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Intervention Strategy for Ports' Energy Efficiency

SMARTPORT Consortium 06/2023

T2.1. Main Output

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Introduction

The present document represents the main output developed within the SMARTPORT project, with the objective of outlining a series of steps, correlated with Deliverables designed to provide a comprehensive overview of RES (Renewable Energy Sources) and RUE (Rational Use of Energy) opportunities, with the aim of achieving improved energy efficiency in South-Adriatic ports.

As clearly expressed in the project application form, this output serves as a valuable platform for formulating existing processes and focusing on further actions to minimize energy usage, including the utilization of renewable energy sources, energy saving, energy storage, and smart grid technology.

By representing the phases followed during the Project as a **process** or workflow, the intention is to create a highly replicable and transferable model to use in other geographical contexts by different stakeholders.
This approach, therefore, aims to offer a useful tool for the replicability and transferability of the project, seen as a **sequence of actions aimed at enhancing the energy efficiency of port areas.**
To facilitate the understanding of the followed process, explanations of the individual key phases of the project are enriched by the annex of the Protocol, or Memorandum of Understanding, signed by all the SMARTPORT project partners, attached to this document as a valuable example of agreement for further future cooperation towards greater sustainability, and by the references to the key project's Deliverables.
The logical and chronological sequence of these described Deliverables is geared towards achieving the overall project goal of greater environmental sustainability.
The latter, represents a true challenge for the port industry: many ports and terminals endeavor to enhance energy efficiency as energy prices have increased through years and climate change mitigation is a key target for the port industry.
Every port infrastructure and the complex of related activities which are implemented in their frameworks have a significant environmental impact in terms of water and air quality, atmospheric emissions, soil and resource consumption, and greater waste production.
In view of all this, and with the purpose of contributing to meeting the commitments made by the European Union for greater sustainability in industrial activities, all the phases of the SMARTPORT project have been oriented towards researching and implementing solutions that make activities in port areas less environmentally impactful.
Following the approach adopted by the project, environmental improvement is considered as one of the competitiveness factors for ports, and energy sustainability is deemed of paramount importance for overall sustainability due to the pervasive nature of energy consumption, its role in economic development and living standards, and its impact on the environment.
Taking these factors into consideration, the SMARTPORT project has focused on the

energy efficiency of ports, developing and implementing a strategy that this document intends to outline and describe.

1. The "Guidelines for a greater sustainability of the local energy system" as a comprehensive guiding tool for the SMARTPORT process.

The Guidelines for a greater sustainability of the local energy system represent a key Deliverable implemented within the SMARTPORT project and are extremely useful in the framework of the present output.
In fact, the Guidelines express the rationale underlying the steps explained in the following of this document, **integrating the logic** of the whole process.

Actually, they encompass a general **vision towards greater sustainability**, or better, they summarize the general strategy that the ports should implement to develop proper energy plan, ensuring greater environmental sustainability and taking into consideration various aspects and measures that can be concretely adopted.
As clearly outlined in the Guidelines conclusions, they are not to be considered exhaustive, but instead must be continuously updated in line with the needs of the various stakeholders (demand pull) and the possibilities afforded by innovation (technology pull), as well as the obligations dictated by national and supranational legislation (legal framework).
The continuously updated environmental energy takes on a crucial role.
The functions that the environmental energy plan must ensure can be summarized as follows:

- collect in a single document all improvements and measures assessed positively in terms of technical and economic feasibility;
- coordinate the programming of improvements over the fixed period, ordering works according to the merit criteria resulting from the CBA (cost-benefit analysis) and other criteria of feasibility and maturity of the projects;
- enable an assessment of the need for and appropriateness of possible financial support for capital projects, in addition to conventional energy efficiency and renewable energy incentive instruments;
- envisage methods for monitoring the improvements and evaluating their effectiveness;
- enable the assessment of CO2 reduction potential, collective utility (net benefits) and investment costs for all planned port improvements, to support the preparation and updating of mitigation policies.

Taking these Guidelines as a framework for the interventions carried out by the Project, the individual operational steps that the SMARTPORT Project has implemented in order to increase the energy efficiency of ports, which represents one of the key aspects of environmental sustainability, move from a study of the state of the art, to assess the energy needs linked to management of the port areas, through a common methodology

(in the case of the SMARTPORT project, developed by ARPAP).
Afterwards, always keeping in mind the importance of involving different stakeholders not only as a specific step, but rather as a transversal aspect of the entire process, a second, more analytical, technical and engineering study phase, focused on the selected port areas, takes place.
It leads to the specific identification of the equipment and works necessary to be carried out.
This phase is followed by the concrete implementation of the interventions, and, to ensure continuity and follow-up to the activities carried out in the ports, the signing of a Memorandum of Understanding is envisaged. The latter formalizes the commitments of the Parties involved in a future perspective.
Finally, monitoring and evaluation activities of the pilot interventions over time must be ensured.
This process as a whole, enriched by the transversal aspect given by the dialogue with stakeholders and the targeted training, highlights the **importance of the commitment of the entire community** at multiple levels, to reach the environmental sustainability of the ports of the South-Adriatic area.

1.1. The Guidelines content

The mentioned Guidelines document, delivered within the SMARTPORT project, is based on the Guidelines for the drafting of Italian Port Network Energy and Environmental Planning Documents; guidelines established by the MIT - Ministry of Infrastructure and Transport.

They move from the assumption that efficient energy and environmental management of ports can lead to significant reductions in greenhouse gas emissions, given the large margins for possible improvement.
Therefore, they set out that the first step required is to make an inventory of the port's CO2 emissions and to monitor the annual trend.
The Port Network Authorities will have to set emission reduction targets in line with national targets, and incentives must be provided towards achieving these targets.
Ports are a key element of logistics chains, and are often also the location of industrial activities, which require energy for their production processes.
The strategic policies to be pursued for energy and environmental sustainability include improvements in the energy sector of ports, divided into three areas:

a. Improvements in the energy consumption of ships, from large to small service vessels; in addition to the electrification of docks discussed below, this category also includes the possible bunkering of large vessels with LNG, providing both the necessary infrastructure for bunkering and incentives for shipowners wishing to retrofit these vessels.

b. Improvements in the energy consumption of port buildings and installations, including equipment such as cranes, cold stores, service vehicles, etc. This category of improvements includes all civil construction works (insulation of building envelopes, window frames, efficient heating systems, shading to reduce cooling, etc.), lighting of outdoor areas.

c. Measures that do not directly involve energy efficiency improvements, but which could lead to significant energy savings through the implementation of incentive schemes to support terminal operators investing in less energy-intensive installations/equipment and/or renewable energy sources, or through the inclusion of energy consumption and efficiency criteria and good operational practices in the selection of concessionaires and procurement processes.

Moreover, the same improvements may refer to:

- electricity consumption;
- energy consumption from other sources, including electrification operations, which often offers benefits not only in terms of energy efficiency and reduced CO_2 emissions, but also in more general environmental terms, particularly for the localised effects in port areas.

