Final Report on the Implementation of the Pilot Actions and Pilot Actions Final Assessment

Final Version 08/09/2023

Deliverable Number D.4.1.4. and D.4.2.14

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Document Control Sheet

Project number:	10252267
Project acronym	SUSPORT
Project Title	Sustainable Ports
Start of the project	July 2020
Duration	36 months

Related activity:	WP4 A 4.1. – WP coordination WP4 A.4.2 – Pilot actions for enhancing cross-border port environmental sustainability and energy efficiency
Deliverable name:	D.4.1.4 Pilot Action Final Assessment D4.2.14 Final Report on the Implementation of the Pilot Actions
Type of deliverable	Evaluation Report
Language	English
Work Package Title	Testing enhanced cross-border port environmental sustainability and energy efficiency
Work Package number	4
Work Package Leader	Central Adriatic Ports Authority (PP6)

Status	Final version
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Version	3
Due date of deliverable	08/09/2023
Delivery date	08/09/2023

Contents

1. Introduction

This document reports the main achievements reached and presents the final assessment at cross-border level for the thirteen Pilot Actions, that are the main outputs of the WP4 of SUSPORT Project. As Pilot Actions are a powerful tool to enhance the ports' overall environmental performance, the evaluation activity consists in:

- identification of impacts of each Pilot Action on environmental protection and energy efficiency in ports;
- measurement and quantification of these impacts by adequate indicators.

The main aim of all this is to improve the role of Adriatic Ports, that are Project Partners (hereafter PPs) in SUSPORT, as green gateways and corridor roots for the transport of goods.
As SUSPORT is a Project of the Interreg Italy-Croatia Programme Area, its PPs are ports competing on both shores of the Adriatic Sea, they have similar traffic flows and the same environmental challenges: impacts of port operations on air quality, greenhouse gases and noise.
So, these pilot activities give PPs the possibility to work together towards the same goal: improving the environmental performance of ports both in Italy and Croatia in a coordinated way. To this end, a systematic reanalysis of the pilot actions' results has been here carried out, providing an overall assessment for each type of the solutions tested during the SUSPORT project. Besides, for each innovation tested, some notes have been developed to ease the transferability of the achieved results in other contexts.

The thirteen Pilot Actions, objects of this assessment, were defined by each PP on the basis of the analysis of the area, the interest of local stakeholders in contributing to the implementation, adopting a typical territorial planning approach.

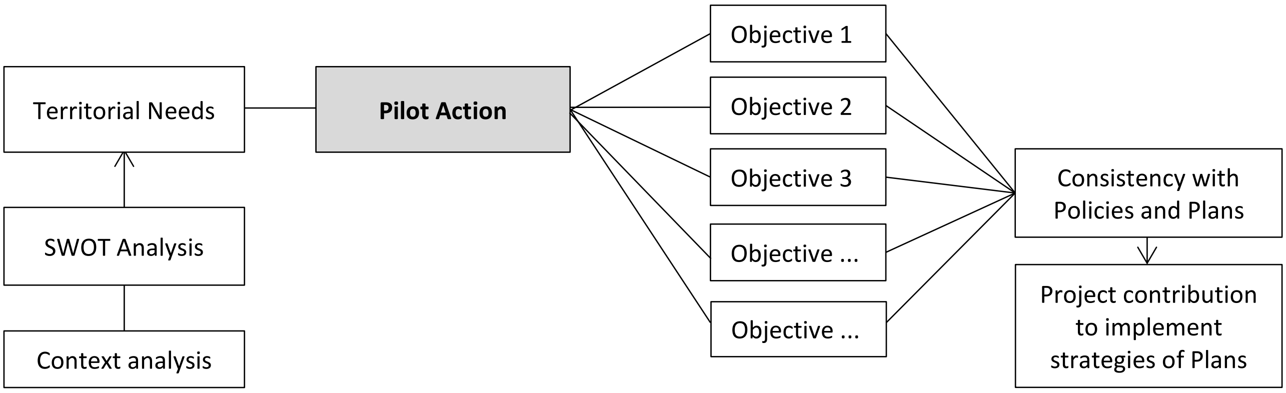
The block diagram below (Fig. 1) shows the process of identifying the Pilot Action of a Project Partner and verifying their consistency[1] with territory, its economic system, policies and plans. In these terms, a Pilot Action becomes part of territorial planning processes.

The context analysis reveals strengths, weaknesses, opportunities and threats of the territory and it is the basis for the SWOT Analysis. Territorial needs emerge from all this, and in turn these territorial needs can be addressed effectively by means of the Pilot Action. It will allow to pursue

[1] For more information on spatial planning theory and criteria for conducting analyses relating to spatial planning processes, among others: McLoughling J.B. (1973) "Urban and Regional Planning: A Systems Approach"; Sir Peter Hall (1988), "Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century"; Steiner F. (2008), "The Living Landscape: An Ecological Approach to Landscape Planning", 2nd ed..

some objectives, that in SUSPORT Project are specifically of environmental kind. To verify the measure of achievement of these objectives, result indicators are selected, measurable both before the construction of the work and during its operation. The objectives consistency with Law, policies, economic and territorial planning is essential.

Fig. 1 - The identification process of a Pilot Action



This Report has the following structure.
After this first paragraph dedicated to the introduction, a brief sum-up of the evaluation methodology and its logical framework in the paragraph 2. The third one (paragraph 3) presents briefly the 13 Pilot Actions and their 36 components, that have been aggregated into 5 "homogeneous groups". So, the following sections are dedicated to each one of these “groups”: cold ironing (§ 4); Port lighting systems (§ 5), e-Cars & hybrid plug-in vehicles (§ 6), photovoltaic Solar Power Plant (§ 7), energy efficiency Port’s Buildings (§ 8). Some Pilot Actions components don’t lead to direct environmental impacts, they are described in paragraph 9. Then tenth one (§ 10) presents the greenhouse gases (GHGs) emissions savings by the 13 Pilot Actions carried out thanks to SUSPORT Project.

2. The logical framework of the evaluation

As said in the introduction, this report presents the evaluation of the 13 Pilot Actions carried out by the SUSPORT's Project Partners. This evaluation method has been extensively described in the document D.4.1.3 (by ITL Foundation), specifically dedicated to this topic.

The main objective of this assessment is the **analysis** and **measurement** of main **impacts** produced by the **Pilot Actions** on the environment. Project Partners usually in their ordinary activity face challenges related to impacts of port operations on air quality, greenhouse gases and noise.
In fact, the production activities, that take place every day within the port areas, generate both **terrestrial** greenhouse gases (**GHGs**) **emissions** (for example: consumption of electricity for lighting public areas; heating and conditioning of buildings; consumption of fuel for the use of service vehicles; etc.) both GHGs emissions deriving from maritime traffic in the port basin. **Maritime GHGs emissions** are in particular: anchor phase; ships in maneuver; ships at berth.

Pilot actions should impact on environmental performance of ports and energy efficiency of ports operations. In fact, the 13 Pilot Actions consist of **components** that allow carrying out some activities in port areas with **innovative tools** and methods that make it possible to **reduce** the amount of **GHGs emissions**.

