Italy

The Port Authority of Genoa[8] carried out several actions to improve energy efficiency and environmental sustainability. Here, an overview of the most interesting in terms of impact on SUSPORT project is provided focusing in particular on the cold ironing.

Green initiatives

Multiple initiatives towards the promotion of the Green Port have been implemented in Genoa, such as:

1. the employment of alternative energy sources, such as LNG and biomass, for heating and cooling buildings;
2. the installation of a 120 kW photovoltaic system on the West Terminal roof of Savona's Palacrociere Cruise Teminal;
3. the replacement of traditional lights with energy-saving lights (LEDs);
4. the provision of shoreside electrical power to the Genoa Prà basin to reduce pollutant emissions, improve energy efficiency and noise reduction impact;

[8] Lint to the Autorità di Sistema Portuale del Mar Ligure Occidentale: https://www.portsofgenoa.com/

5. the introduction of a cold ironing system (**Error! Reference source not found.**) which p rovides shoreside electrical power to vessels at berth whilst the main and auxiliary engines are switched off, leading to a reduction of CO2 emissions in the Vado Ligure basin.

Added value for SUSPORT / link to pilot actions

Actions undertaken by Ports of Genoa could be a benchmark to pilot actions dealing with:

- replacement of the existing lighting system with LED light bulbs
- installation of photovoltaic and solar thermal systems
- installations of sensors and stations to monitor noise, air and water quality
- pre-investment studies for onshore power supply

Cold ironing in the port of Genoa

Usually, when a ship is docked, its propulsion engines are turned off. But it is necessary to ensure the continuity of on-board services (lighting, heating, hot water, air conditioning, cargo handling operations, etc.), thus auxiliary engines are activated. Even if they are powered by low sulfur content fuels (technically, Low Sulphur Fuel Oil, LSCF), they consume large quantities of fuels, generating exhaust gases (mainly containing CO2, SOx, NOx, atmospheric particles and volatile organic compounds), noise and vibrations. A cruise ship docked in 10 hours produces about the same amount of carbon dioxide (CO2) that 25 mid-sized cars produce in a year. On the other hand, when powered by electricity, the same large cruise ship absorbs an amount of electricity roughly equivalent to that of a city of 80,000 inhabitants. A large container ship requires energy equivalent to that of 25-30,000 people. In addition, these large quantities of energy, in order to be transferred to the quay of a port and to the ship, must be concentrated in very confined spaces and pass through dock-ship connection systems, which are technically complex and economically expensive.

Systems for powering ships stationary on the quay constitute the architecture of a "cold ironing" system, which is the central theme of this document. The main characteristics of the cold ironing plant active in the port of Genoa, its limits and benefits are described below. In addition also the "added value for SusPort Project and links to pilot action in the port of Ravenna".

The *architecture of a cold ironing plant*

In order to define the architecture of a cold ironing plant, it is necessary to analyse the infrastructure for ship power supply and its main components.

Infrastructure for ship power supply

The constituent elements of a ship's power supply system are the following, showed also in the figure[9] below (see "Position" in Figure 5):

1. an electric cab connected to the national power grid
2. power line inside the port area
3. 50 Hz - 60 Hz conversion cab
4. power lines distribution to the ship power supply connection points
5. ship power supply connection system
6. power supply connection and on board interface panel
7. on board MT/BI transformer
8. ship power grid.

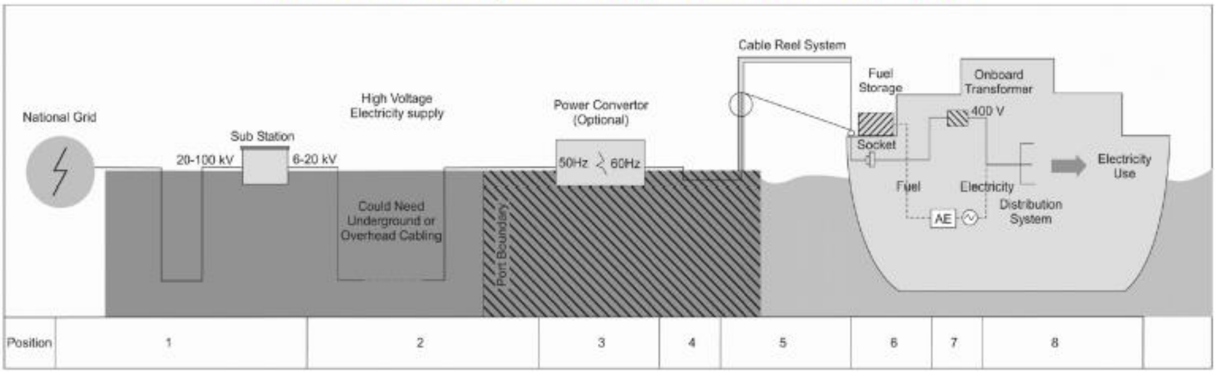

Figure 5 - Infrastructure for ship power supply (source: European Commission Directorate General Environment)

The ship power supply connection system (point 5 above) is the ships' shore power supply composed also by the quay-ship connection system. This connection system and the 50 Hz – 60 Hz conversion system (point 3) are the essential elements of the cold ironing infrastructure.

[9] European Commission Directorate General Environment, "Service contract on ship emissions: assignment, abatement and market-based instruments – Task 2a: Shore-Side Electricity", Final Report, Aug.2005, Entec UK Ltd.

Ships' shore power supply is only possible in the presence of international legislation that defines the methods for connecting ships. The fundamental and reference standard, to ensure interoperability between the ground and on-board system, is IEC 80005-1, published in 2012 by the Institute of Electrical and Electronics Engineers (IEEE) and adopted also by the International Organization for Standardization (ISO).

The frequency converter (point 3 above) is powered by the medium voltage network (in Italy at 15 or 20 kV at 50 Hz) and generates an output voltage of 6.6 or 11 kV at 60 Hz.

Harmonic distortion

Frequency converters draw a distorted current from the mains which can alter the shape of the mains voltage, thus interrupting the operation of other powered consumers. This is an electromagnetic compatibility (EMC) problem, addressed using the harmonic decomposition of distorted current and voltage (Fourier transform). The main standards suggest the use of interface transformers with multiple secondary windings. They achieve "harmonic cancellation" which helps to keep the mains-side distortion parameters of the converters within normal limits. At the same time, the adoption of IGBT technology (Insulated Gate Bipolar Transistor) and the insertion of an output filter makes the voltage to the vessel highly sinusoidal.

Safe operations

Before activating the shore power supply of a ship, there must be a compatibility check first, and then a predisposition of the ground and on-board electrical systems. It is, therefore, necessary to define an information exchange protocol according to the minimum set of data defined in the standard IEC 80005-1, above already reported.

The cold ironing in the port of Genoa

The Port System Authority of the Western Ligurian Sea has been dealing with the electrification of the docks of the under its responsibility since almost 20 years ago. At the moment the area of the dry docks of the port of Genoa has been electrified. The berths of the ports of Prà, Savona and Vado Ligure is electrifying. The interventions carried out and in progress make the ports of the Western Ligurian Sea the first Italian and Mediterranean port system to offer the possibility of supplying almost all types of moored ships from land.