According to the Guidelines, the improvements, and measures to be implemented must be subjected to a technical-economic feasibility assessment, including a cost-benefit analysis. Therefore, adequate regulations must be established for the effective pursuit in port networks of the strategic efficiency policies.
As outlined in the Guidelines, the **Port Network Master Plan (PRdSP)** must foresee redevelopment objectives within short-, medium- and long-term energy planning that pursue high performance in terms of functionality, service continuity and eco-sustainability, based on cost-benefit analyses.
Energy planning must take into account organizational procedures and tools that favor the use of the various incentives available, or to be promoted with appropriate regulation, in order to achieve the set objectives.
As far as electricity is concerned, given that hundreds of operators operate independently in every port, it requires unitary management in the port network area, coordinated by the AdSP, from the perspective of a single user integrated as a “portgrid” or port microgrid.
Operations to improve functional and energy efficiency are facilitated by the coordination in a single portgrid, which can also integrate local generation and possible storage, of all individual user electrical systems.
The portgrid must include all stakeholders in energy planning (in addition to the AdSP, service companies, terminal operators and ship owners, local and regional authorities of the contiguous urban areas engaged in their various capacities), foreseeing incentives and/or compensation for the costs of implementing energy innovations.

The portgrid can ensure functional performance, business continuity, fault tolerance and integrate shore-side energy use with the power supply of moored ships and boats, as well as accommodate local power generation and storage useful to mitigate peak loads. The specific objectives to be pursued to improve the energy sustainability of the Port Network, as indicated in the Guidelines for the PRdSP (Port Network Master Plans), can be summarised as follows:

- improve the energy efficiency of buildings, installations and equipment, favouring the abandonment of particularly polluting fuels in favour of LNG, when it is not possible or affordable to electrify consumption;

- adopt incentives to support port operators and in particular terminal operators investing in less energy-intensive and/or renewable energy facilities/equipment, i.e. by including technical-economic consumption and energy efficiency criteria and good operating practices in concessionaire selection processes and procurement processes;

- electrification, if validated by the cost-benefit analysis, and in particular:

- the electrification of docks to allow docked vessels to switch off their engines; this conversion is very effective and applies to both large and small vessels;

- the electrification of building heating systems, which is particularly cost-effective when combined with electricity generation from renewable sources;

- the installation of electric charging stations to encourage the use of electric vehicles within the port;

- the electrification of small vessels serving port facilities.

Analyzing more in detail the topic of energy efficiency and use of renewable sources, the first aspect to be mentioned is **the management of the port as "PortGrid"**.
If the port system is to be competitive, it must guarantee high performance in terms of functionality, safety and quality of electricity, business continuity and promote adequate innovation in compliance with energy and environmental sustainability.
The main objectives of a port electricity management plan can be summarised as follows:

- technical functionality
- energy efficiency;
- business continuity;
- monitoring and control of the load diagram.

The Plan should be based on the criteria of the "four Ls", the pillars of functional and sustainable energy consumption:

- Levelized;

- Limited;
- Locally generated;
- Locally used.

Levellized consumption is achieved by optimising the duration of maximum energy utilisation, while limited consumption is a consequence of improved efficiency and reduced waste. Local consumption (net zero) uses locally generated energy for self-consumption.
Operations to build an adequate port network, which are described in more detail below, must contribute to:

- planning combined heat/electricity/CDZ production, wind farms and photovoltaic facilities, efficient lighting systems;
- configuring facilities with flexible and partitionable structures;
- implementing non-conventional electrical systems, special voltage levels specifically for port use, possible portions of the DC grid, electric vehicle charging systems, storage systems, power supply for refrigerated container parks, shore power supply systems for moored ships (cold ironing).

The second topic to deepen is represented by the **Cold Ironing.**
While at berth, ships shut down their propulsion engines but use auxiliary engines to ensure continuity of services and power to all electrical equipment on board, such as lighting, heating and load handling operations.
On-board electricity is supplied by generators consisting of a transformer coupled to a diesel engine or a turbine (gas or steam).
Thus, keeping a ship at berth involves substantial fuel consumption, generating exhaust gases (such as SOX, NOX, atmospheric particulate matter and volatile organic compounds), noise and vibration.
The topic of sustainability has become a major issue at national, European and international level, and the electrification of docks is one of the fast-spreading technological solutions in this field.
Cold Ironing, also known as 'Alternative Marine Power' (AMP), 'onshore power supply" (OPS) or 'shore-to-ship power' (STS), is a particularly effective solution for reducing pollutant emissions from ships in ports.
Electrifying docks means connecting ships to the dock and supplying them with the power they require while at berth via a power line connected to the national grid, thus enabling them to turn off their on-board engines. The ship can remain at berth with its engines switched off, but can continue all loading/unloading operations and all passenger services are guaranteed. This would significantly reduce pollutant emissions produced during mooring, considering that emissions from the electrified docks are significantly lower than those produced by marine fuels. If the boats were powered by electricity from renewable energy sources, emissions could even be completely eliminated.
Cold ironing also mitigates the problem of noise, which disturbs the harbour and

surrounding residential neighbourhoods. The rumble generated by ship engines during mooring accounts for a majority of the noise pollution; it is a low-frequency noise (< 100Hz) that travels over long distances. Connecting ships to shoreside power would also reduce noise pollution as they would switch off their engines while berthed.

When defining the green tech solution of cold ironing at a regulatory level, we must first refer to Art. 4 of the European Directive "on the deployment of alternative fuels infrastructure" - DAFI 2014/94/EU - which foresees, in point 5, the installation of shore-side electricity supply by 2025, giving priority to the ports in the TEN-T network.

To date, not many ports are equipped with cold ironing infrastructures, and there are also few ships equipped to receive shore-side electricity. The reasons why the deployment and installation of the facilities has been prevented can be identified by comparing the perspectives of the two main stakeholders involved in the maritime sector: Port Network Authority and ship owners. For the authorities, given the few ships equipped for electrification, the investment has a certain risk of being unprofitable. For shipping companies, on the other hand, it is equally risky to adapt ships when cold ironing facilities are not yet developed in all ports.

Another complication in deploying these facilities is that the ships to be serviced are very different from each other and the infrastructure has to be adapted to the ships requiring power. For example, power, frequency, connection and interface must be taken into account. As far as the connection is concerned, there is no single connection point for all boats, which can vary in height as well as the length of the cables required.

The actual use of cold ironing is closely related to the type of ships and boats and also to the actual power available from the electrical grid to which it is connected in order to transfer sufficient energy.

Ministerial Decree 330 of 13/08/2021 approves the programme of port infrastructure improvements that are synergic and complementary to the National Recovery and Resilience Plan (PNRR), which foresees the financing of cold ironing facilities in 37 Italian ports. This addresses two of the main obstacles mentioned above: on the one hand, it supports investments by authorities, thus mitigating the associated risk; and on the other hand, it provides for the creation of a network of ports equipped for cold ironing, reassuring shipping companies that ships converted to this technology can be used everywhere.

The technical reference standard for the deployment of cold ironing facilities is IEC8005-1: “Design. Standard for Shore to Ship Power”. It focuses on standards for plugs, sockets and ship couplers for high voltage shore connection systems (HVSC systems).

There are several types of ship-dock connections, depending on the ship itself and the space available on the dock for loading and unloading:

- Barge power supply system: made by adapting a barge to house the connection system and, where required, the transformer system for adjusting voltage levels;
- Mobile power supply system: consists of a trolley equipped with a cable reel with a power cable with at one end a connector for the shore connection box and at the other end a connector for the ship;

- Fixed supply system: consists of fixed cable cranes built close to the connection boxes.