Each Project Partner drafted a "Final Pilot Action Report" containing: a) the description of each component of the Pilot Action and b) the elaboration of **a set of indicators** (or KPI, key performance indicators) that describe the main aspects of each components of the Pilot Action and provide information for its evaluation. The indicators have been identified according to the scope, the methodology, the beneficiaries and the stakeholders involved in the implementation of the pilot action. The suggested indicators aim:

- to collect specific information regarding the implementation of pilot actions;
- to evaluate the sustainability of pilot actions by measuring or estimating indicators that relate to all three pillars of sustainability: economy, society and environment.

In order **to evaluate impacts** of Pilot Actions and their sustainability, ITL Foundation in the deliverable D.4.1.3 proposed **two approaches** (called A and B), and invite all the Project Partners to adopt the most appropriate to their pilot action.

The first one (called A) could be adopted by the Project Partners responsible of "energy" pilot actions that concern projects directly related to energy saving. In these cases, usually the pilot action operates using **electricity from renewable sources**, consequently it replaces the traditional electricity from fossil fuels. This replacement reduces CO2 emissions. So, we proposed to use the indicator "**tons of avoided CO2eq emissions**". This indicator would allow easier comparisons with the ecological footprint calculated in the Territorial Needs Assessments (TNAs, WP 3, Activity 3.2).

And it allows to each Project Partner to communicate more effectively how much CO2eq has been saved thanks to the SUSPORT Project.

The second approach (called B) to evaluate impacts of pilot actions could be obtained from Evalsed[2] by European Commission, in particular in chapter 8 "Impact evaluation" of the Guidance "Evalsed Sourcebook: Method and techniques"[3]. This chosen approach consists in the **comparison "before-and-after"**, in a situation in which pilot action has been implemented (also called "ex-post evaluation"). So, based on this approach, one way to evaluate the pilot action is to compare the energy consumption of the system currently in use with the energy consumption of the new system provided by the pilot action. Another way is to compare the amount of pollutant emission by the system currently in use with the amount of pollutants emitted by the new system provided by the pilot action.

Summing up

In their "Final Pilot Action Report", each Project Partner has described one by one all the components that make up its Pilot Action, providing technical, organizational and economic details. For each component of the Pilot Action, they also provided indicators relating to energy consumption and GHG emissions that the Pilot Action saves compared to the current situation.
By aggregating all the Pilot Projects carried out by the Project Partners, the total amount of energy savings and emission reductions is obtained, achieved thanks to the SUSPORT Project.

3. Evaluation activity objects: the pilot actions

Thanks to SUSPORT Project, **all the Ports**, that generate **freight transport** in the Italy-Croatia Interreg Programme Area, have carried out **thirteen Pilot Actions** (Tab. 1).
With the exception of the pilot actions of the Port of Ortona and the Port of Dubrovnik (each consisting of only one component), **each Pilot Action** is subdivided into **several components** with very **different** technical-organisational characteristics, economic dimensions and operational contents. However, the individual components of each Pilot Action are **complementary** to each other of the same Pilot Action, even if different. Furthermore, the single components of Pilot Actions of **different Ports** often have the **same contents**. They are ways of promoting **collaboration** between **ports** that often are **in competition** to each other. They are **common solutions** to **common problems**.

For example, the Pilot Action of the Port of Trieste is divided into 4 components: lighting system; monitoring environmental effects; pre-investment study of on-shore power supply; purchase of two

[2] https://ec.europa.eu/regional_policy/en/policy/evaluations/guidance/.
[3] It is available online at this link (accessed in May 2021):
https://ec.europa.eu/regional_policy/sources/docgener/evaluation/guide/evaluation_sourcebook.pdf.

electric vehicles and installation of charging stations (see Tab. 1 below). As can be seen, the 4 components are very different from each other, but are complementary (for the protection of the environment, the efficient use of resources, the containment of emissions, etc.), and in addition a similar study of pre-feasibility of "cold ironing" is part of the Pilot Action of the Port of Ancona, the purchase of e-cars is also foreseen in the Pilot Actions of 8 other Project Partners, as the modernisation of lighting systems of port areas that is the component of other 8 Pilot Actions (Tab. 1).

The **thirteen Pilot Actions** of WP4 consists altogether of **36 components**, different but complementary to each other in the same Pilot Action, very similar or equal in different Pilot Actions. The following Table 1 lists the 13 Pilot Actions, for each one are indicated, in the first two columns, a) the Project Partner, who carried it out, and, the third columns b) the titles of the components into which each Pilot Action is subdivided.
For each component of the Pilot Actions, the paragraph of analysis is indicated.

Tab. 1 - The Pilot Actions by Project Partner

PPs	**Project Partners**	**Pilot actions description**
LP	Port Network Authority of the Eastern Adriatic Sea (AdSP MAO)	The pilot action of the Port of Trieste has four components: 1) **lighting system** of the public areas: replacement of existing lamps with LEDs (see § 5); 2) monitoring environmental effects from Strategic Environmental Assessment (§ 9); 3) pre-investment **study** of **on-shore power supply** (OPS) in the Port of Trieste (§ 4); 4) purchase of two **electric vehicles** and installation of **charging stations** (§ 6).
PP01	Consorzio di Sviluppo Economico del Friuli (COSEF)	The pilot action of Porto Nogaro (COSEF) has three components: 1) **lighting system**: replacement of existing lamps with LEDs (§ 5); 2) improvement of the **energy efficiency** of the port's main **building** (which hosts the Harbour Master's office, Customs, ONG "Stella Maris", etc.) (§ 8); 3) pre-investment **study** assessing the **use of geothermal power** (§ 9).
PP02	North Adriatic Sea Port Authority - Ports of Venice and Chioggia (AdSP MAS)	The pilot action of the Port of Venice has three components: 1) **lighting system**: replacement of existing lamps with LEDs (§ 5); 2) purchase of two **electric vehicles** (§ 6); 3) purchase of a **hybrid plug-in vehicle** (§ 6).
PP05	Port of Ravenna Authority (AdSP MACS)	The pilot action of the Port of Ravenna has three components: 1) installation of a **photovoltaic system** (§ 7); 2) purchase of an **electric vehicle** (§ 6); 3) purchase of a **hybrid plug-in vehicle** (§ 6).

(continued)

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PPs	Project Partners	Pilot actions description
PP06	Central Adriatic Ports Authority (AdSP MAC)	The pilot action of the Port of Ancona has three components: 1) **feasibility study** to test the application of innovative technologies for the **supply of electric power** to ferries while at port (§ 4); 2) **lighting system**: replacement of existing lamps with LEDs (§ 5); 3) purchase of two **hybrid plug-in vehicles** (§ 6).
PP07	Agenzia di Sviluppo, Special Agency of the Chamber of Commerce Chieti-Pescara (ASVI)	The pilot action of the Port of Ortona has one component: 1) **lighting system**: replacement of existing lamps with LEDs (§ 5).
PP08	Southern Adriatic Sea Port Authority - Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli (AdSP MAM)	The pilot action of the Port of Bari has two components: 1) installation of **sensors** and **stations to monitor** noise, air (concentrations of PM, pollutant gases) and water quality (ship traffic, etc.) (§ 9); 2) purchase of two **electric vehicles** (§ 6).
PP09	Rijeka Port Authority (LUR)	The pilot action of the Port of Rijeka has three components: 1) **lighting system**: replacement of existing lamps with LEDs (§ 5); 2) purchase of an **electric vehicle** (§ 6); 3) installation of **charging station** for electric vehicles (§ 6).
PP11	Port of Zadar Authority (LUZ)	The pilot action of the Port of Zadar has three components: 1) installation of **photovoltaic system** for port lightening including charging for an electric vehicle (§ 7); 2) installation of **energy storage system** for night consumption (§ 7); 3) purchase of 1 **electric vehicle** and installation of a **charging station** (§ 6).
PP12	Split Port Authority (LUS)	The pilot action of the Port of Split has three components: 1) acquisition of **mobile environmental laboratory** (MEL) to measure concentrations of pollutants in the port area (§ 9); 2) **lighting system**: replacement of existing lamps with LEDs (§ 5); 3) purchase of a **hybrid vehicle** (§ 6).