The Port Authority has started the electrification campaign starting from the area of the dry docks and ship repairs (in Italian: Bacini di carenaggio e delle riparazioni navali), because it is the closest to the city of Genoa and where the ships stay longer. The final electrification project for this area dates back to 2010. The tender for the executive design and execution of the works (integrated tender) was launched in 2010 and the contract was awarded in 2011. The works were completed in 2017. From the first months of 2018, cold ironing began operating for all ships in Bacini di carenaggio (Figure 6).

These works amount to Euro 9,800,000 financed by the Liguria Region (through POR FESR Liguria 2007-2013 funds) and by the Ministry of the Environment. The charges for connection to the national e-distribution grid amount to Euro 670,000.

Electric power needed and available

The power supply needs of this area are particularly complex, in particular, because it is necessary to provide power supply with very different characteristics:

- cruise ships up to	10 MW at 10 or 11 kV, 60 Hz
- freight ships and ferries	4-5 MW at 6,6 kV, 50 or 60 Hz
	2 MW a 690 V, 50 o 60 Hz
	2 MW at 400 or 440 V, 50 or 60 Hz
- shore loads	1-2 MW at 400 or 440 or 690 V, 50 or 60 Hz

The electricity for the ships comes from the national grid. The electric power involved is already very relevant nowadays:

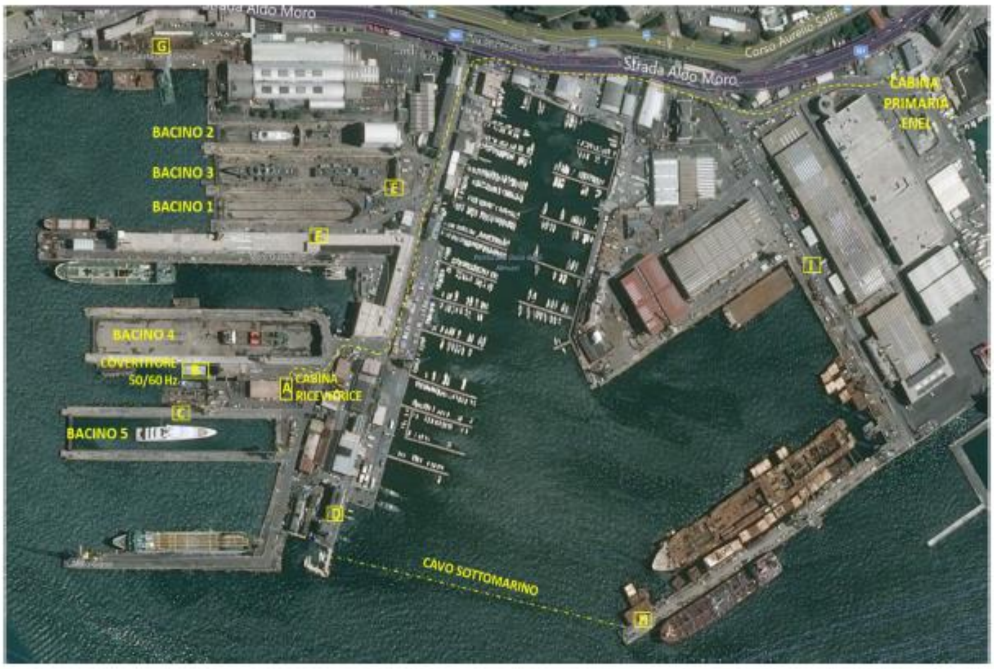

Figure 6 - Bacini di Carenaggio in the port of Genoa (Source: Port System Authority of the Western Ligurian Sea)

- Bacini di Carenaggio of Genoa 10 MW
- Port of Prà 2x10 MW
- Maersk Platform at Vado Ligure 7,5 MW.

To have a reference term, the average annual power for all domestic users in the City of Genoa is around 75 MW. The electrification of the docks, therefore, entails a significant increase in the power that must be made available on a territory, Genoa and Savona, characterized by chronic difficulty in creating new transformer stations.

In addition, the power supply from ground is complex for docked ships, because most of the ships' electrical equipment is supplied with 60 Hz, while in Europe the electricity network is at 50 Hz. For this reason, it is necessary to include frequency inverters from 50 to 60 Hz.

For the electrification of Bacini di Carenaggio in the port of Genoa, Enel has built specially for this purpose a new primary transformer substation at the Fiera di Genova, with which the cold ironing of the dry docks is powered, at 15 kV[10].

From this new primary transformer substation at the Fiera di Genova a 15 kV, 50 Hz grid branches off and also a line to the FV Cab where the frequency converter is located. This converter powers the grid at 60 Hz. In turn, it powers the dockside transformers that allow the power supply of ships (at 690 V and 440 V). The solution of using the 11 kV at 60 Hz network as a distribution network to supply low and medium voltage to ships is innovative and unique in its kind. Where necessary, the 60 Hz network can be operated at 50 Hz by changing the output frequency of the converter.

The power supply of ships

In Bacini di Carenaggio of the port of Genoa, very different kinds of ships can berth, ranging from container ships to ro-ro or cruise ships. Each type of ship requires a specific connection in terms of voltage level, frequency, type of connector, number of cables. Furthermore, in Bacini di Carenaggio there is a total of 14 berths, in 5 dry docks and two naval repair piers. And the position of the ships with respect to the docks is variable. The connection point can therefore be in different positions on any platform. It was therefore necessary to study a power supply system for ships that can:

- be positioned along the entire length of the quays
- be connected to the power supply points provided on all docks
- receive and connect the plugs of ships that are equipped with them (ro-ro, container ships)
- bring the plugs to the right height to connect to ships equipped with sockets (cruise ships).

The wheeled structure shown in the figure below (Figure 7) was therefore created. When a docked ship is to be powered, the structure is brought into position on the quay.

[10] To meet the expected increases in the Port of Prà, the Port Authority requested e-Distribuzione for a high voltage connection with a power of 40 MW.
In order to power the Maersk Platform of Vado Ligure, the Port Authority acquired the former Vetrotex high voltage substation that has an overhead line of 132 kV.

Figure 7 - Mobile structure for powering ships (Source: Port System Authority of the Western Ligurian Sea)

The submarine cable

To bring the power supply to the Naval Repairs area, a 15 kV connection was made through the use of a submarine cable (450 mt) between the Giano Pier and the area of the New Industrial Dock where the shipyards are located (Figure 6). The use of a submarine cable, in addition to shortening the connection, has avoided the construction of a conduit in areas where there is already a large number of underground services that would have originated interference not easy to solve (Figure 8). But a submarine cable presents serious problems linked to:

- the risk of an anchor being dragged to the bottom by a ship, hooking the cable and pulling it from its hooks,
- dredging operations that are periodically carried out to guarantee the seabed for the ships.

A solution was therefore devised for connecting the cable at both ends by means of removable sockets-plugs.

Figure 8 - Submarine cable vs the construction of a conduit in the dry docks (the red line)
(Source: Port System Authority of the Western Ligurian Sea)

The SCADA system

The electrical distribution in the dry-docks is equipped with a supervision and control system (SCADA) based on an Ethernet fiber optic network. The SCADA system has a main control room at the offices of Ente Bacini, and there is an operator interface touch screen equipped with all the functions in the cabin of the frequency converter. The SCADA is remoted through the internet using a remote desktop application with user authentication.