Concerning the **Liquefied Natural Gas (LNG)** as marine fuel, according to the Guidelines it should be considered that:

- Maritime transport and port activities are still heavily dependent on fossil fuels. In the shipping industry, liquefied natural gas (LNG) is a viable and affordable alternative for overcoming new regulations lowering the maximum sulphur content in fuels.
- There are currently limits on the sulphur content in marine fuels:
- All ships moored in EU ports (and at least two hours before mooring): 0.10%;
- Ships within a SECA (Sulphur Emission Control Area) for both navigation and mooring: 0.10%;
- Passenger ships operating a scheduled service within the territorial waters of Member States: 1.50%;
- Any ship sailing outside territorial waters: 0.5%.
- On 1 January 2020, the new IMO (International Maritime Organization) regulations came into force. These regulations forcibly encourage the adoption of new greener technologies and fuels.
- The use of LNG is an integral part of the EU's broader energy and environmental policy design, which aims at the gradual transition to a low-carbon economy through the substantial reduction of pollutant emissions, the use of clean fuels and the use of renewable sources.
- It will therefore be essential to allocate the necessary space in ports for LNG facilities, facilitating the creation of the infrastructure required to refuel ships using this fuel. In this regard, Leg. Decree 257/2016 invites Member States to secure the installation of a sufficient number of LNG bunkering points in the maritime ports of the core TEN-T network and an adequate number of LNG bunkering points accessible to the public for heavy road vehicles. Both provisions must be met by 31 December 2025. Furthermore, the same Leg. Decree dictates the bureaucratic procedures for small-scale LNG storage and transport infrastructures (less than 50 tonnes m/m).

Four main bunkering options are defined for LNG refueling:

SHIP-TO-SHIP (STS) refueling:

- the transfer of LNG from a ship or barge, carrying LNG, to another ship for use as fuel. STS offers a wide range of applications and bunkering operations can be carried out at the port or, alternatively, at sea. The main advantages of this type of transfer include the possibility of operating at sea even without entering the port if the weather and wave conditions allow, as well as the possibility of transferring rapidly large volumes of product.

TERMINAL/PIPELINE-TO-SHIP (PTS) refueling:

- LNG is transferred from a stationary onshore storage tank via a cryogenic line with loading arms (in the case of a regasification terminal storage tank), with a flexible end or the pipe of a ship moored at a nearby quay or dock. The proximity is dictated by the installation and operating costs of a cryogenic pipeline. The onshore tank can be a buffer storage, at an LNG terminal or at an onshore storage facility. It can be a small pressurized tank fed by tanker, train, shuttle vessel or mini liquefaction facility. Another option is to use a large tank at ambient pressure (especially if there is a regasification plant nearby). The PTS solution guarantees higher flow rates, suitable for refuelling large ships, than the Truck-to-Ship solution.

TRUCK-TO-SHIP refueling:

- This is the transfer of LNG from a tanker truck to a ship moored at the dock or jetty. This normally involves connecting a special LNG cryogenic pipe. A tanker of this type can carry 40-50 m3 and transfer a full load in about an hour. This mode of transfer offers great geographical flexibility and is particularly attractive in the start-up phase due to the low investment; on the down side, only small quantities can be transferred. This type of operation is suitable for vessels with small tanks, such as tugboats, fishing boats, etc., but is not a viable solution for larger vessels, such as ferries, which have 400 m3 tanks.

Refueling from mobile tanks or cryogenic ISO-containers:

- These tanks can be used as mobile fuel storage and the amount of product transferred is flexible as it depends on the number of tanks. Mobile tanks include ISO containers, which are standard-sized mobile cryogenic tanks equal in size to an ISO container (1 twenty-foot equivalent unit (TEU)) or a double container (2 twenty-foot equivalent units TEU)2. They are used as mobile fuel storage and the amount of product transferred is flexible as it depends on the number of tanks. They can be loaded onto a vessel using special container cranes or onto a truck in RoRo mode (Roll-on/Roll-off) They are intermodal like all ISO containers, so they can travel by truck, train or ship. The tank is pressurised and has a capacity of between approximately 20 m3 and 45 m3.

In the field of the **development of the electricity production from renewable sources in the port area**, the Guidelines highlight that the construction of small-scale renewable energy plants in ports can help to reduce CO2 emissions and to reduce absorption from the national power grid (and thus of infrastructure), including via the use of solar-thermal plants.
By way of example only, the physical and climatological peculiarities of ports make them more suited to improvements in the following areas:

- Photovoltaic systems that, despite the absence of an incentive scheme, guarantee economic sustainability and reduced peak loads;
- mini wind turbines, both horizontal and vertical axis, which can be a solution

subject to the existence of suitable anemometric conditions;
- installations that exploit wave motion, with various technical solutions that are already being experimented in ports and that could benefit from the implementation of DEASPs to find interesting areas for deployment.

Also the **power storage systems** are taken into account within the Guidelines.
The unpredictability of energy produced from renewable sources could give rise to critical issues in the management of the electricity distribution network. Efficient management of this variability calls for the use of systems for storing excess self-produced electricity for self-consumption at times of peak demand. This would transform the port into a smart grid allowing for greater flexibility.
The storage system industry is evolving rapidly from a technological point of view and their deployment in ports could be very useful to promote innovation and economic competitiveness. At present, stationary electrochemical storage can only be economically viable if it contributes to different grid interfacing applications, such as load shifting, peak shaving or power quality & reliability, thus saving on electricity supply contracts, whose economic conditions could be further improved by a greater drive towards electrification of services, such as mobility.

The topic of **green shipbuilding** is relevant as well. The improvement of energy efficiency in the shipping industry is a priority of institutions; in 2011, the IMO (International Maritime Organisation) defined energy efficiency standards (EEDI - Energy Efficiency Design Index) for newly built ships starting in 2015. In February 2013, the European Commission, in cooperation with the shipbuilding industry in the Member States, launched the "Leadership 2020 initiative", which provides a set of recommendations to support the revitalisation of the European shipbuilding industry with a view to sustainable development and the creation of high value-added jobs.
Nowadays, there are several technological solutions for green shipbuilding, such as Air Cavity System, Waste Heat Recovery System, Engine Auto-Tuning, Energy Saving Devices, propeller and rudder replacement, integrated information systems or anti-fouling systems.

Within the Guidelines, the **E-mobility** plays a crucial role too. The Alternative Fuels Infrastructure Directive (AFID) foresees the establishment of an adequate number of publicly accessible recharging points to ensure interoperability between existing and newly installed recharging stations, depending on market needs, ensuring that electric vehicles can be operated at least in urban and suburban agglomerations, other densely populated areas and other networks.
In this context, by virtue of the needs of internal mobility, ports could consider the establishment of vehicle recharging stations, which could also serve possible internal electric vehicle rental services or internal shuttles.
Mobility within the port could also benefit from the transition to electric vehicles in terms of energy efficiency and air quality (elimination of on-site emissions of pollutants and

fine particles). The focus should be on investments in low-emission fleets and equipment (cranes, tractors, utility vehicles and boats, etc.) and the establishment of electric charging stations to facilitate their use.