(continued)

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PPs	Project Partners	Pilot actions description
PP13	Ploče Port Authority (LUP)	The pilot action of the Port of Ploče has six components: 1) **lighting system**: replacement of existing lamps with LEDs (§ 5); 2) purchase and implementation of **environment protection barriers** (§ 9); 3) installation of **sensors** and **stations** for **monitoring** noise, air and water quality to measure concentrations in port areas (§ 9); 4) replacement of the existing **air condition system** in Port of Ploče Authority data centre with energy-efficient technology (§ 9); 5) micro data centre solution for data recovery site (§ 9); 6) digital green incident management (§ 9).
PP14	Dubrovnik Port Authority (LUD)	The pilot action of the Dubrovnik Port Authority has one component: 1) **lighting system**: replacement of existing lamps with LEDs (§ 5).
PP15	Dubrovnik Neretva County (DNR)	The pilot action of the Dubrovnik Neretva County has one component: 1) purchase of an **electric vehicle** (§ 6).

Sources: SUSPORT Application form, page 58; 7th Steering Committee Meeting on 29.03.2023; Joint Methodology for the implementation of the WP (D.4.1.1)

In order to facilitate the evaluation analysis, the 36 components of the 13 Pilot Actions (listed above in Tab. 1) have been aggregated into 6 "homogeneous groups", as proposed in the Application Form (page 110). These 6 homogeneous groups are the following:

1) cold ironing (paragraph 4);
2) Port lighting systems (paragraph 5);
3) e-cars, plug-in hybrid vehicles and charging stations (paragraph 6);
4) photovoltaic solar power plant (paragraph 7);
5) improvement of the environmental performance of port's buildings (paragraph 8);
6) sensors and stations to monitor noise, air and water quality (paragraph 9);

The following paragraphs describe the main characteristics of the elements that make up the 6 homogeneous groups listed above. For each of these 6 groups, the savings in energy consumption achieved by each Project Partner and the reduction in emissions that has been made possible by the implementation of the Pilot Action are indicated.
In some cases, what has just been described above, cannot be done. This is because some components of some Pilot Actions do not directly involve energy consumption and therefore do not directly involve polluting emissions.
This is the case, for example, of the "monitoring system of environmental effects" of the Pilot Action of the Port of Trieste. This is the case of some components of the Pilot Action of the Port of Bari: sensors and stations to monitor noise, air and water quality. Also in the cases of:

- two “charging stations” for electric vehicles installed in the Port of Rijeka;
- the “mobile environmental laboratory (MEL) that will measure concentrations of pollutants” in the port area of Split;
- the environment protection barriers; the replacement of the existing air condition system; the Micro Data Centre solution by the Port of Ploče Authority.

The paragraph 9 is entirely devoted to all these cases, some pages below (§ 9).

In Figure 1, an overview of the pilot actions carried out within the SUSPORT project area is provided. The map has been updated considering also the additional components not initially planned but anyway financed by budget savings.

Fig. 1 - The components of each Pilot Action

Source: SUSPORT EU Project[4]

[4] SUSPORT’s Technical documents are available on the official Project website: https://programming14-20.italy-croatia.eu/web/susport/docs-and-tools.

4. Cold ironing

The improvement of the environmental and energy performance of the port activities is one of the main strategical challenges of Italian and Croatian Ports Authority in the Interreg Programme Area and SUSPORT's Project Partners. It is in line with the objectives of the European Green Deal policy to **decarbonize transport** and reduce emissions by 90% by 2050 through the promotion of **alternative fuels technologies** and processes and on shore power supply implementation.

On the other hand, at national level, the Italian Government launched a series of intervention in the framework of the Piano Nazionale per gli Investimenti Complementari (National Plan for Complementary Investments) to contribute to the decarbonization of maritime transport and the **reduction of GHG emissions**.

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.

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, LSFO), they consume large quantities of fuels, generating exhaust gases (mainly containing CO2, SOx, NOx, atmospheric particles and volatile organic compounds), noise and vibrations. . This issue is magnified for passenger vessels, which still require large hotel loads at berth. For instance, a large cruise ship can require an electric power of up to 16 MW at berth producing 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.
Systems for powering ships stationary on the quay constitute the architecture of a "cold ironing" system.
Cold Ironing, so, 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.

In order to understand the weight of these consumption and emissions savings, they have been compared with the total emissions of each Port examined (Tab. 2).
In the WP3 of the SusPort Project, within the Territorial Needs Assessment (TNA) document, each Project Partner calculated the carbon footprint of its Port, distinguishing terrestrial emissions from maritime ones.
In the **Port of Trieste**, the saving of **12,398 t CO2 eq.** per year due to the Pilot Action represents **10.8%** of the GHGs **emissions for** the **consumption of energy** due to maritime activities in port in phase of "ships at berth" (see the carbon footprint in TNA deliverable). In addition, it is also noted that the total terrestrial and maritime emissions of the Port of Trieste amount to 172,765 t CO2 eq. per year. The savings in GHG emissions obtained thanks to this component of the Pilot Action is equal to **7.2%** of **total Port emissions** (Tab. 2).

In the **Port of Ancona**, the saving of **3,759 t CO2 eq.** per year thanks to the Pilot Action represents **15.8%** of the GHGs **emissions for** the **consumption of energy** due to maritime activities in port in phase of "ships at berth" (see the carbon footprint in TNA deliverable). In addition, the total terrestrial and maritime emissions of the Port of Ancona amount to 28,749.3 t CO2 eq. per year. The savings in GHG emissions obtained with the Pilot Action is equal to **13.1%** of **total Port emissions** (Tab. 2).

Tab. 2 - Cold ironing: GHG emissions savings (t CO2 eq/year; %)

Project Partners		Pilot Actions Cold ironing Emissions Savings (A)	Ships at berth maritime emissions of each port (B)	Total terrestrial & maritime emissions of each port (C)	% Pilot Actions savings	
					(A/B)	(A/C)
LP	Port of Trieste	12,398.0	114,160.2	172,765,0	10.8%	7.2%
PP06	Port of Ancona	3,759.0	23,797.6	28,749.3	15.8%	13.1%
Total t CO2 eq.		16,157.0	137,957.8	201,514.3	11.7%	8.0%

Source: Final Pilot Action Report and Territorial Needs Assessment (TNA) by each Project Partner involved in the activity

These **two pilot projects** that implemented the Pilot Actions in question (cold ironing) achieved a **reduction in GHGs emissions** equal to **almost 12%** of **maritime port emissions** due to "ships at berth" consumption. And it is equal to **8%** of the **total terrestrial and maritime emissions** produced in the two Ports of the two Project Partners (Tab. 2 above).