Electrification of the Cruise and Ferry Terminals in the port of Genoa

In order to maximize the exploitation of the frequency converter installed at the dry-docks (see previous section 3), a new project was studied to bring a power supply to 60 Hz also at the Cruise Terminal (Maritime Station) and at Ponte Doria in the port of Genoa. A mixed route has been studied, which includes a section of submarine cable and a section of underground cable, as shown in the figure below (Figure 9). By increasing the number of users, this solution will allow increasing the annual operating hours of the converter, therefore the electricity sold to ships, with the consequent environmental benefits.

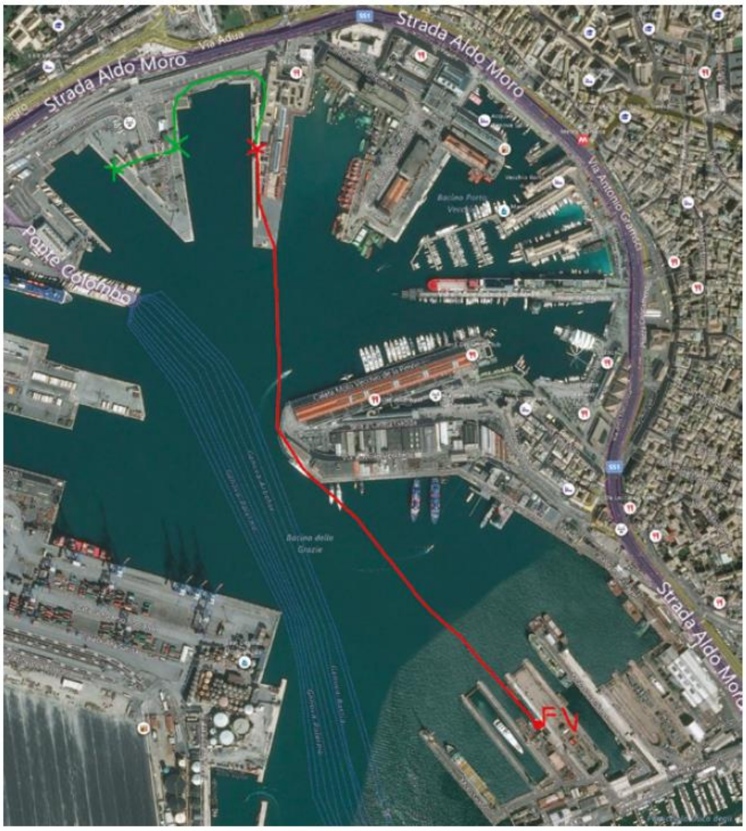

Figure 9 - Electrification of the Cruise and Ferry Terminals in the port of Genoa (the red line)
(Source: Port System Authority of the Western Ligurian Sea)

The project includes:

- the construction of a submarine line from the FV Cab (where the frequency converter is located) to the top of Calata Gadda where a sectioning point is installed;
- a second submarine section up to the top of the Ponte dei Mille and the construction of a power point for cruise ships;
- a cable duct along Calata degli Zingari up to the Andrea Dora Bridge where there are two connection points for ferries.

The supply of ships on the quay is subject to the needs of the dry docks, and is mutually exclusive, with priority for cruise ships that have a higher load, and therefore emissions.

Lessons learnt

The activities of design, construction, commissioning, and use of the cold ironing systems of the dry-docks in Bacini di Carenaggio of the port of Genoa have highlighted some important aspects for correct development of the project.

In terms of Project Management, the experience gained has shown that for contracts with such a high technological content, the only sustainable tender mechanism is the one that provides for the choice of the economically advantageous offer with a mixed type contract (part of works and part of supply and services). The greater complexity of this type of contract compared to a more usual tender at the maximum discount is justified by the possibility of selecting the supplier on the basis of the real technical skills acquired, thus skimming the bidders going into the merits of the technical-economic offers. Furthermore, since these technologies are still innovative and constantly evolving, this type of tender allows suppliers to propose the most modern and efficient solutions, which ultimately translates into a benefit for the contracting authority.

On the engineering level, the most critical problems for this type of systems, and which therefore require a careful and in-depth study, are related to:

- the availability of energy by the distributor. The high power required by cold ironing may not be available to the local distributor who must therefore provide for an expansion of the network (in Genoa, Enel has built a new Primary Substation within the port area), or it may be necessary to procure high energy tension (as was done in Vado Ligure). Both solutions involve high costs and long production times, so this activity must be considered a prerequisite for any cold ironing project;
- shore power systems for ships are complex and intrinsically dangerous, due to the high voltages and currents involved. It is, therefore, necessary during the design phase to give absolute priority to the development of very precise safety logics that respect the functional safety criteria defined by international standards;
- because of the complexity of the systems, ample space must be given to training and technical updating of the staff who will have to manage and maintain the systems.

Added value for SUSPORT / link to pilot actions

Cold Ironing can contribute to reaching the objectives of SUSPORT Project, in particular, to enhance the environmental sustainability and energy efficiency of Italian and Croatian ports.

Cold Ironing is a particularly valid technological solution for the purpose of reducing emissions and pollutants generated in the port and contributes to the improvement of air quality, not only in the port areas directly affected by maritime operations, but also in the rear-port and urban ones. This is particularly true in the case of port nodes located in close proximity to city areas.

Cold Ironing, in fact, was created above all to facilitate the abatement of pollutants in the port, allowing moored ships to turn off the auxiliary engines to connect to the electricity grid present on land. In this way, the loading/unloading operations of the ship can continue and all the services for passengers can be kept on board, despite the unit being moored with the engines off. This system takes the form of connecting the ship to the quay by means of a cable, comparable to an extension from the ground, in order to supply it with all the energy necessary to stop its engines and therefore to significantly improve the quality of the air in port.

Port of Hamburg - Germany

The port of Hamburg[11] tested new advanced technologies to improve traffic and infrastructure control as well as environmental monitoring in the port area. The experience gained in a pilot project is here provided.

Advanced technology solutions for the port operations and management

The Port of Hamburg is testing the implementation and realisation of 5G and network slicing in a real-world operational environment, to gather hands-on experience with the capabilities of the new communication system, and to explore the arising possibilities for improving the port's operations and processes.

The focus of the implemented applications is on improving the traffic and infrastructure control as well as the environmental monitoring within the port area. For example, traffic lights are connected to the central traffic control and steering system using a wireless connection, which is clearly faster

[11] Link to Port of Hamburg: https://www.hafen-hamburg.de/

and cheaper to install compared to a fixed line. This approach would even allow integrating temporary traffic lights at construction sites.

Environmental measurements acquired from sensors – partially installed on mobile barges roaming within the port – are meant to be gartered and processed in real-time. In addition, Augmented Reality-based applications are planned to help maintenance teams controlling the infrastructure to create a safer environment.

Applications that are a part of testing are: (1) traffic lights are connected with the central traffic control through the 5G mobile communications, (2) environmental sensors situated on Hamburg Port Authority ships can provide real-time data, (3) engineers can test constructions and studies in the port area on-site through VR- and AR-goggles.