Regarding the **energy efficiency of buildings within the port and the illumination of outdoor areas**, as stressed in the Guidelines, it offers ample opportunities for reducing CO_2 emissions.
There is now an extensive literature in the industry on the possible improvements and their cost-effectiveness, as well as their environmental benefits. By way of example, we can highlight:

- Improvements to the cladding, walls, installations and roofs, aimed at increasing both thermal resistance and thermal inertia and thus efficiency in terms of heating/cooling consumption, i.e. adequate solar shading;
- Improvements to systems, including low-temperature heating systems, possibly powered by heat pumps;
- The illumination of outdoor areas, with more efficient lighting and control systems;
- The reduction of the albedo effect in asphalted yards, which is particularly important for cooling in the summer.

For our purposes, the Guidelines take into consideration the **Energy Efficiency oriented port organization** as well, stressing that, in the implementation of Directive 2010/40/EU, in 2014 Italy adopted the National Plan for the Development of Intelligent Transport Systems (ITS). The Plan estimates that the deployment of ITS can generate energy savings of around 10-12%.
ITS integrate information and communication technologies (ICT) in transport infrastructure, vehicles and services, and include a wide range of tools and systems for document management and dissemination of multimodal mobility information, in order to improve cooperation between operators and coordinate port activities, making terminal operations more efficient by reducing the time cargo units and users spend in port.
The implementation of these tools is recommended by the European Community, with a view to the development of rail-sea and road-sea multimodality, in order to diminish the negative external effects of road transport and the problems related to energy security, which is overly dependent on fossil fuels.

Concerning the **opportunities offered by waste management**, the Guidelines observe that ports generate and have to manage many types of waste, from ordinary rubbish to hazardous materials. It is clear that waste reduction, as well as the recycling of separately collected waste, has positive effects on CO_2 and greenhouse gas emissions in general, especially due to the reduced use of virgin materials.
In addition, ports, especially passenger ports, produce large quantities of biowaste, which can be used to produce green energy, even locally. The collection, for example, of

used vegetable oils from large cruise ships can justify the construction of small power generation plants, preventing the dispersion of such hazardous waste.

Lastly, as regards the **other opportunities for CO2 emissions reductions**, the following aspects should be mentioned:

- Transport infrastructure with CO2 reduction potential: intermodal centres or connections that use more energy efficient modes of transport than road transport (e.g. rail terminal in the port, construction of new rail bars at specific docks, rail links to intermodal centres outside the port);
- port infrastructure (quays, yards) allowing access, mooring and loading/unloading of ships with a better energy efficiency design index (EEDI) rating (deeper channels, longer quays, wider yards, etc.);
- waste-to-power generation plants (waste heat from industrial processes, etc.);
- Facilities for port recovery and reuse of frigories from cryogenic processes (e.g. LNG);
- IT systems and software for maritime traffic management aimed at preventing port congestion by reducing ship speed and consumption, or for optimizing handling flows in the yard;
- public works for infrastructure maintenance (energy-efficient dredging projects/works, reuse of dredging materials);
- techniques to reduce energy consumption during the construction and operation of port infrastructure.

The mentioned content represents the framework of the steps in which the SMARTPORT Project is articulated, described in the following paragraphs, and should be keep in mind as the general vision towards a greater sustainability of the local energy systems in the port areas.

2. The operative steps of the SMARTPORT Project: an overview

The following infographic represents the single steps of the SMARTPORT project, offering an overview of the implemented activities, which are then described in the paragraphs below one by one.

The process is represented as a circle because the last step, i.e. the evaluation and monitoring of the interventions carried out, can ideally also constitute the first step of a new virtuous circle for improving the energy condition of the port areas.
In fact, monitoring and assessment activities can determine the detection of aspects to improve and work on further, and therefore can trigger the beginning of a phase of new studies and insights into the state of the art, with consequent **resumption** of the improvement process.
However, some clarifications must be made regarding the sequence of the individual steps.

First of all, it is not a closed and concluded circle, but a process that **tends to continuous improvement** towards environmental sustainability, and therefore more similar to a spiral shape.
Secondly, the involvement of local communities, professionals and stakeholders at multiple levels, is not a truly isolated step of the process, but rather a transversal aspect which runs in parallel with the rest of the activities implemented within the Project.
Furthermore, the involvement and engagement of stakeholders finds its fulfillment in signing of the Memorandum of Understanding (MoU), which formalizes the commitments made by civil society stakeholders, at cross-border level, to continue working together for the environmental sustainability of ports, with a future perspective.

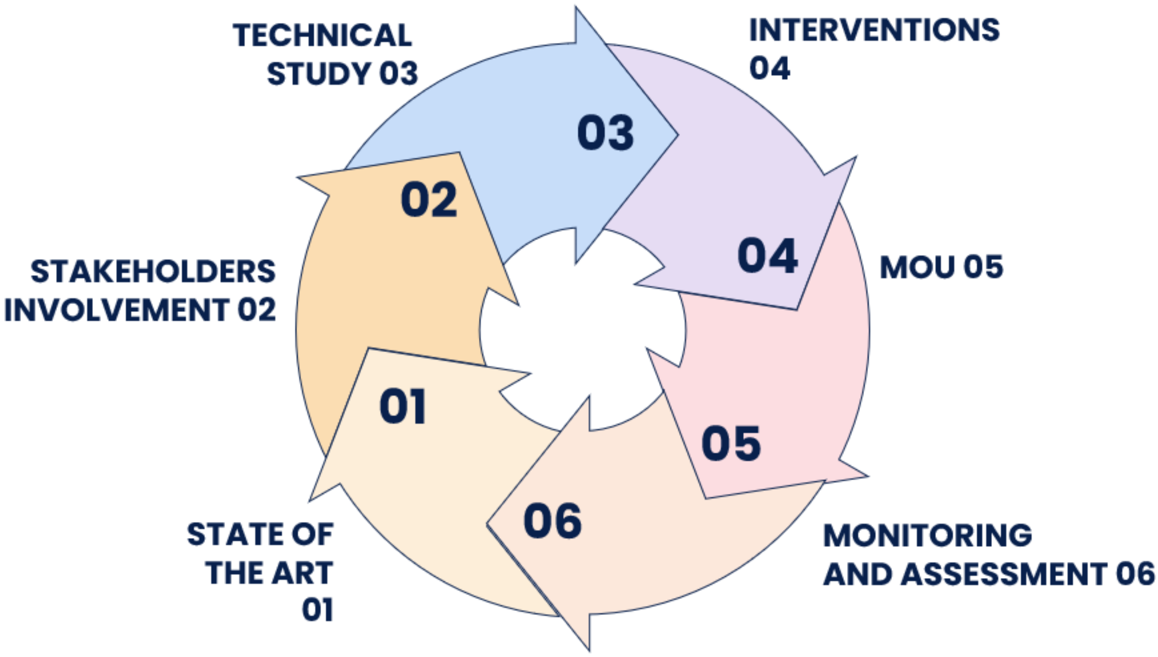


Fig. 1. Representation of the steps of the SMARTPORT process integrating an Intervention Strategy

2.1. Step 1: The state-of-the-art analysis

The first step, which involves the analysis of the state of the art, first of all materializes in the Deliverables produced within the scope of activity A.T.1.1 "Energy evaluation analysis" in the communities involved, starting from the fact that even if Ports are important infrastructures for economic growth and development, on the other hand, they may have impacts on the environment, climate and on population living in the neighborhood of the ports.