Transferability of the results

According to the results of the Cross-border study on port environmental sustainability and energy efficiency (D.3.2.14) moored ships are responsible for 65% of the CO2 emissions in the project area, being widely recognised as the primary cause of pollution in port areas. Cold ironing, cutting this emission voice, can certainly play a primary role in improving port sustainability and climate neutrality. However, the installation of such systems is not without its complexities. There are several challenges associated with implementing cold ironing systems. Challenges include high infrastructure costs, retrofitting older ports, technical compatibility issues, sourcing sustainable energy, and meeting strict regulations. The installation is more challenging in ports housing a large number of passenger vessels at a time due to the large electric demand. In such cases it is essential to have a sustainable source of power, and avoid to switch on onshore thermoelectric plants to face the increased energy demand (this process would lead only to delocalise pollution). Besides, the shore grid might require an upgrade to face the power peaks. Limited space in busy ports and varying vessel power requirements add further complexity. To address these challenges, a comprehensive feasibility assessment is needed, along with stakeholder collaboration, adherence to regulations, system customization, sustainable energy sources, and incentives. Training and maintenance programs are vital, and long-term planning is essential to ensure scalability and adaptability. The studies carried out during the SUSPORT Project can be considered a best practice for the implementation of future cold-ironing systems in other contexts.

5. Port lighting systems

Relamping is one of the key interventions when it comes to energy efficiency. As the word itself suggests, relamping consists of **replacing traditional luminaires**, such as halogen, incandescent or fluorescent lamps, **with modern LED** (Light Emitting Diode) **lamps**.
This modernisation of port lighting systems is in accordance with the new regulations and standards for ports in order to make savings in electricity consumption, to achieve reduction of harmful gas emissions and carbon footprint reduction.

Nine of the 13 Pilot Actions of SUSPORT Project involve the implementation of new lighting systems in public and operational areas of the participating ports.
These 9 pilot actions consist of the following steps and objectives:

- revitalization of electrical infrastructure using energy efficient lighting;
- alignment of the existing lighting system with standard lighting values (HRN EN 12464-1 and HRN EN 12464-2);
- environmental protection (removal of harmful light source refrigerants, reduction of greenhouse gas emissions) and in accordance with the Law on Protection from Light Pollution NN 14/19.

The application of these new technologies reduces maintenance costs and thus reduces disruption and increases efficiency and safety of people. Perhaps the most important advantage of LEDs is their control, i.e. the ability to control their brightness and colour temperature remotely. All aspects of smart lighting make this technology even more interesting with a view to using it only when and where it is really needed.
In addition, the reduction of environmental impact should not be overlooked, as LED lamps are non-toxic and do not contain mercury.

As shown in the following table (Tab. 3), thanks to SUSPORT Project, the **9 Project Partners**, that implemented these 9 Pilot Actions, have replaced traditional lamps with about **1,100 LED light bulbs**, all considered together.
With its own Pilot Action, **Trieste** is the Port that planned to replace the largest number of traditional lamps with LEDs (523 light bulbs). And in fact it is also the Project Partner that obtains the greatest reduction in GHGs (greenhouse gases) emissions (134 t CO2 eq. per year) (see Tab. 3 below).

In term of environmental impacts of the lighting systems, the second one is the **Port of Venice** with 78 lamps and 125 t CO2 eq. per year (Tab. 3).
The last column of the following Table 3 indicates the reduction of GHGs emissions obtained thanks to the implementation of the Pilot Actions by each Project Partner. The 9 Pilot Actions altogether make it possible to reduce the GHGs emissions by around 412 tons CO2 eq. per year.

Tab. 3 - Technical specifications of "lighting systems" by Project Partner

Project Partners		n. lights	Installed power (kW)	Energy consum-ption savings (MWh/year)	Pilot Actions lighting systems Emissions savings (t CO2 eq/year)
LP	Port of Trieste	523	n.a.	n.a.	134.0
PP01	Port of Nogaro	108	n.a.	50.0	31.0
PP02	Port of Venice	78	n.a.	n.a.	125.0
PP06	Port of Ancona	27	n.a.	44.8	11.4
PP07	Port of Ortona	83	32.90	85.8	41.4
PP09	Port of Rijeka	n.a.	12.40	14.2	3.3
PP12	Port of Split	148	12.79	49.4	11.6
PP13	Port of Ploče	n.a.	47.62	132.7	21.1
PP14	Port of Dubrovnik	122	36.86	159.2	33.4
Total		1,095	---	---	412.2

Source: Final Pilot Action Report by each Project Partner involved in the activity

In order to understand the weight and significance of these savings, they have been compared with the total emissions of each Port examined (Tab. 4).

In the WP3 of the SusPort Project, within the Territorial Needs Assessment (TNA) document, each Project Partner calculated the carbon footprint of its Port, distinguishing terrestrial emissions from maritime ones.

The replacement of traditional lamps with LEDs in the **Port of Trieste** allows a saving of GHG emissions equal to 134 t CO2 eq. per year. To use these LEDs it is necessary to use electricity. The overall consumption of electricity in the Port of Trieste, for the performance of its territorial activities, determines the production of 11,774 t CO2 eq. per year. The saving of **134 t CO2 eq.** per year due to the Pilot Action represents **1.1%** of the GHGs **emissions for** the **consumption of electricity** in carrying out the terrestrial activities of the Port. In addition, it is also noted that the total terrestrial and maritime emissions of the Port of Trieste amount to 172,765 t CO2 eq. per year. The savings in GHG emissions obtained thanks to the Pilot Action is equal to **0.1%** of **total Port emissions** (Tab. 4).

In the same way, it is possible to evaluate the emission savings obtained by all the other Project Partners which have carried out a Pilot Action concerning the adaptation of the lighting systems to the standards of environmental protection and the safety of places and people.

Five PPs deserve particular mention: PP01 - Port of Nogaro – Cosef; PP12 - Port of Split; PP13 - Port of Ploče; PP02 - Port of Venice; PP15 - Port of Dubrovnik. In these 5 cases, with the pilot action of replacing traditional lamps with LEDs, it is possible to reduce terrestrial emissions due to the consumption of electricity, respectively of: -34%; -25%; -24%; -17%; -7% (Tab. 4).

The **nine pilot projects** that implemented the Pilot Actions in question (replacement of traditional light bulbs) achieved a **reduction in GHGs emissions** equal to **almost 3%** of **terrestrial port**

emissions due to electricity consumption. And 0.2% of the total terrestrial and maritime emissions produced in the 9 Ports of the 9 participating Project Partners (Tab. 4).