The pilot testing is a part of the project 5G-MoNArch (5G Mobile Network Architecture) as a research project funded by the European Commission within the Horizon 2020 Framework Programme

Added value for SUSPORT / link to pilot actions

The best practice example of the Port of Hamburg shows the piloting and practising the usage of different advanced technologies ordered for the purpose of optimisation of port's operations and management of the port towards sustainable and smart port.

The example shows the collaboration among different technological solutions (e.g. sensors, platform, VR/AR applications) for the ultimate goal linked by the latest connectivity solution (5G network).

The link to the pilot action is within the planning of the pilot action for the Port of Dubrovnik and its' implementation. Thus, the overview of the future actions to be consider and planned in order to achieve the goal od smart and sustainable green port.

Port of Koper - Slovenia

The port of Koper[12] as been recently committed in testing solutions to improve energy efficiency inside port warehouses and terminals. Here the experience gained during two pilot projects is provided, highlighting how both technology and monitoring means can concur in improving the port sustainability.

Introducing high-efficiency lighting technologies

The port of Koper has introduced high-efficiency lighting technologies within the Interreg Central Europe project TalkNET as a pilot activity for ECO-innovations on energy efficiency deployment: test of energy efficiency in cargo handling.

As declared in the Pilot action final report of the project TALKNet, one of the main goals in the port of Koper regarding the operational costs is the rationalization of the costs for energy. Port of Koper aims to achieve this goal also with the use of high-efficiency lighting technologies, like solutions based on LED (light-emitting diode) and automated solutions. These solutions can offer a significant improvement in energy efficiency compared with installed conventional metal-halide lighting system while maintaining equal or providing an even better quality of light and improved illumination. Market analysis and consultations with potential technology providers for this pilot activity within Port of Koper for the purposes of the project TalkNET proved that a combination of a lighting controls system with occupancy sensors and energy-efficient lamps and luminaires produces the best possible outcome in terms of lighting performance in a selected general cargo warehouse.

Therefore, the new LED lighting system with powerful monitoring and control capabilities was implemented in the selected general cargo warehouse No.33. It provides a flexible and open concept for upgrading electrical lighting installations and it must be capable to operate in a standalone mode or integrated in a future smart grid. The documentation/project design of electrical installations and electrical equipment for reconstruction of the electrical installations in the warehouse 33A, B, C, D in the Port of Koper was prepared on the basis of the project task of the investor (Implementation of alternative solutions for electrical installations in the warehouses 33A, B, C, D, in Port of Koper).

[12] Link to the port of Koper: https://www.luka-kp.si/

This project has high replicability potential since there are around 2,200 similar lamps installed in other warehouses in the port of Koper that can be replaced with new and energy-efficient lamps. The proposed solution can operate fully automatic with remote control or in a standalone mode. Additionally, the proposed solution has the potential to reduce peak power on the port level.

Existing metering system was upgraded and additional sub-meters for direct measuring of electricity consumption for indoor and outdoor lighting were installed. The proposed solution upgraded existing light level/illuminance and consequently improve working conditions in the selected general cargo warehouse no. 33 in the Port of Koper. An additional benefit is that proposed LED-based solution will require less maintenance than existing, conventional high-pressure metal halide lamps and it is desired that the electricity for port operations comes from renewable or at least low carbon energy sources.

Addressed warehouse no. 33 (Picture 1) is used for the storage of general cargo and it is in constant operation since 1995. The building has a typical warehouse design where the main construction material is the reinforced concrete. The total useful surface of the warehouse is around 7,032 m2 and the height is around 8 m. Warehouse is divided by walls into four equal storage units (no. 33A, 33B, 33C and 33D) with the surface of 1,758 m2 each. Each storage unit has its entrance.

Figure 10 - Warehouse No.33 in the port of Koper

Cargo handling operations are managed by several warehouse workers which are responsible for all aspects of warehouse functions including the receiving, storing, handling, shipping and preparing of materials and goods for delivery while maintaining the warehouse in a safe and orderly fashion.

The main environmental impact that can be attributed to the processes related to the addressed general cargo warehouse no. 33 can be attributed to electricity consumption which is mainly used for indoor and outdoor lighting. Working hours of the electrical lighting system (indoor and outdoor) are in close connection with the associated cargo operations. The electricity consumption of the entire general cargo warehouse no. 33 is metered, and available data represents a solid background for the monitoring and verification of future energy savings.

The meter is installed at the main supply cable in the transformer station. On the annual level, electricity consumption of the addressed general cargo warehouse is around 60 MWh of which 74% is for indoor and 23% for outdoor lighting. Around 3% of annual electricity consumption can be attributed to other systems (office and other small cargo handling equipment, etc.). This graph shows the electric energy consumption for the lighting system in the warehouse no. 33 when operating. With reduction of power by 51% for interior lighting and establishing a control system, the warehouse 33's electricity consumption is reduced from 44,400 kWh to 22,500 kWh per year, which is an approximate consumption of one RMG crane per month.

Sankey diagram of electricity consumption in general cargo warehouse no. 33 is given in Figure 11. Flows are in kWh per year (reference year is 2017).

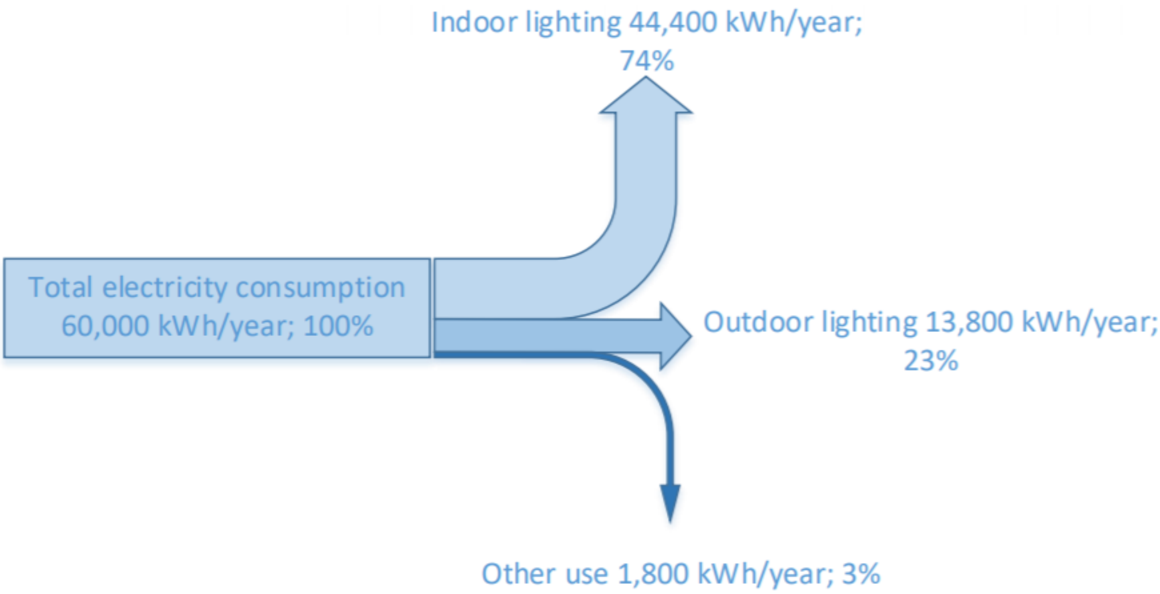

Figure 11 - Sankey diagram of electricity consumption in general cargo warehouse no. 33 in 2017

Before the pilot action implementation, seventy-two (72) Osram 400 W high-pressure metal-halide lamps are used for indoor lighting in the addressed warehouse no. 33. Total installed power of the indoor lighting system, including ballasts and control gear, in the addressed warehouse, amounts to 31.68 kW. Additionally, it needs to be clarified that metal-halide lamps cannot immediately begin producing their full light capacity because the temperature and pressure in the inner arc chamber require time to reach full operating levels. This is the reason why in many cases metal-halide fixtures have more operating hours than actually needed since the shop-floor workers tend not to turn off the lighting system due to the safety reasons. Average illuminance in the addressed warehouse amounts to 189 lux (before the pilot action).