The environmental impact of ports may, therefore, be related to a wide range (and nature) of activities, products and services, having a direct or indirect impact on air, water, soil and sediment, on resource consumption and waste production, as well as on the quality of life of local communities.
As already mentioned, in view of all these factors in recent years several efforts have been

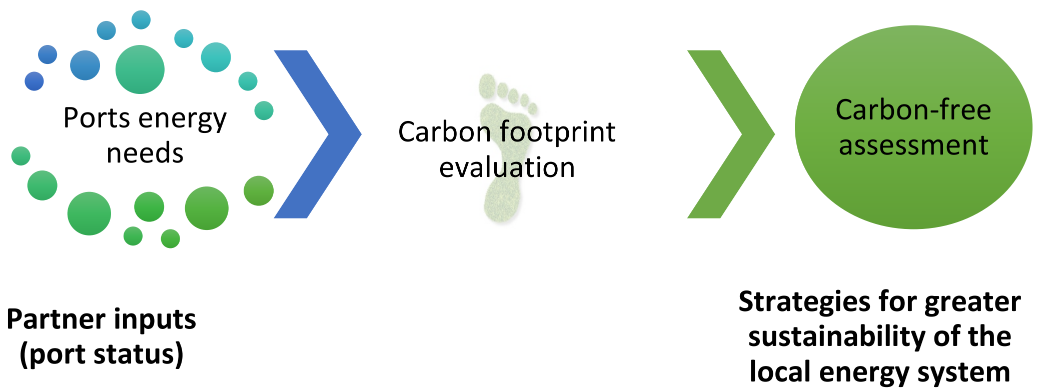
made to control environmental impacts in ports, based on the commitments made at European level and due to the increasing attention to the sustainability of economic activities[1]. The reform of the 'Port System', to which the project and the analysis of this activity refers, which has the primary objective of improving its competitiveness, it is directing the sector towards the search for solutions that make activities in port areas less impacting, identifying environmental improvement as one of the competitiveness factors of ports.

Sustainable energy includes activities focused on improving energy efficiency and increasing the use of new and renewable energy sources.

Energy sustainability is of great importance to overall sustainability given the pervasiveness of energy use, its relevance in economic development and living standards, and its impact on the environment.

Such environmental imperatives will focus attention on the port sector's initiatives in order to demonstrate competence in the effective management of such critical topics as carbon footprint, and so it will be possible to define strategies for greater sustainability of the local energy system. Ports will need to utilize a whole range of actions across all business areas to significantly reduce their emissions. A number of regulations and requirements, directly affecting ports, have been set in recent years to help tackle emissions and to control the growing climate crisis[2].

Moving from these assumptions and on the basis of these principles, the first step of the process envisages the **evaluation of local energy needs and production**, followed by an **assessment of carbon footprint of the ports involved**. This valuation should represent the baseline for developing a carbon-free strategy and identifying initiatives to reduce energy needs in the project areas, as represented in the figure below.



[1]The EU has laws in place to regulate shipping and its environmental impacts in Member States. In regulation of maritime transport, the International Maritime Organization (IMO) plays the most important role.

[2] The 2021 EU Green Deal set a target of 90% emissions reductions for EU port cities by 2050. The International Maritime Organization (IMO) set a CO_2 reduction target of at least 40% for international shipping by 2030, pursuing efforts towards 70% by 2050, compared to 2008 levels. The EU declared a need to bring shipping under the Emissions Trading System ETS.

Fig. 2. Schematics showing the main flow in the evaluation process

Considering that ports differ from each other in terms of in terms of size, volume of ships and goods movements and infrastructure, they consequently have different energy needs and different carbon footprint from one another.

In view the complex nature of ports, and differences between various realities (including the ports of the SMARTPORT project), this first step leads to findings, related to each port involved, which emphasize the importance of a coordinated strategy for sustainability of the energy system and the adoption of carbon-neutral technologies and energy reduction measures in ports (**D.T1.1.1. Report of energy needs and production**).

Therefore, based on the state of the art in order to identify general integrated energy and environmental objectives, **measures and interventions** to achieve the identified objectives were identified, as well as the strategy for greater sustainability of local port systems, within the mentioned Guidelines.

As already mentioned, the delivered document is always in progress, according to the needs of different stakeholders, possibilities afforded by innovation, and legal framework provisions. The main results of this Deliverable are the following:

- achieving energy efficiency and environmental sustainability in port networks requires a comprehensive approach that encompasses ships, port buildings, terminal operations, and the adoption of alternative fuels;
- the port planning activity should prioritize functionality, energy efficiency, business continuity, and monitoring and control of the load diagram;
- with coordinated efforts from port network authorities, terminal operators, ship owners, and relevant stakeholders, ports can significantly reduce their environmental impact and improve their competitiveness in the global market.

Besides materializing in the Deliverables of the Activity A.T1.1, this first step also envisages the "SWOT analysis on energy use in port areas", as foreseen by the Activity A.T1.2 and related Deliverable **D.T1.2.1 "Report on the current status of port areas".**

It consists of a SWOT analysis, conducted on the ports involved in the SMARTPORT project (Bar, Taranto, Vlore, and Termoli), to identify the internal and external factors influencing the successful implementation of port energy management system.
The SWOT analysis examines the strengths, weaknesses, opportunities, and threats associated with each port's energy and environmental management system development, also providing an assessment of the energy status of the ports involved in the project.
In particular, a SWOT analysis allows an assessment of the parameters influencing the application of such strategic planning process of environmental and energy

management, and also could be a useful tool as it identifies:

- advantages for an organization from the implementation of a plan (strengths);
- obstacles preventing the successful implementation of the plan according to the initial goals (weaknesses);
- opportunities related to the plan;
- threats from the implementation of the plan associated with external factors.

For this aim, the report presents a first approach at the assessment in terms of SWOT analysis, followed by an evaluation of the current status of the involved ports.

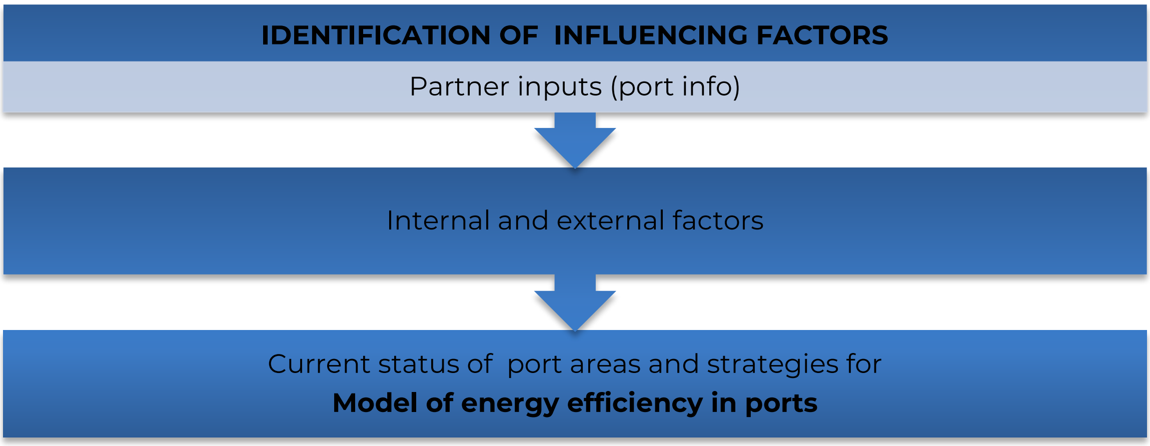


Fig. 3 Schematic showing the main flow in SWOT analysis process

Regardless of the specific findings related to the ports involved in the project, it is to note that while specific actions may require a case-by-case approach, the common points identified in the common SWOT analysis can serve as an evaluation chart for an overall energy strategy.
Generally, the SWOT analysis highlights areas for improvement, potential strategies and challenges that need to be addressed to achieve energy efficiency and environmental sustainability goals in each port.
In conclusion, the report provides an overview of the energy consumption and status of the ports involved in the SMARTPORT project, and the findings serve as a baseline for planning actions and measuring the outcomes of pilot projects. The report also proposes a roadmap for reducing energy needs and emissions in the ports, highlighting key common strategies.