Tab. 4 - Lighting systems: reductions of GHGs emissions estimates (t CO2 eq. per year; %)

Project Partners		Pilot Actions lighting systems Emissions Savings (A)	Electric energy terrestrial emissions of each port (B)	Total terrestrial & maritime emissions of each port (C)	% Pilot Actions savings	
					(A/B)	(A/C)
LP	Port of Trieste	134.0	11,774.1	172,765.4	1.1%	0.1%
PP01	Port of Nogaro	31.0	90.0	14,240.0	34.4%	0.2%
PP02	Port of Venice	125.0	733.0	182.795.0	17.1%	0.4%
PP06	Port of Ancona	11.4	541.5	28,749.3	2.1%	0.04%
PP07	Port of Ortona	41.4	n.a.	n.a.	n.a.	n.a.
PP09	Port of Rijeka	3.3	1,003.5	24,078.1	0.3%	0.01%
PP12	Port of Split	11.6	46.5	15,252.9	24.9%	0.1%
PP13	Port of Ploče	21.1	88.3	2,587.0	23.9%	0.8%
PP14	Port of Dubrovnik	33.4	454.7	36,849.8	7.3%	0.1%
Total t CO2 eq.		412.2	14,731.6	294,522.5	2.8%	0.1%

Source: Final Pilot Action Report and Territorial Needs Assessment (TNA) by each Project Partner involved in the activity

Transferability of the results

LED lighting bulbs are a quite consolidated technology which does not imply significant transferability challenges. A few issues shall be considered when programming a replacement of traditional lighting bulbs with LED ones: Firstly, LED lighting may differ in terms of colour rendering and intensity, potentially impacting the visual acuity and perception of port workers and mariners. Secondly, the transition to LED lighting may necessitate alterations in lighting fixtures and infrastructure, incurring additional costs and logistical challenges. Moreover, LED lights often have distinct characteristics, such as directional illumination, which can affect the distribution and spread of light within the port environment. This shift in lighting patterns may require adjustments to existing lighting designs to maintain safety and operational standards. Nevertheless, during SUSPORT Project no significant issues concerning this technology implementation have been reported.

6. e-Cars & hybrid plug-in vehicles

Cars and road vehicles are useful to support the operational and institutional activities of the ports. Thanks to the SUSPORT Project (Interreg Programme), the Italian and Croatian Port Authorities – participating in the Project and bordering the Adriatic Sea – have been able to renew parts of their car fleets, yet made up largely of "old" vehicles equipped with conventional engines, implementing the number of environmentally friendly vehicles.
So, in line with the results of the Territorial Needs Assessment (TNAs elaborated in WP3 of SUSPORT), in order to enhance the sustainability and energy efficiency through concrete actions aimed at saving CO2 emissions, **9** of the 13 **Pilot Actions** of SUSPORT Project have concerned the purchase of one or more electric and hybrid vehicles (identified respectively by these two acronyms: EV and PHEV). In all, the **9 Project Partners**, that implemented these 9 Pilot Actions, bought **15 new vehicles**. Only three of these 9 Pilot Actions include also some "**charging stations**", exactly **five** (Tab. 5). The table below lists the nine Project Partners that have started the renewal of their fleet of vehicles, buying one or more new vehicles with a more sustainable environmental impact that will contribute to reduce pollution and in particular CO2 emissions. And the charging stations installed.

Tab. 5 - e-cars, hybrid plug-in vehicles and charging stations by Project Partner

Project Partners		e-cars (EV)	hybrid plug-in vehicles (PHEV)	Total vehicles (EV + PHEV)	Charging stations
LP	Port of Trieste	2	0	2	2
PP02	Port of Venice	2	1	3	0
PP05	Port of Ravenna	1	1	2	0
PP06	Port of Ancona	0	2	2	0
PP08	Port of Bari	2	0	2	0
PP09	Port of Rijeka	1	0	1	2
PP11	Port of Zadar	1	0	1	1
PP12	Port of Split	0	1	1	0
PP15	DNR	0	1	1	0
Total new vehicles		9	6	15	5

Source: Final Pilot Action Report by each Project Partner involved in the activity

This operation represents one of the elements of the strategy of the Italian and Croatian Port Authorities participating in the Project to improve environmental sustainability and energy saving towards de-carbonisation.
According to Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014, ports are incentivised to consider, for internal mobility, the transition to the electric vehicle.

This will allow ports to benefit in terms of energy efficiency and air quality (no on-site emissions of pollutants and fine dust). The focus is therefore on investment in electric vehicles and the construction of electric charging points to promote their use.
It shows also clearly the need for the Italian and Croatian Port Authorities to deploy resources for the energy transition.

The two tables below show in detail the technical characteristics of each of the vehicles purchased by the 9 Project Partners, thanks to the SUSPORT Project.
The first table (Tab. 6) concerns the **six** plug-in **hybrid** vehicles (PHEV), which ensure a total emissions reduction of **31.2 t CO2 eq. per year**.

Tab. 6 - Technical specifications of the plug-in hybrid vehicles by Project Partner

	PP02	PP05	PP06	PP12	PP15
Project Partner	Port of Venice	Port of Ravenna	Port of Ancona	Port of Split	Dubrovnik County
Manufacturer	Volkswagen	Jeep	Volvo	Nissan	Skoda
Model	Multivan	Compass	XC40	Juke	Superb iV
n. vehicles	1	1	2	1	1
Technical Specs					
Engine power (kW/Cv)	110 / 150	96 / 130	155 / 211	84 / 114	150 Cv
Engine torque	360 Nm	270 Nm	245 Nm	200 Nm	250 Nm
Top speed	190 km/h	200 km/h	180 km/h	180 km/h	221 km/h
Consumption (l/100 km)	6,40 l/100km	1,90 l/100km	2,10 l/100km	5,0 l/100 km	6,2 l/100km
CO2 Emissions (g/km)	169	43	47	115	141
Estimates					
CO2 reduction *(tons/year)*	1.4	1.6	10.2	8	10

Sources: car manufacturers' websites

The second table (Tab. 7, in the next page) concerns the nine full electric e-car (EV), which ensure a total emissions reduction of **52.1 t CO2 eq. per year**.

Tab. 7 - Technical specifications of the e-cars by Project Partner

Project Partner	LP	PP02	PP05	PP08	PP09	PP11
	Port of Trieste	Port of Venice	Port of Ravenna	Port of Bari	Port of Rijeka	Port of Zadar
Manufacturer	Renault	Nissan	Volkwagen	Volkwagen	Hyundai	Renault
Model	Megane	Leaf	ID.3	ID.4	Kona	Twingo
n. vehicles	2	2	1	2	1	1
Technical Specs						
Battery pack capacity	60 kWh	40 kWh	62 kWh	77 kWh	64 kWh	23 kWh
Range WLTP	380 km	270 km	429 km	522 km	484 km	190 km
Engine power (kW/Cv)	160 / 218	110 / 150	150 / 204	128 / 174	150 / 204	60 / 82
Engine torque	300 Nm	320 Nm	310 Nm	235 Nm	395 Nm	160 Nm
Top speed	160 km/h	144 km/h	160 km/h	160 km/h	167 km/h	135 km/h
Consumption (1) (Wh/km)	105 - 222	110 - 236	112 - 232	128 - 261	108 - 229	104 - 237
CO_2 Emissions (g/km)	0	0	0	0	0	0
Estimates						
CO_2 reduction *(tons/year)*	16.0	1.6	2.5	16.0	8.0	8.0

Note (1): Indication of real-world energy use in several situations. Cold weather: 'worst-case' based on -10°C and use of heating. Mild weather: 'best-case' based on 23°C and no use of A/C. For 'Highway' figures a constant speed of 110 km/h is assumed. The energy use will depend on speed, style of driving, climate and route conditions. Sources: https://ev-database.org/; https://evcompare.io/

In order to understand the weight and significance of these savings, they have been compared with the total emissions of each Port examined (Tab. 8).
In the WP3 of the SusPort Project, within the Territorial Needs Assessment (TNA) document, each Project Partner calculated the carbon footprint of its Port, distinguishing terrestrial emissions from maritime ones.