According to results of simulations the total installed power of new system amounts to 16.06 kW (before the realization of the pilot action was 31.68 kW). Also, according to the results of simulation new lighting system in the addressed warehouse no. 33 provides an average illuminance of 236 lux which represents an upgrade of the existing illuminance level for 25%.

As stated in the Pilot action final report of the project TALKNet which has been used as a reference for this BP description, measurements of electricity consumption for indoor lighting show that about 4,300 kWh is consumed per quarter of the year, which amounts to 17,200 kWh annually, which means that electricity consumption is decreased by 26,800 kWh or 60.1% compared to the estimations of electricity consumption.

Sankey diagram of electricity consumption in general cargo warehouse no. 33 is given In Figure 12. Flows are in kWh per year (reference year is 2020)

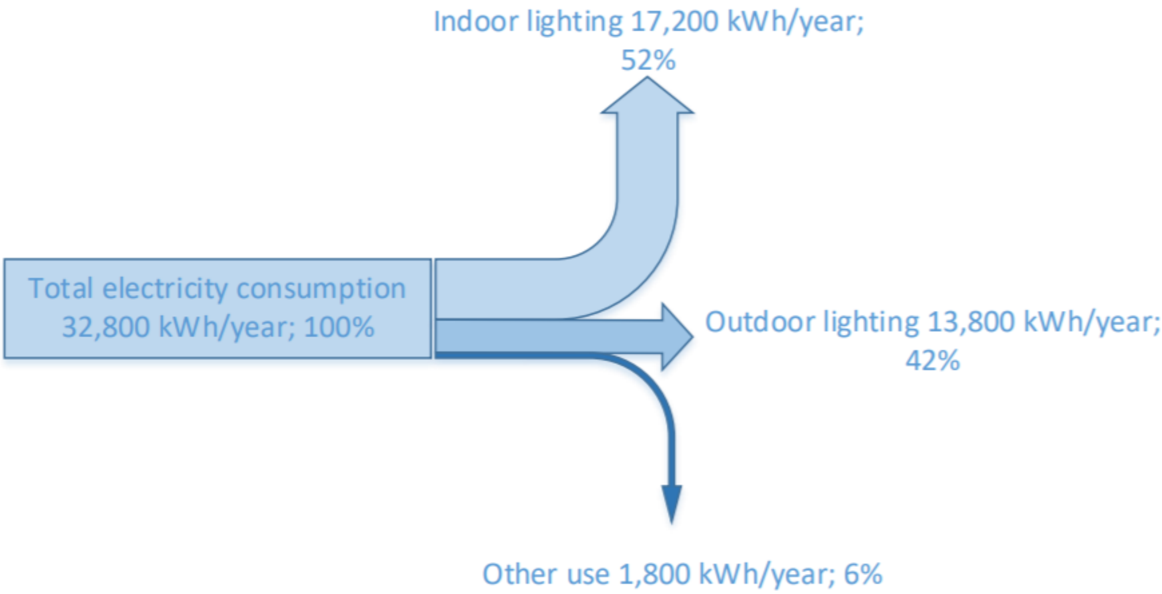

Figure 12 - Sankey diagram of electricity consumption in general cargo warehouse no. 33 in 2020

The transport and logistic players included in the operations before and after the implementation of the investment:

1. Forwarding agents (Port community - 46 members)
2. Shipping agents (Port community – 20 members)
3. Shipping companies

These players daily express their satisfaction with the solutions of the investments and the satisfaction with the realization of the ordered service.

The players:

1. Ministry of infrastructure (Slovenian Maritime Administration, 2 Municipalities)
2. Institutes, companies – logistic area, traffic and transport are involved in the preparation of the investment documentation.

Added value for SUSPORT / link to pilot actions

The solution of improvement of energy efficiency in the selected cargo warehouse (Port of Koper pilot action) has been developed to the point that can be adapted/exchanged in this case in all kinds of warehouses and also in external areas on other terminals - nodes by all stakeholders in ports even in the Italy-Croatia region.

The advantages of the new lighting system are mainly energy and environmental savings and lower operating costs, which can be even greater after the replication and transferring of the tested solution to other external and internal locations within the port. With the installation of the new LED-lightning system, there is reduced energy consumption in the warehouse for up to 50% and reduced costs of energy in the warehouse for up to 50%. This activity can be identified as an added value to SUSPORT project especially since other partner ports also plan to install LED lighting within their port areas by replacing their old lighting systems.

Monitoring can bring savings

The port of Koper, through the Greenberth project (Interreg MED), implemented a pilot system to monitor the energy consumption on the Fruit Terminal. The idea behind was that the energy consumption will grow if not monitored, and the Fruit Terminal is an important consumer of electricity. The pilot project included the installation of metering and communication equipment in the transformer station 17 that feeds 3 cold warehouses, 3 warehouses, 1 roofing as well as reefer electrical outlets. The installed metering transformers and network analysers were connected to the system SCADA, that stores data about consumption and enables insight into data to users. The pilot was successful and based on the experiences gathered through the Greenberth project Luka Koper plans to continue with the installations of equipment in the transformer stations. In 2020 they obtained ISO 50001:2018 for the energy management system.

Added value for SUSPORT / link to pilot actions

The experience and findings in energy efficiency gained by Koper port authority can provide a valuable example to be replicated within SUSPORT partners.

Port Macquarie - Hastings - Australia

The actions carried out by the Port Authority of Macquire - Hastings[13] provide a valuable example of the results coming from a massive replacement of the lighting system. The experience gained is here provided.

LED Street Upgrade

More than 5,000 street lights were switched to new energy efficient LED technology across the Port Macquarie-Hastings in Australia. This LED upgrade will save approximately 320,000 dollars per year in maintenance and electricity costs, and it will also reduce power usage of around 410,000 kWh per year. Local street lighting costs around 1.6 million dollars each year, and the upgrade will go a long way to reducing this cost and provide significant long term savings as LED's are far more efficient, require less maintenance and use far less power. Total of 2 million dollars was invested to complete the bulk upgrade, and costs are expected to be recouped within five years. It is estimated that savings will be around 31% on maintenance costs, and experience ongoing energy savings of around 61% compared to traditional lighting technology. There are approximately 7,400 street lights currently in use across the region, leaving around 2,400 lights servicing areas such as main roads and town centres that are currently being considered as part of a future upgrade program.