2.2. Step 2: Stakeholders' involvement

In the context of the process we are describing, the step involving stakeholders is of fundamental importance. It should be understood not so much as a distinct phase but as a **cross-cutting element** throughout the entire process towards a better energy

sustainability of ports.
It is such an emblem of the importance of operating on multiple levels, not only technically but also in terms of human and social capital.
Indeed, the energy sustainability of ports is not merely a technical matter; it also involves human and social capital, requiring a balance between advanced technology and people's awareness. This creates a synergy that leads to lasting results.

Within the framework of the SMARTPORT project, this is expressed in **two different yet complementary aspects**, both necessary to ensure that the involvement is genuinely multi-level.
The first one is related to the Deliverable within Activity A.T1.3, "Exchange of national or regional best practices regarding saving technologies and policies", in particular **D.T1.3.1** "**Conferences and round tables** reports", and Activity A.T1.4 "Institutional learning process", **D.T1.4.1 "Institutional meetings".**
The second one is linked to the capacity building and training activities (T3 - Capacity Building) namely A.T3.2 "Organization of training courses for energy managers" and related Deliverable **D.T3.2.1 "Training course**".

Regarding the first aspect, within the implemented model/process, the organized local **Round tables** and the conference as well aimed at discussing with targeted stakeholders about best practices regarding energy saving technologies and policies.
More in detail, and by way of example, the **topics addressed** have been: the climate change in the Mediterranean Area, the naval emissions in ports, and the energy-environmental planning of the ports involved; the CB cooperation for port energy efficiency, the 3 dimensions of the Sustainability: Environmental, Social and Economic, the Development of tourism in the port areas involved and the Future Funding Opportunities to promote energy efficiency in port areas, the comparison between the experiences in the different territories involved both in terms of methodologies and achievements, the analysis of trend in the energy sector in the Port Ecosystem, as well as the opportunities for public bodies and research sector to foster the energy efficiency and environmental sustainability.
Therefore, the *fil rouge* linking the single round tables and the **International Conference** as well is represented by the exchange of good practices designed to strengthen energy performance and reach high levels of energy efficiency.

Furthermore, **Institutional meetings** were organized, aiming both at promoting good practices which complement the definition of the conceptual framework and presenting real applications regarding the energy efficiency.
For this aim, the topics which can be useful to address, and which have been the subject of the meetings organized within the SMARTPORT project, are the new opportunities, perspectives and challenges offered by the CB cooperation in the 2021-2027 programming period, the presentation of the pilot intervention realized in the Port of Taranto, the vision and the Energy-Environmental Strategy of the ports involved (namely

in the Port of Taranto), the research and monitoring activities carried out, the Green Ports, the Green Deal and the Sustainable Development in the Adriatic - Ioanian Macro-Region, the energy transition and the environmental sustainability, the good practices and proposals for the decarbonization of maritime transport, the anti-pollution activities, solid and liquid, in the port area and offshore.

The second aspect in which this step is articulated is expressed by the organization of **training courses** for energy managers, in particular aiming at increasing the skills of the Public Administration in reducing energy waste and / or replacing the use of fossil fuels with renewable energy sources, on the basis of a common methodology and program drafting.
The qualification of Energy Manager allows participants, working in public administrations, to achieve demonstrably the maximum level of competence in energy management. The pursued goal is offering an overview of the main technical and commercial topics in energy management, providing a good understanding at executive level of sustainable energy (renewable energy) technologies and applications, policies/regulations and planning, environmental and social impact, barriers, and potential market reforms to facilitate sustainable energy development.

In order to assure a proper dissemination and qualified participation, the sessions have been organized in collaboration with the Professional Order of the Engineers of the territories involved, also recognizing Professional Training Credits and, in some cases making the event available both in streaming and in person.

Overall, Round tables, Institutional meetings, training sessions – as well as communication actions through project website, social media, press releases – played the fundamental role to reach the targeted stakeholders and stimulate their interest and awareness raising with the reference of the specific topic of energy savings and efficiency, thus encouraging the production of energy from renewable sources, obtained in sustainable way.

2.3. Step 3: Technical study of the selected port areas and identification of interventions

The third step of the process basically envisages a phase of more in-depth technical and engineering study of the selected ports, in order to specifically identify the interventions to be carried out.
It encompasses the Deliverables included in the Activity A.T2.1 “Identification of the most appropriate area and energy model in each area”, namely Deliverables **D.T2.1.1 “Report on identified area”**, and **D.T2.1.2 “Report on selected energy model”**.
The mentioned activity aimed at identifying the most appropriate site in port area where the pilot action have been implemented, as well as the most suitable energy model for each area basing on the studies previously carried out.
For this purpose, the PPs finalized their Deliverables according to a common template

defined by LP, including two main chapters: the identification of the Areas and the Selected Led Lighting Equipment.
Afterwards, this step envisages the specific selection of the energy model: LP requested some data referring to the Technical lightening categories & reference parameters, and to the Lighting Calculations.
In particular, as part of the technical lighting categories and reference parameters various aspects related to lighting standards for outdoor workspaces have been analyzed and discussed, specifically focusing on road lighting according to UNI EN 12464-2 and UNI 11248.
While the lighting calculation is related to the lightening installation, that must ensure satisfactory visibility conditions and visual comfort, for which optimum values of the following parameters have been determined: minimum maintained illuminance, average maintained illuminance, overall lighting uniformity and visual tasks.

It is important to stress that environmental energy planning in port areas is specified in the DEASPs (Environmental Energy Planning Documents for Port Systems), the document supporting the assessment of the port system's energy demands and identifies solutions for the supply and use of energy to ensure long-term environmental sustainability, and on which **D.T3.4.1 Energy plan**, within Activity A.T3.4 Environmental Energy Planning in port areas, is focused.
The Energy plan documents identify the measures and interventions needed to improve energy planning, sustainability, and the reduction of CO2 emissions in port areas. Therefore, they are focused on technical documentation referred to the upgrading/optimization of port infrastructure and operations through the green upgrading of port infrastructure. The purpose is allowing the ports to move to a more efficient use of energy in port operations to reduce costs, improve its overall efficiency and increase environmental performance.