The substation of vehicles equipped with conventional engines by means of electric cars and plug-in hybrid ones in the **Port of Trieste** allows a saving of GHG emissions equal to **16 t CO2 eq. per year**. The emissions produced by vehicles used in port areas - in calculating the Carbon Footprint of the Port (WP3) – have been classified in the group "Means of service". The overall consumption of fuel for road transport in the Port of Trieste 3,373.7 t CO2 eq. per year. The saving of **16 t CO2 eq.** per year due to the Pilot Action represents **0.5%** of the GHGs **emissions** caused by "**means of service**" in carrying out the terrestrial activities of the Port.
In addition, as the total terrestrial and maritime emissions of the Port of Trieste amount to 172,765 t CO2 eq. per year, then the savings in GHG emissions obtained thanks to this component of the Pilot Action is a little part of the total, equal to **0.01%** of **total Port emissions** (Tab. 8).

In the same way, it is possible to evaluate the emission savings obtained by all the other Project Partners which have carried out a Pilot Action concerning the "replacement of car equipped with endothermic engine by means of e-cars and plug-in hybrid ones".

The **nine pilot projects** that implemented the Pilot Actions in question (new e-cars and plig-in hybrid ones) achieved a **reduction in GHGs emissions** equal to **almost 1.1%** of **terrestrial port emissions** due to the consumption of fuel for transport by "means of service in port areas". And 0.02% of the total terrestrial and maritime emissions produced in the 9 Ports of the 9 participating Project Partners (Tab. 8).

Tab. 8 - e-cars & plug-in hybrid vehicles: reductions of GHGs emissions (t CO2 eq. per year; %)

Project Partners		Pilot Actions e-cars & plugged-in Emissions Savings (A)	Means of service terrestrial emissions of each port (B)	Total terrestrial & maritime emissions of each port (C)	% Pilot Actions savings	
					(A/B)	(A/C)
LP	Port of Trieste	16.0	3,373.7	172,765.4	0.5%	0.010%
PP02	Port of Venice	3.0	262.0	182.795.0	1.2%	0.001%
PP02	Port of Ravenna	4.1	3,671.9	107,602.0	0.1%	0.004%
PP06	Port of Ancona	10.2	0.0	28,749.3	---	0.040%
PP08	Port of Bari	16.0	0.0	39,005.9	---	0.041%
PP09	Port of Rijeka	8.0	469.4	24,078.1	1.7%	0.030%
PP11	Port of Zadar	8.0	0.0	4,351.6	---	0.200%
PP12	Port of Split	8.0	0.0	15,252.9	---	0.050%
PP15	DNR	10.0	n.a.	n.a.	n.a.	n.a.
Total t CO2 eq.		83.3	7,777.0	391,805.2	1.1%	0.021%

Source: Final Pilot Action Report and Territorial Needs Assessment (TNA) by each Project Partner involved in the activity

Transferability of the results

The introduction of electric (EVs) and plug-in hybrid vehicles (PHEVs) in a port area presents a range of transferability issues that necessitate careful consideration. The acquisition of vehicles per-se is not very challenging as the necessities of port authority/stakeholder are identified. The main issue relates to the infrastructure for charging stations, which must be established, adding a layer of expense and logistical complexity.

Furthermore, the charging infrastructure's location and capacity planning are essential to ensure efficient vehicle operations within the port area. Compatibility issues may arise with different vehicle types, necessitating standardized charging interfaces for PHEVs. Additionally, the duration and frequency of charging sessions need to be optimized to minimize disruptions to port operations and maximize vehicle availability.

Operational and maintenance adjustments may also be required, as EVs and PHEVs have different maintenance needs compared to conventional vehicles. Lastly, the environmental impact of electrifying the port's vehicle fleet, including potential changes in emissions and energy sources, should be assessed comprehensively.

Addressing these transferability issues necessitates a thorough feasibility study, collaborative efforts among stakeholders, strategic infrastructure planning, and careful consideration of environmental implications to ensure a successful transition to EVs and PHEVs within the port area. In that sense, SUSPORT Project provides a set of best practices that have been already exploited in the project framework: two project partners, using budget savings, have acquired electric vehicles or PHEVs which were not initially planned.

7. Photovoltaic Solar Power Plant

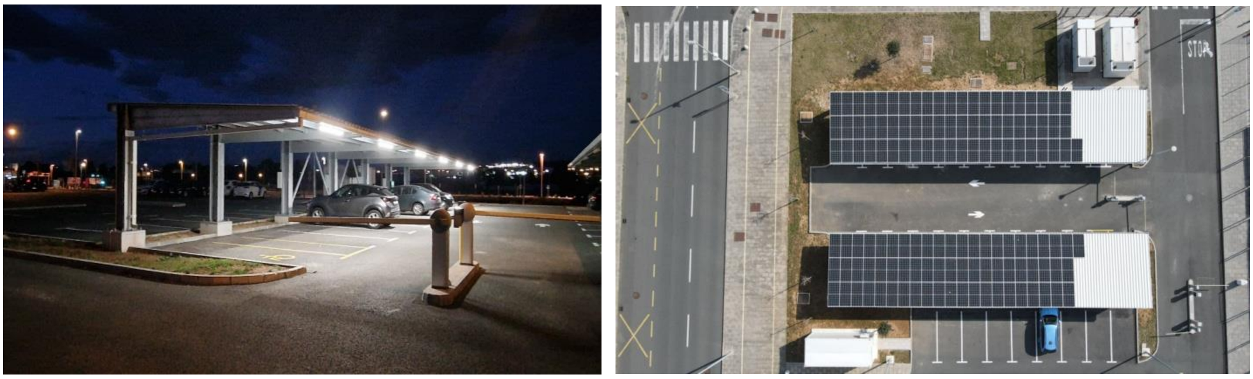
As planned for the activity 3.2 of WP3, a specific SWOT analysis was carried out by each Port participating to the SUSPORT Project. This analysis was conducted taking into consideration the maritime and terrestrial activities of each Port, and the data and experiences shared by the main stakeholders of the port.
These SWOT analyses revealed some of the main weaknesses of each port when considering the negative environmental impacts. One of them was the high level of GHG emissions generated by the ships at berth. In other cases, it was the high level of GHG emissions produced by vehicles. But also industrial, commercial, freight movement and many other activities in the port areas contribute to determining and/or varying air quality, not only in port areas.

In order to deal with the emissions produced by these various port activities, the **Port of Ravenna** and the **Port of Zadar**, participating in SUSPORT Project, decided to install a photovoltaic system each one in their port area. These systems produce energy to consume in different kinds of activities. They are briefly described here below.

The photovoltaic system of the **Port of Ravenna** has been installed at the premises of the Port Authority, more specifically in the parking lot, with the aim to increase its energetic independence, adding to the already existing photovoltaic panels on the rooftop of the Port Authority headquarters. The power of the new photovoltaic system is 122,208 kWh per year, which will add to the previous system producing 38,602 kWh.