Figure 13 - Lighting system upgrade operations in the Port Macquarie - Hastings

[13] Link to the Port Authority of Macquarie - Hastings : https://www.pmhc.nsw.gov.au/Home

Added value for SUSPORT / link to pilot actions

This activity can be identified as an added value to SUSPORT project especially since other partner ports also plan to install LED lighting within their port areas by replacing their old lighting systems. It is chosen to showcase the possibilities of LED lighting in terms of contributing to energy efficiency which is one of SUSPORT activities.

Port of Ravenna - Italy

The port authority of Ravenna[14] employed a solution to increase the energy efficiency of the building where the port headquarters are accommodated.

Photovoltaic system on the roof of the Port of Ravenna Authority headquarters

A photovoltaic system has been installed on the roof of the Port of Ravenna Authority headquarters. Since, inside the building, all energy needs are satisfied by electricity (no gas or other source of energy), the installation of this new system reduced the costs incurred by the Port of Ravenna Authority for the supply of energy and also decreased its energy consumption and the CO2 emissions.

Added value for SUSPORT / link to pilot actions

This Best practice inspired the pilot action of the Port of Ravenna Authority, consisting of the realization of a photovoltaic system in the parking of the Port of Ravenna Authority headquarters. This infrastructure, equipped with an electric charging column, will be used to recharge electric vehicles that will be purchased within the SUSPORT project.

[14] Link to Ravenna port authority website: http://www.port.ravenna.it/

Port of Rijeka - Croatia

The port of Rijeka[15] put in place a comprehensive set of measures aimed at reducing the environmental impact of the activities connected to cruise ships operation. The plan is expected to enhance the port capacity through easier access to berths and an improvement in passenger transport from/to the city centre.

Low-Carbon Transport and Mobility Plan

The Port of Rijeka Authority has developed the Low-Carbon Transport and Mobility Plan. Rijeka is just one of the seven destinations where plans have been developed. The Plan was developed on the basis of guidelines for drafting the plans which were developed by the technical partners of the Interreg MED LOCATIONS project. It should be noted that Rijeka is a specific destination because there are concrete data on the activities of cruise ships in the destination only since 2015. In a way that is an aggravating circumstance because concrete data on cruise ships and tourist trends in the city are available only since 2015.

As a new destination, Rijeka is aware of all negative impacts brought by the flow of tourists/goods related to cruise ships and looks into the future with the aspect of a sustainable way of developing the cruise ship tourism. A new berth is defined for cruise ships on the breakwater by the passenger terminal which will accept more than 90% of all cruise ships calling at this destination and in a sustainable way transport all passengers to destinations all over the city, county and wider area.

Sustainable way of transport is the lowest possible interaction of vehicles for transportation of passengers with the local traffic and promotion of cleaner, alternative types of transportation of cruise ship passengers/cargo.

The general goals of this Plan are:

1. To reduce the pollution and accelerate the flow of vehicles used for the transport of passengers/goods connected to cruise ships in order to reduce the jams at the connection point between the breakwater and Road D404;
2. To promote alternative means of transport to the main destination attractions.

[15] Link to Port of Rijeka authority: https://www.portauthority.hr/en/

The Specific measurable goals which will contribute to the achievement of each general goal within the given time frame are:

3. Reduction of CO2 emmisions per 1000 passengers by 5% compared to 2018: increasing the capacity of cruise berth at the breakwater; Introduction of the CNG drive in waste disposal vehicles
4. Reduction of the time necessary to reach road D 404 from the breakwater and vice versa for 10 minutes compared to 2018: Elimination of the bottleneck between the breakwater and road D 404
5. Introduction of at least 5 electric vehicles for the transportation of passengers to the main city attractions by 2028: Introduction of electric scooters and charging stations; Traditional shuttle boat;
6. Promotion of alternative means of transport at the destination: Installation of interactive information panels.

Added value for SUSPORT / link to pilot actions

The implementation of the pilot project of the Port of Rijeka Authority within the SUSPORT project is a continuation of some activities that began with the development of the Low Carbon Transport and Mobility Plan. The implementation of the SUSPORT pilot project will enable the realization of some of the main goals and their activities in the development plan of the Port of Rijeka Authority. This example can serve other ports in developing their plans with an emphasis on ecology, transport and mobility.

Port of Rotterdam - The Netherlands

The Port of Rotterdam[16] carried out several actions to improve energy efficiency and environmental sustainability. Here, an overview of the most interesting in terms of impact on SUSPORT project is provided.

[16] Lint to the Port of Rotterdam: https://www.portofrotterdam.com/

Carbon footprint and sustainable initiatives

Rotterdam Port Authority lists among its objectives a strong reduction of CO2 emissions since 2011 with an initiative called CO2-Neutral Sin. The policy applied on the one hand encourages the port operators to report carbon footprint while on the other adopts measures to reduce its CO2 emissions such as using renewable energy, fossil fuel saving for the patrol ships and lending energy cars for the employees.

The remaining emissions are compensated for by means of Gold Emission Allowances purchase.

Among the main initiatives the followings can be highlighted:

1. Carbon capture and storage: the port Authority cooperated with many partners to study the construction of a pipeline in the port area that allows the private companies to catch the CO2 to transfer it into the empty gas fields in the North Sea.
2. Portshuttle: a rail shuttle system to transfer containers in the port area, operative 24/24 and 7/7; this allows transport operators and logistics service providers to strengthen the goods flows, optimize the logistics inside Rotterdam and thus constitute a concrete example of efficient use of the existing railway line.
3. Portbase for the information planning and exchange: the Port Community System is used for the logistics planning and information exchange also for road transport. The drivers can use the service to anticipate information of their arrival to terminals and empty warehouses with the scope of allowing them to get ready.
4. Sustainable logistics chains: to assure that more efficient ship navigation, based on digital tools, it is promoted the use of electric cranes and transition fuels such as the LNG, that will be substituted in the long term by Hydrogen and synthetic fuels.
5. Free emission short trips to/from the port by 2040: there are three conditions to be fulfilled that are the availability of alternative fuels and its distribution grid, the conversion of truck engines (also by means of pilot projects), the economic advantage of using alternative fuels (also by means of incentives).
6. Container transport with e-truck in the whole port: the Port Authority commissioned a feasibility study of containers being transported by electric of hydrogen-powered trucks, assessing that I 2024, the purchase of a battery truck might be cheaper than a traditional diesel truck considering the truck entire life cycle. While hydrogen-fueled trucks might be more advantageous in 2030, even in the battery truck might still be the cheapest. However, infrastructure optimization for the use of the electric truck is necessary.

Added value for SUSPORT / link to pilot actions

The best practices of the port of Rotterdam represent a valuable example to be followed by SUSPORT partners and in particular by North Adriatic Sea Port Authority (NASPA). Within the SUSPORT project the following Actions are foreseen:

- the purchase of two electric cars to be used by the port Authority staff;
- a feasibility study for the introduction of hydrogen as an alternative fuel for transport and other small scale uses;
- the replacement of traditional lighting with LED in the port area of Sant Andrea-San Basilio (that will save 125 ton/year of CO_2).

Other initiatives towards a greener port adopted by NASPA are:

- OPS onshore power supply infrastructure
- The sizing, place and use of OPS is being studied to supply ships of cold ironing service.