2.4. Step 4: Energy efficiency interventions

The fourth step of the process is referred to the **implementation of pilot activities** in the selected areas (therefore the purchase of equipment and related necessary works), on the basis of the preliminary and more in-depth studies carried out in the previous steps, enriched and validated by the stakeholders ‘involvement.
Therefore, this step is linked to the Deliverables **D.T2.2.1, “LED luminaire lightening system”**, developed within the Acitvity A.T2.2 “Installation of the necessary equipment”, aiming at putting in use eco-sustainable lighting system for large spaces with LED luminaire.
In particular, following the detailed analysis carried out by technical experts and the data reported in the previous Deliverables, within the SMARTPORT project pilot LED luminaire lightening system were implemented in each port (n. 26 LEDs were installed in the Port of Taranto, n. 10 in the Port of Termoli and n. 73 in the Port of Bar).
Where possible, the LEDs have been powered by photovoltaic panels, thus using the

renewable source of the sun.

2.5. Step 5: MoU Signature

The fifth phase envisages the signature of a Memorandum of Understanding (MoU), which is a Protocol aiming at increasing the awareness raising and the engagement of targeted stakeholders for integrating Renewable Energy Sources (RES) and promoting Rational Use of Energy (RUE) in the ports located in the South-Adriatic and Ionian region. The specific purpose of the Protocol is reducing the carbon emissions, enhancing sustainability, and optimizing energy consumption in port operations beyond SMARTPORT project conclusion.

By endorsing this Protocol, port authorities and stakeholders can contribute to a sustainable and low-carbon maritime transport sector, reducing environmental impact and enhancing energy resilience in the area.

Although the Protocol does not create any legally binding rights or obligations or consequences, by signing it the Parties formalize their commitment to enhance the cooperation between them, as well as to create a transnational cooperation network for the purpose of spreading the knowledge and to raise the awareness about the energy efficient measures through their future activities beyond project duration.

Within the Protocol, it is specified that all the included activities shall be carried out according to the applicable national regulations on a voluntary basis, without any financial obligations from the signatories.

In particular, the activities which are subject to agreement between parties are the following:

- to promote and support the process of current energy consumption patterns and identify potential areas for improvement.
- to assess the renewable energy potential of the port area, considering factors such as solar irradiation, wind speed, and hydrokinetic energy.
- to identify energy-efficient measures that can be implemented in port operations to reduce energy demand, such as lighting upgrades, efficient equipment, and process optimization.
- to develop an integrated energy plan for the port system that incorporates RES technologies and energy-efficient design principles.
- to determine the appropriate RES technologies for the port, considering factors such as available space, resource availability, and grid connection options.
- to Incorporate energy-efficient measures in the design and construction of new port infrastructure, including efficient lighting, insulation, and HVAC systems.
- to install and commission the selected RES technologies, such as solar panels, wind turbines, and hydrokinetic systems, as applicable and feasible.
- to implement energy-efficient measures in port operations, including optimizing vessel movements, implementing shore power facilities, and using energy management systems.
- to collect and analyze data to assess the effectiveness of RES technologies and

energy-efficient measures in reducing carbon emissions and optimizing energy usage.

- to identify opportunities for further improvements and adjustments based on the needs, including potential expansion of RES installations and additional RUE measures.
- to continue to comply with applicable national and international regulations and certifications related to energy efficiency and renewable energy integration in port operations.

The Protocol, signed by all the SMARTPORT PPs, is envisaged within the Activity A.T3.1, "Drafting a protocol for the adoption of RES and RUE policies in port areas", integrating the Deliverable **D.T3.1.1 "Protocol for furthering RES and RUE principles in South-Adriatic ports"**, **attached to this document.**
It is important to stress that, in the framework of an Intervention Strategy for Ports' Energy Efficiency, this step plays a crucial role for two reasons: on the one hand, it represents the highest moment of stakeholders' involvement in the pathway towards improving the energy efficiency of ports and, more broadly, in the process towards greater environmental sustainability of ports.
On the other hand, it also serves as an essential prerequisite, along with the Guidelines mentioned in the initial part of this document as the framework for all steps, to ensure a follow-up of the project itself in future perspectives.

2.6. Step 6: Monitoring and Assessment

The last, but not least step, includes monitoring and assessment activities, which, within the SMARTPORT project, are foreseen in the context of Activity A.T2.3 "Development of tools for monitoring and evaluating the energy chain", and specifically they are subject of Deliverables **D.T2.3.1 "Monitoring report"** and **D.T2.3.2 "Evaluation report"**.

They are both essential aspects of this process, performing the function of closing pilot activities on one hand, as they provide control and evaluation to understand the achieved results, and on the other hand, as a potential resumption of the path towards the energy efficiency of the ports.
Monitoring activities can, in fact, lead to conducting new studies and surveys to optimize, refine, or intervene again.
Appropriate monitoring is key for ensuring the necessary accountability in relation to the performance of a pilot project and it assesses the effectiveness of a piece of project.
It can also highlight whether pilot project is moving successfully towards achieving what it set out to do, or whether it is moving in a different direction.

For this purpose, within the SMARTPORT project, Monitoring reports have been delivered, to document the progress of SMARTPORT pilots.
During several online meetings, the scope and the methodology to carry out the

monitoring activities were discussed by the technical team of the PPs.
Each partner developed its own Monitoring report in order to adequately follow the steps of pilot implementation and shared the related results.

The possibility to compare the results and to discuss about the related effectiveness was ensured by defining a common path for the monitoring and, consequently, a common Table of Contents for the report.
The latter, therefore, was structured in the following chapters:

- Background
- Rationale for pilot action
- Pilot action implementation
- Monitoring data
- Stakeholders involved
- Problems and solutions found
- Additional information
- Annexes.

The information about the ongoing SMARTPORT pilots which PPs provided, summarized the following topics, on which the partners had the chance to discuss in a structured way:

- State of the art prior to the implementation of the pilot
- Detailed steps in the implementation of the pilot
- Criticalities found during the implementation.

Concerning the Evaluation activities, it is important to stress that the Evaluation report summarized the effectiveness of a pilot according to the relevant procedures and standards, supporting the sustainable development by being as objective and balanced as possible and should be based on a solid foundation of evidence of its impact.
In this regard, an Intervention Strategy should take into account that Evaluation is most effective when: it is a continuous process informing planning and delivery as the project develops; it involves all those with an interest in the project in defining the questions they want answered; it uses creative approaches, which engage those involved; it helps projects to be more accountable to the wider community; it highlights and celebrates successes and achievements; it encourages an honest appraisal of progress, so that it can learn from what hasn't worked as well as what has.

The results of this evaluation report have been joint and shared within the final common Deliverable as results of cooperative work of all partners.
All partners were required to provide the information about the SMARTPORT pilots that summarized:

- Steps in the implementation of the pilot action
- Technical data related to the pilot action
- Impact assessment of the implementation.