The solar power plant project of the **Port of Zadar Authority** includes a charging station for electric vehicles. The project included installation of a canopy with integrated photovoltaic panels in the area of the Port of Gaženica. 56kW of photovoltaic modules (128 pieces) were installed, monocrystalline, Half-Silent, nominal power 445 Wp with battery system with a total capacity of 30 kWh. From 1.11.2022. until 1.03.2023. that is, in a total of 120 winter days, the power plant produced 2,135 kWh, which is an average of 17.5 kWh per day.
The electricity produced from the photo panels is used to charge the electric vehicle of the Zadar Port Authority as well as for external lighting in front of the terminal building. The current state of works can be seen in the photos below (Fig. 2).

Fig. 2 - The solar power plant in the Port of Zadar



Source: Final Pilot Action Report by each Project Partner involved in the activity

The table below lists some of the main technical specifications of the photovoltaic systems, briefly described above. They contribute to reduce pollution and in particular greenhouse gases (GHGs) emissions, respectively equal to almost 65 t CO2 eq. per year in the case of the Port of Ravenna and 1.4 t CO2 eq. per year for the Port of Zadar (Tab. 9).

Tab. 9 - Technical specifications of the Photovoltaic Solar Power Plants

Project Partner	PP05	PP11
	Port of Ravenna	Port of Zadar
Technical Specs		
Electric power (MWh/year)	122	6
Photovoltaic modules (n. pieces)	n.a.	128
Estimates		
CO2 eq. reduction *(tons/year)*	64.8	1.4

Source: Final Pilot Action Report by each Project Partner involved in the activity

In order to understand the weight of these savings, they have been compared with the total emissions of each Port examined (Tab. 10).

In the WP3 of the SusPort Project, within the Territorial Needs Assessment (TNA) document, each Project Partner calculated the carbon footprint of its Port, distinguishing terrestrial emissions from maritime ones.

In the **Port of Ravenna**, the saving of **64.8 t CO2 eq.** per year due to the Pilot Action represents **1.8%** of the GHGs **emissions for** the **consumption of electricity** in carrying out the terrestrial activities of the Port. In addition, it is also noted that the total terrestrial and maritime emissions of the Port of Ravenna amount to 107,602 t CO2 eq. per year. The savings in GHG emissions obtained thanks to the Pilot Action is equal to less than **0.1%** of **total Port emissions** (Tab. 10).

In the **Port of Zadar**, the saving of **1.4 t CO2 eq.** per year thanks to the Pilot Action represents **1.0%** of the GHGs **emissions for** the **consumption of electricity** in carrying out the terrestrial activities of the Port. In addition, the total terrestrial and maritime emissions of the Port of Zadar amount to 4,351.6 t CO2 eq. per year. The savings in GHG emissions obtained with the Pilot Action is equal to less than **0.1%** of **total Port emissions** (Tab. 10).

Tab. 10 - Photovoltaic Solar Power Plants: GHG emissions savings (t CO2 eq/year; %)

Project Partners		Pilot Actions photovoltaic systems Emissions Savings (A)	Electric energy terrestrial emissions of each port (B)	Total terrestrial & maritime emissions of each port (C)	% Pilot Actions savings	
					(A/B)	(A/C)
PP05	Port of Ravenna	64.8	3,671,9	107,602,0	1.8%	0.06%
PP11	Port of Zadar	1.4	139.9	4,351.6	1.0%	0.03%
Total t CO2 eq.		66.2	3,811.8	111,953.6	1.7%	0.06%

Source: Final Pilot Action Report and Territorial Needs Assessment (TNA) by each Project Partner involved in the activity

These **two pilot projects** that implemented the Pilot Actions in question (photovoltaic solar plant) achieved a **reduction in GHGs emissions** equal to **almost 2%** of **terrestrial port emissions** due to electricity consumption. And almost 0.1% of the total terrestrial and maritime emissions produced in the 2 Ports of the 2 participating Project Partners (Tab. 10 above).

Transferability of the results

Photovoltaic panels are a quite consolidated technology which does not imply significant transferability challenges. Operational adjustments may be required to manage energy production and consumption effectively. Finally, regulatory compliance and permitting processes for PV installations must be carefully navigated to ensure adherence to environmental and safety standards. Particular attention shall be due if an energy storage is fitted, especially when it is used for recharging EVs. Due to the intermittent nature of solar energy, effective energy storage, typically through batteries, is essential. The choice, sizing, and integration of the storage system must align with the port's energy demands for EV charging, adding complexity to the Photovoltaic system implementation project. This consideration ensures a consistent and reliable power supply for EVs, regardless of fluctuations in solar energy production. Addressing these transferability issues demands meticulous planning, feasibility assessments, and compliance with regulatory frameworks to maximize the benefits of PV systems in a port environment. Nevertheless, during SUSPORT Project no significant issues concerning this technology implementation have been reported.

8. Energy efficiency Port's Buildings

The second component of the Pilot Action of the Port of Nogaro (Cosef) is entitled "improvement of the energy efficiency of the port's main building (which hosts the Harbour Master's office, Customs, ONG "Stella Maris", etc.)".
The interventions carried out, listed below, take place on the office building, the adjacent technical building and the port warehouses:

A) Completed works of insulation of the building envelope:

1. elimination of the external air conditioning units fixed to the perimeter walls. Preparation of the prefabricated panel for subsequent processing;
2. realization of external thermal coat with application of glass wool panel on all facades;
3. replacement of external windows for windows including windows with PVC products with thermal break and glazing with triple glazing and double air chamber.

B) Technological systems efficiency completed works:

1. dismantling of the existing gas-fired boiler and all the equipment supplied inside the thermal power plant;
2. dismantling of fan coils, radiators and air conditioning units located inside the service building;
3. installation of the VRV system, consisting for winter and summer air conditioning;
4. installation of domestic hot water producer inside the technological plant, with thermal panels installed on the roof of the external technical building;
5. installation of the 14.85 kW photovoltaic system consisting of 54 photovoltaic modules of 275 Wp each. The system has a inverter with a nominal power of 15.0 kW.

In the WP3 of the SusPort Project, within the Territorial Needs Assessment (TNA) document, each Project Partner, and so Cosef, calculated the carbon footprint of its Port, distinguishing terrestrial emissions from maritime ones.
The intervention above described produced savings in energy consumption and reductions in GHGs emissions. In order to understand the weight of these savings, they have been compared with the total emissions of each Port examined (Tab. 11).
In the **Port of Nogaro**, the saving of **31 t CO2 eq.** per year due to this component of the Pilot Action represents **34.4%** of the GHGs **emissions for** the **consumption of electricity** in carrying out the terrestrial activities of the Port. In addition, it is also noted that the total terrestrial and maritime

emissions of the Port of Nogaro amount to 14,240 t CO_2 eq. per year. The savings in GHG emissions obtained thanks to the Pilot Action is equal to more than **0.25%** of **total Port emissions** (Tab. 11).

Tab. 11 - Energy efficiency Port's Building: GHG emissions savings (t CO_2 eq/year; %)

Project Partners		Pilot Action Energy efficiency Port's building Emissions Savings (A)	Electric energy terrestrial emissions of each port (B)	Total terrestrial & maritime emissions of each port (C)	% Pilot Actions savings	
					(A/B)	(A/C)
PP02	Port of Nogaro	31.0	90,0	14,240,0	34.4%	0.2%
Total t CO2 eq.		31.0	90,0	14,240,0	34.4%	0.2%

Source: Final Pilot Action Report and Territorial Needs Assessment (TNA) by each Project Partner involved in the activity

Transferability of the results

All the solutions installed in Porto Nogaro are based on cutting-edge technologies which do not imply significant transferability challenges. The pilot action carried out during SUSPORT project demonstrates that provided that interventions are planned considering the specific context and carrying out proper planning and feasibility assessment, the improvement of energy efficiency of port buildings can be successfully achieved. In fact, during SUSPORT project no significant issues concerning these technologies implementation have been reported.