Figure 14 - Venice lagoon highligting the NASPA main infrastructures

DATAMART to improve the landside port performances

Through the "Smart Traffic Management Tool" it was achieved a comprehensive knowledge of the infrastructures and energy demand developed on the allocation of structures and activities carried out inside the port area. The report showed a relational database and the data model is mainly subdivided into four groups: 1. Processes; 2. Datasets; 3. Software; 4. Issues. A new DATAMART reporting system was developed to analyse heavy-duty traffic flows deriving from gate in / gate out phases of the Venice Marghera port area main commercial road routes.

Energy performance diagnosis of the NASPA buildings for their requalification.

NASPA developed an energy diagnostic system for the public property or public use buildings to plan new technologies investments to decrease energy consumption and therefore the decrease in environmental impact. Performance of the buildings at the port will be defined on the basis of the quantity of energy needed each year to meet the need of each building and that corresponds to the global annual basic energy needs in primary energy for heating, air conditioning, ventilation, hot water, lighting, and plants operation (e.g. elevators, escalators). In order to achieve a classification, the energy performance of the buildings is expressed by the index of non-renewable global energy performance “EPgl,nren”. The certification of energy performance is a tool that will help, when the improvements are implemented, to increase the value of the buildings which by then will be characterized by low energy consumption. The increased efficiency, within the renovation interventions, will decrease the level of C02 emissions when the building is in use.

Port grid efficiency update

NASPA is considering the possibility of enhancing the port grid and modernize the terminals medium voltage cabins, in order to gain:

- Economic benefits, due to a dedicated grid to each terminal;
- Management and business continuity benefits, due to more autonomy at each terminal in terms of electricity thanks to specific ad-hoc contracts and the possibility to self-generate power through power plants (e.g. photovoltaic plants).

Energy Efficiency of Machinery

A dedicated electrical supply line for the machinery operating at quays, docks and port services areas in order to switch from a diesel power supply model to an electric power supply model will be further investigated, exploiting a new technology that can save and reuse the otherwise dissipated energy and as well for Reefer plugging system.

Development, dissemination and data collection by means of a questionnaire to gather specific data on the activities of each terminal carried out at the Port of Venice.

The questionnaire has defined the baseline needed to identify possible improvements in terms of energy efficiency, which could be a factor of assessment in the future tenders for concession agreement documents, in terms of development and payback, considering also the duration of the concession.

Ecoports network - UE

EcoPorts is the main environmental initiative of the European port sector. It was initiated by a number of proactive ports in 1997 and has been fully integrated into the European Sea Ports Organisation (ESPO) since 2011. The overarching principle of EcoPorts is to raise awareness on environmental protection through cooperation and sharing of knowledge between ports and improve environmental management[17]. In this framework several initiatives have been put in place, providing also different tools devoted to assess and improve the port sustainability. These tools can be applied by all the ports within and also outside the Ecoports network. Here, two of these tools are analysed.

Self Diagnosis Method

The Self Diagnosis Method (SDA) is one of the tools offered within the EcoPorts initiative, which is fully integrated with ESPO since 2011. The tool is configured as a checklist which helps a port authority in identifying the main environmental risks that affect the port area. Moreover, it enables the comparison of port environmental performances with the European average in order to improve their environmental management and policies by prioritising future actions. Within the EcoPorts initiative, experts review the SDA and can provide customised advice and recommendations according to port main priorities to ensure sustainable development.

Added value for SUSPORT / link to pilot actions

The SDA can help SUSPORT partners in improving their awareness of environmental protection, helping to improve the environmental management and planning of the future developments of the

[17] https://www.ecoports.com/

port area. Hence, with this tool, it can be possible to assess the effect of the actions implemented during the SUSPORT project and better integrate them into the sustainable development of port area and operations.

Port Environmental Review System

The port of Rotterdam defined a tool to assess the sustainability performance of a port considering several different sustainability issues. The system, named Port Environmental Review System (PERS), has been developed is in line with ESPO recommendations concerning port sustainability and it is now part of the tools provided by EcoPorts Initiative. The PERS incorporates also the current recognised environmental management standards, such as ISO 14001. A wide range of sustainability issues is addressed by PERS including noise, air and water quality, waste treatment, problems connected to dredging operations and disposal, bunkering operations, dust, pollution due to ships and port operations, port energy consumption, the interaction between the port and the local community and with the port and the habitat/ecosystem with special attention to climate change. The PERS can help port authorities in facing environmental challenges and improving their environmental management. Ports from EcoPorts network can apply to obtain a PERS certificate independently reviewed by Lloyd's Register and valid for two years.

Added value for SUSPORT / link to pilot actions

The PERS, despite was initially implemented for the Rotterdam port, is now a flexible and userfriendly tool applicable to other contexts (ports with different infrastructures, terminals, location, etc.). The PERS covers multiple aspects which are encompassed by SUSPORT project objectives, linking them to in a broader context. Hence, the PERS might help to link the actions carried out during the project within a more organic and certified environmental policy.

Ports in Adrion Region – UE

Transnational Strategy for low-carbon transport systems in the Adriatic Ionian basin (Figure 15) provides a set of key guiding principles for its roll-out by the Network members and outlines the key policies at international, European and national level that is being aligned with.Action plans produced within the SUPAIR project funded under the ADRION programme cover a broad range of fields and promote solutions identified by the port authorities aimed at reducing the environmental impacts of shipping and on-shore port operations. Each port focused on specific areas of interest. Action plans are produced for the following ports:

- Port Network Authority of the Eastern Adriatic Sea (Port of Trieste)
- North Adriatic Sea Port Authority, ports of Venice and Chioggia
- Port of Koper
- Port of Bar Holding Company
- Durres Port Authority
- Piraeus Port Authority S.A.
- Thessaloniki Port Authority S.A.

Added value for SUSPORT / link to pilot actions

Although this strategy and action plans were developed for the wider ADRION region, these documents can be used and consulted within SUSPORT project for the activities of improving energy efficiency and sustainability in port areas in Italy-Croatia region. These documents are therefore an added value to the SUSPORT project and the implementation of project activities.