With this purpose, also considering the Deliverables planned for the pilot, the evaluation report has been structured in the following chapters:

- Background
- Pilot actions description
- Data analysis of the post installation measurements and evaluation of data
- Conclusions
- Annexes

Among **the results** highlighted by the Evaluation report, representing the outcomes of the followed process, we mention the significant benefits and improvements to the area brought by the LED Technology.
In the Port of Taranto, LED Technology offers energy savings of 50% to 80% compared to traditional sodium lamps. The white light from LEDs improves visibility, shortens response time to unexpected events, and improves color rendering. LEDs also penetrate fog better and improve the quality of images captured by security cameras. In addition, LED lamps have a longer life, estimated at 50,000to 100,000 hours, and require minimal maintenance compared to high-pressure sodium lamps.
With reference to the Port of Termoli, exploitation of renewable resources, reduction of emissions into the atmosphere, emissions linked to the production of electricity from non-renewable sources, reduction of light pollution dictated by the dispersion of luminous flux upwards or peripheral areas to the areas subject to illumination, and energy independence have been obtained.
The Port of Bar obtained an estimated annual saving of 50.435,38 kWh (34,68% less energy consumption), resulted in environmental benefit associated with the replacement of LED luminaires of over 31,5 tons of CO_2 equivalent emissions avoided per year (source: EUROSTAT and Action plan for sustainable and low carbon Port of Bar – WTW CO_2e emission factor (kg CO_2e/kWh) = 0,623). With this pilot project, the Port of Bar has significantly improved the lighting system at the terminals, while saving energy and reducing CO_2 emissions at the same time.

Conclusions

The sequence of the steps described above constitutes a replicable and transferable process, representing the model of a strategic Intervention plan for energy efficiency in ports implemented within the SMARTPORT project.
What stands out most from this process is that ports are strategic infrastructures for territories, yet highly energy-intensive, and that **collective efforts** are necessary to reverse the situation, exploiting their potential while respecting environment.

The underlying idea is that addressing the challenges related to the energy efficiency of ports and achieving environmental sustainability requires a collaborative approach.

Only the **joint effort** of stakeholders can contribute to making ports more environmentally sustainable.

In fact, as the described process demonstrates, port energy efficiency is not solely tied to the technological and scientific component, although crucial. Research and development play a fundamental role in progressing towards the environmental sustainability of productive activities but, alongside the technological component, a human-social component is necessary.

This is fueled by **awareness-raising activities**, **engagement**, and **capacity building** at various levels of society and stakeholders, as effectively carried out in the SMARTPORT project.

In other words, the described process provides evidence that energy transition, a fundamental part of the EU-promoted Green Deal, can only occur by not leaving anyone behind. This entails involving policymakers, civil society, citizens, and professionals. Neither the private nor the public sector, considered individually, can achieve optimal results in the green transition.

In this sense, a viable path could be leveraging the potential of public-private partnerships to implement interventions consistent with environmental sustainability goals.

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This document has been produced with the financial assistance of the Interreg IPA CBC Italy-Albania-Montenegro

Annex 1. D.T3.1.1 “Protocol for furthering RES and RUE principles in South-Adriatic ports”

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SMARTPORT

Protocol for furthering RES and RUE in South Adriatic Port

Version n.1

D.T3.1.1 06/2023

Interreg - IPA CBC
Italy - Albania - Montenegro
SMARTPORT

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Disclaimer

List of project partners involved

PP NUMBER	PP NAME
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PP3	Comune di Termoli (IT)
PP4	Luka Bar AD (ME)
PP5	Porti Detar Vlore Sh.A (AL)

INTRODUCTION

Project SMARTPORT aims to enhance South Adriatic and Ionian ports' energy profile by introducing eco-sustainable LED lighting systems through pilot actions and adopting new and efficient energy strategies that, following the European standards, combine the use of renewable energy sources, energy saving, energy storage and smart grid technologies. The expected results are: improved port area capacity in sustainable energy planning; adoption of energy efficiency and sustainable energy production programs for public administrations; reduction of energy consumption and CO2 emissions in the ports; contribution to prevent climate change, and better use of energy in the programme area.

Nowadays achieving a carbon-neutral economy is a priority and Ports, as nodes of the economy, are expected to reduce emissions and energy consumption. Furthermore, port authorities are looking to protect local communities from any negative effect caused by their operations. On this base, the main goal of SMARTPORT project is, in fact, the willingness among the ports of the southern Adriatic Sea aimed to assess the good practice in terms of renewable energy sources implementation and energy efficiency promotion.

The objective of this protocol is to increase the awareness raising and engagement of targeted stakeholders for integrating renewable energy sources (RES) and promoting energy efficiency (RUE) in the ports located in the south Adriatic and Ionian region. The protocol aims to reduce carbon emissions, enhance sustainability, and optimize energy consumption in port operations beyond SMARTPORT project conclusion.

This protocol applies to all ports within the Adriatic and Ionian Sea region, including container terminals, passenger terminals, and auxiliary facilities. It encompasses the assessment, implementation, and monitoring of RES technologies and RUE measures specific to port operations and infrastructure.

This protocol provides a framework for integrating renewable energy sources and promoting energy efficiency in the ports located in the south Adriatic and Ionian Sea region. By endorsing this protocol, port authorities and stakeholders can contribute to a sustainable and low-carbon maritime transport sector, reducing environmental impact and enhancing energy resilience in the area.

PROTOCOL

The purpose of this Protocol is to enhance the cooperation between the Parties, as well as to create a transnational cooperation network for the purpose of spreading the knowledge and to raise the awareness about the energy efficient measures through their future activities beyond project duration.

The partners on the project SMARTPORT (Smart and Sustainable Energy Port) cofunded by IPA CBC Italy – Albania - Montenegro Programme 2014 – 2020 (https://smartport.italy-albania-montenegro.eu/) hereinafter referred to as the *Parties* have agreed on the following:

- to promote and support the process of current energy consumption patterns and identify potential areas for improvement;
- to assess the renewable energy potential of the port area, considering factors such as solar irradiation, wind speed, and hydrokinetic energy;
- to identify energy-efficient measures that can be implemented in port operations to reduce energy demand, such as lighting upgrades, efficient equipment, and process optimization;
- to develop an integrated energy plan for the port system that incorporates RES technologies and energy-efficient design principles when possible;
- to determine the appropriate RES technologies for the port, considering factors such as available space, resource availability, and grid connection options;
- to incorporate energy-efficient measures in the design and construction of new port infrastructure, including efficient lighting, insulation, and HVAC (*Heating, Ventilation and Air Conditioning*) systems;
- to install and commission the selected RES technologies, such as solar panels, wind turbines, and hydrokinetic systems, as applicable and feasible;
- to implement energy-efficient measures in port operations, including optimizing vessel movements, implementing shore power facilities, and using energy management systems;
- to collect and analyze data to assess the effectiveness of RES technologies and energy-efficient measures in reducing carbon emissions and optimizing energy usage;
- to identify opportunities for further improvements and adjustments based on the needs, including potential expansion of RES installations and additional RUE measures;

- to continue to comply with applicable national and international regulations and certifications related to energy efficiency and renewable energy integration in port operations.

The *Parties* acknowledge that the Protocol is only intended to promote cooperation among the *Parties* and does not create any legally binding rights or obligations or consequences.

All activities specified in this Protocol shall be carried out according to the applicable national regulations on a voluntary basis without any financial obligations from the signatories.

This Protocol is signed by the following representatives on behalf of their respective organizations.

Interreg - IPA CBC
Italy - Albania - Montenegro
SMARTPORT

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Name & Surname, Title

Il Presidente
Prof. Avv. Sergio Prete
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Signature

AUTORITÀ DI SISTEMA PORTUALE DEL MAR IONIO ★ PORTO DI TARANTO

30/06/2023
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PORTI DETAR VLORE SH.A (AL)

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