9. Pilot Actions without direct environmental impacts

Within the 13 Pilot Actions carried out by the SUSPORT Project Partners, there are some components (or operational projects) that have no direct impact on the environment.
Consequently they do not lead to a direct saving in energy consumption neither a direct reduction in greenhouse gases (GHG) emissions.
These projects (or components of Pilot Actions) are listed here below:

1) Eas Monitoring: Implementation of the Integrated Monitoring Plan in the framework of the Port Regulatory Plan for the Port of Trieste - ante operam (LP - **Port of Trieste**);
2) study on potential use of geothermal energy in Porto Nogaro (PP1 - **Cosef**);
3) installation of sensors and stations to monitor noise, air (concentrations of PM, pollutant gases) and water quality (ship traffic, etc.) (PP8 - **Port of Bari**);
4) mobile station to monitor air quality (PP12 - **Port of Split**);
5) PP13 - **Port of Ploče**:
    - purchase and implementation of environment protection barriers;
    - installation of sensors and stations for monitoring noise, air and water quality to measure concentrations in port areas;
    - replacement of the existing air condition system in Port of Ploče Authority data centre with energy-efficient technology;
    - micro data centre solution for data recovery site;
    - digital green incident management.

Transferability of the results

The installation of sensors and monitoring systems to collect data is essential to properly plan actions to reduce the environmental impact and energy efficiency of port areas. It can be considered a prerequisite to the rational planning of all the solutions previously considered as well as enable the identification of critical situations and plan countermeasures. During the SUSPORT project, several actions in pilot projects have been successfully implemented after careful planning and feasibility assessment. No critical issues regarding the implementation of these actions have been reported.

10. GHGs emissions savings by all the Pilot Actions

The **thirteen Pilot Actions** carried out by the Project Partners make it possible to **reduce** greenhouse gases (**GHGs**) **emissions** by about **16,750 t CO2 eq per year**. Since the Italian and Croatian ports under consideration have an ecological footprint corresponding to approximately 628,000 t CO2 eq, per year, then the **13 Pilot Actions** allow to **reduce emissions by almost 3%** of the total emissions caused by terrestrial and maritime activities in port areas (Tab. 12)

The **major contributions** to the reduction of greenhouse gases (GHGs) emissions are guaranteed by the two **cold ironing projects**, one by the Port of Trieste and the other by the Port of Ancona.

The other projects offer smaller contributions to reducing emissions, but still significant when compared to the ecological footprints of the individual Ports involved.
They are positioned in this order: Port lighting systems (emissions saving: 412 tons CO2 eq per year); e-cars & plug-in hybridvehicles (83 t CO2 eq/year); photovoltaic systems Energy (66 tons CO2 eq per year); efficiency port’s building (31 t CO2 eq/year).

Tab. 12 - All the Pilot Actions: reductions of GHGs emissions estimates (t CO2 eq. per year; %)

Project Partners		Pilot Actions Emissions Savings						Total terrestrial & maritime emissions of each port (B)	% Pilot Actions Savings (A/B)
		Cold ironing	Port lighting systems	e-cars & plug-in hybrid vehicles	Photovoltaic systems	Energy efficiency port's building	Total Emissions Savings (A)		
LP	Port of Trieste	12,398.0	134.0	16.0	---	---	12,548.0	172,765.4	7.3%
PP01	Port of Nogaro	---	31.0	---	---	31.0	62.0	14,240.0	0.4%
PP02	Port of Venice	---	125.0	3.0	---	---	128.0	182,795.0	0.1%
PP05	Port of Ravenna	---	---	4.1	64.8	---	68.9	107,602.0	0.1%
PP06	Port of Ancona	3,759.0	11.4	10.2	---	---	3,780.6	28,749.3	13.2%
PP07	Port of Ortona	---	41.4	---	---	---	41.4	n.a.	n.a.
PP08	Port of Bari	---	---	16.0	---	---	16.0	39,005.9	0.0%
PP09	Port of Rijeka	---	3.3	8.0	---	---	11.3	24,078.1	0.0%
PP11	Port of Zadar	---	---	8.0	1.4	---	9.4	4,351.6	0.2%
PP12	Port of Split	---	11.6	8.0	---	---	19.6	15,252.9	0.1%
PP13	Port of Ploče	---	21.1	---	---	---	21.1	2,587.0	0.8%
PP14	Port of Dubrovnik	---	33.4	---	---	---	33.4	36,849.8	0.1%
PP15	DNR	---	---	10.0	---	---	10.0	n.a.	n.a.
Total t CO2 eq.		16,157.0	412.2	83.3	66.2	31.0	16,749.7	628,277.0	2.7%

Source: Final Pilot Action Report and Territorial Needs Assessment (TNA) by each Project Partner

11. Conclusions

The thirteen Pilot Actions carried out thanks to SUSPORT Project make it possible to reduce greenhouse gas emissions by 16,750 tons CO2 eq. per year, corresponding to almost 3% of the total emissions produced by the 13 Italian and Croatian maritime Ports involved.

SUSPORT has been the first Interreg Italy-Croatia Project which has brought together all the Ports of this Programme Area. They don’t have a common model of environmental planning and energy efficiency. On one side, the Italian Port System Authorities have ministerial guidelines published in December 2018, on the other hand the Croatian Ports have their own impact mitigation strategies. Therefore, efficient coordination and a common cross-border strategy are lacking. Consequentially, they usually adopt mitigation measures in a non-coordinated way, with a non-homogeneous result in terms of environmental protection.

SUSPORT Project has been a valid tool to strengthen the institutional capacity and cross-border governance of these Ports. Thanks to SUSPORT, all the Project Partners have looked for common solutions to common problems. In fact, all Ports face common challenges: improving air quality (impact at the local level) and reducing greenhouse gases (impact at the global level), at the same time guaranteeing a fluid and fast transit of the goods to ensure the economic and social development, all the more necessary as traffic flows are common (i.e.: the same ships call in all Ports of the Programme Area).

The Pilot Actions carried out by all the Project Partners were useful for indicating ways in which to protect environmental sustainability and strengthen energy efficiency. The Pilot actions provide a strong knowledge basis that can be transferred to other contexts. Transferability of most of the tested technologies has been demonstrated to be quite easy provided proper planning and analysis of the peculiarities of the site.

Furthermore, they have subscribed a Memorandum of Understanding (WP5 of SUSPORT) for the application of a joint cross-border strategy in this Area, thus harmonizing the policies in the medium and long term. This joint protocol is a concrete condition for creating a long-term cross-border institutional platform in order to **share know-how** and best practices, at the same time supporting their competitiveness to improve their connection and integration to the TEN-T corridors and increasing collaboration and cohesion at cross-border level, with benefits **on both sides** of the **border**.

The challenge of guaranteeing **sustainable development** in this Programme Area – on the one hand the protection of the environment and the reduction of emissions and on the other hand ensuring economic development, employment and a decent income – cannot be faced only at the local level. They are challenges of cross-border level and they require a shared approach among all the Stakeholders involved.

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