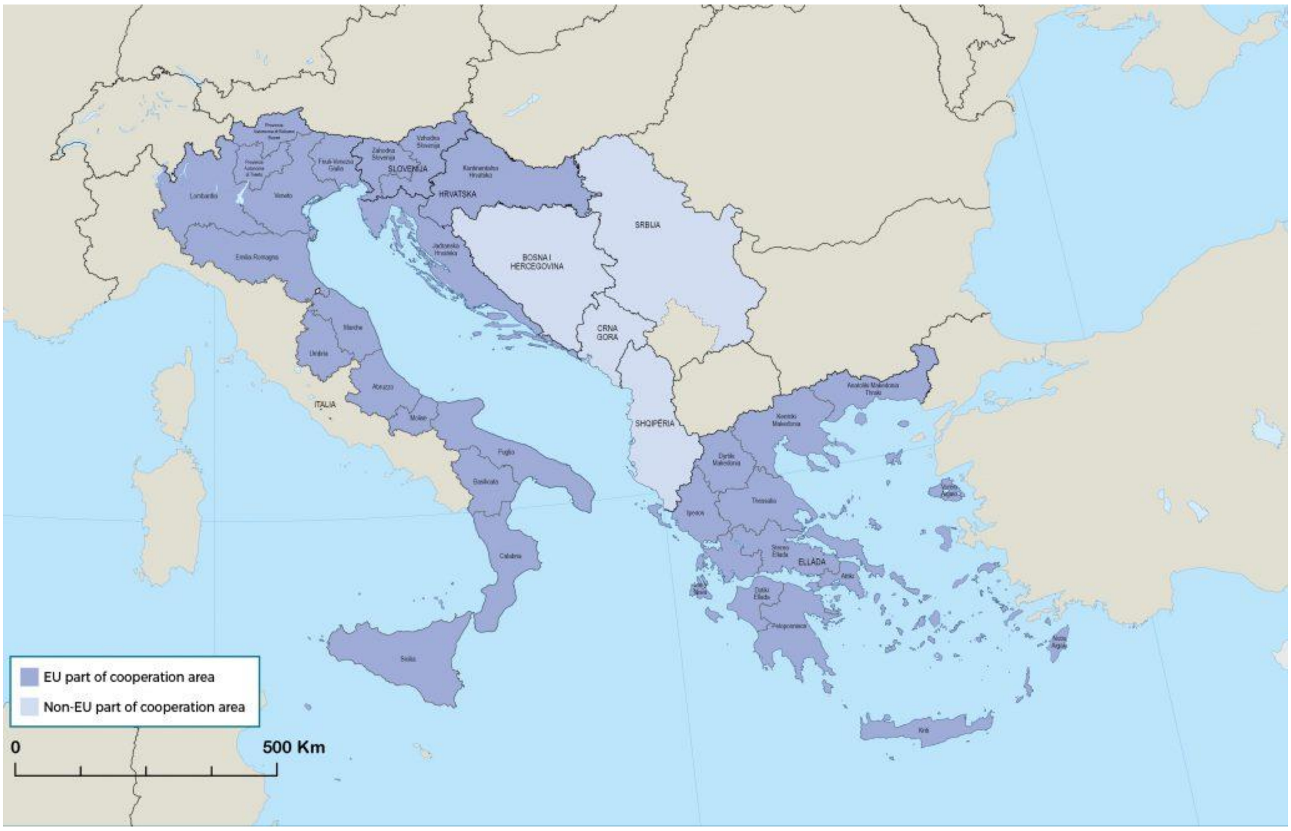

Figure 15 - Adrion region

Conclusions

The outcomes of the best practices analysis carried out within the SUSPORT project has been here presented. The analysis offers an overview of the actions that can be carried out to improve environmental sustainability and the environmental efficiency of port operations. The importance of an overall environmental policy has been highlighted by several virtuous examples available in northern Europe. In particular, the large ports of Rotterdam, Antwerp and Amsterdam shows that with proper planning, the environmental impact can be taken under control and also reduced in port areas, despite an increasing volume of wares.

Besides, several shreds of evidence show that the objective can be reached 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. In this context also monitoring devices and data analysis play a key role: they enable to control the air/water quality and the principal sources of pollution (e.g. maritime and road traffic inside the port) while allowing a better action planning and an objective assessment of the results.

In conclusion, it shall be noted that the present best practices analyses mostly deal with the European context, which is the most familiar context for the project partners but also where the environmental issues are more considered by the administrations in the international scenario. The present analysis does not pretend to provide a comprehensive discussion of the environmental sustainability topic, which is outside the purpose of SUSPORT project, but a valuable collection of practical examples that can be directly applied in the Programme Area as well as in other contexts. Hence, it is expected that sharing information about environmental sustainability among the project partners and local stakeholder can help in planning the next phases of the project to maximise their impact in each specific local context.

Appendage 1 – Template for the collection of best practices

SUSPORT – TEMPLATE FOR COLLECTING BEST PRACTICES (FOR D.3.2.13)

Introduction

SUSPORT aims to enhance the environmental sustainability and energy efficiency of Italian and Croatian ports.

In its initial phase, each PP analyses the ongoing situation concerning these two aspects in its own territory, through ad hoc Territorial Needs Assessments (TNAs) (D.3.2.2-12) and develop local action plans (D.3.3.2-12).

1. Aim of document

The document defines the common template for the collection of best practices in the domain of port environmental sustainability and energy efficiency which PPs will be asked to fill in for the elaboration of Best Practice Analysis (D.3.2.13).

Ideally, this document lies between the TNAs and the local action plans: after analysing the ongoing level of environmental sustainability and energy efficiency identifying related needs through the TNAs, PPs learn from other EU and international experiences in order to gather precious lessons for the elaboration of the local action plans, the cross-border action plan and the pilot actions.

2. Template

PPs will fill in the following table, identifying best practices involving port environmental sustainability and energy efficiency.

Title
Location
Description of the best practice

Added value for SUSPORT / link to pilot actions

Appendage 2 – Contibution of SUSPORT project partners

The contribution to this document provided by SUSPORT project partners is summarised i.

Contribution	Location	Partner
Port of Amsterdam smart public lighting on DC	Amsterdam (NL)	PP10 - KIP
ECO-solutions deployment in the Ports of Amsterdam	Amsterdam (NL)	LP - ADSPMAO
Overall sustainability strategy	Amsterdam (NL)	PP03 - VIU
Port Authority-CNR agreement to reuse the former Fincantieri building	Ancona (IT)	PP01 - COSEF
PIA – Progetto Inquinamento Ancona	Ancona (IT)	PP06 - ADSPMAC
Ancona Blue Agreement	Ancona (IT)	PP06 - ADSPMAC
Onshore power supply	Ancona (IT)	PP06 - ADSPMAC
Analysis of energy consumption	Ancona (IT)	PP06 - ADSPMAC
Interact City in the Port of Antwerp	Antwerp (BE)	PP11 - LUZ
ECO-solutions deployment in the Ports of Antwerp	Antwerp (BE)	LP - ADSPMAO
Overall sustainability strategy	Antwerp (BE)	PP03 - VIU
Electric vehicles for Port of Bar	Bar (ME)	PP11 - LUZ
Public lighting in the port of Corigliano Calabro	Corigliano Calabro (IT)	PP01 - COSEF
ECO measuring station by Dubrovnik Port Authority	Dubrovnik (HR)	PP12 - SPA
Alterenergy project	Dubrovnik-Neretva Region (HR)	PP15 - DNR
Green initiatives	Genoa (IT)	PP07 - ASVI

Cold ironing in the port of Genoa	Genoa (IT)	PP04 - ITL
Advanced technology solutions for the port operations and management	Hamburg (DE)	PP14 - DPA
Introducing high-efficiency lighting technologies	Koper (SI)	PP11 - LUZ
Monitoring can bring savings	Koper (SI)	PP10 - KIP
LED Street Upgrade	Port Macquire-Hastings (AU)	PP12 - SPA
Photovoltaic system on the roof of the Port of Ravenna Authority headquarters	Ravenna (IT)	PP05 - ADSPRA
Low Carbon Transport Plan	Rijeka (HR)	PP09 - LUR
Carbon footprint and sustainable initiatives	Rotterdam (NL)	PP02 - ADSPMAS
Ecoports network - UE		PP03 - VIU
Ports in Adrion Region - UE		PP11 - LUZ