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SMARTPORT

D.T2.3.1 - Monitoring Report

Port Network Authority of Ionian Sea – Port of Taranto 06/2023

Port Network Authority of the Ionian Sea
Port of Taranto
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Disclaimer

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Work Package T2

The goal of WP is identification of the most appropriate area and energy model in each area. In each port area intelligent LED luminaire will be installed: suitable places will be identified inside the port (with the support of an expert who knows the area perfectly) for the 23 LEDs in LP, 10 in PP3, 50 in PP4 and 20 in PP5. The energy model suitable for each area starts from the previous study and analysis carried out jointly by the partners; in addition, experts will check the value and suitability of the product identified and evaluate any applicable changes or improvements (through the systematic and continuous collection of data useful for further analysis or change). This WP is the pilot action of the project. LED lighting and the use of presence detection sensors to illuminate only areas actually used could further improve energy use. The project therefore proposes a state-of-the-art eco-sustainable lighting system for large spaces, with LED modules. It is planned to use innovative LED products characterized by an extremely long useful life and an exceptionally high efficiency, which allow the reduction of maintenance/replacement costs, resulting in an investment of considerable profitability, characterized by a "life time" guarantee, certificates for a period of twenty years, with a duration of up to 100,000 hours (12h to day). The innovative technology proposed will be characterized by an innovative remote-control system, which analyses instant information of various types from the illuminated area and is programmed to guarantee punctual attention of energy consumption and/or increasing the light intensity from the individual LED pole.

Activity A.T2.3 Development of tools for monitoring and evaluating the energy chain

The aim of this action is draw up monitoring and evaluation reports that will support and improve the design work. Responsible of action is PP3 and with support of PP4 will develop monitoring tools while all PPs involved in pilot action will provide expert for local reports.

Monitoring of pilot projects aims at supporting project management to assess and review the extent to which innovative LED system in local development is being implemented and to undertake corrective measures if necessary.

Purpose of this document

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.

Distribution of tasks for the drafting of deliverable

No. partner	Partner	Involvement in the activity

LP	Port Network Authority of The Ionian Sea – Port of Taranto	Involved
PP2	Apulia Regional Agency for Environmental Prevention and Protection	Involved
PP3	Municipality of Termoli	Activity coordinator
PP4	Port of Bar	Activity coordinator
PP5	Port of Vlora	Involved

Structure of the monitoring report

The results of this monitoring report will be joint and shared within the final common deliverable as results of cooperative work of all partners. All partners are requested to provide the information about the ongoing SMARTPORT pilots that will summarize:

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

With this purpose, also considering the deliverables planned for the pilot, the template to draft the monitoring report has been structured in the following chapters:

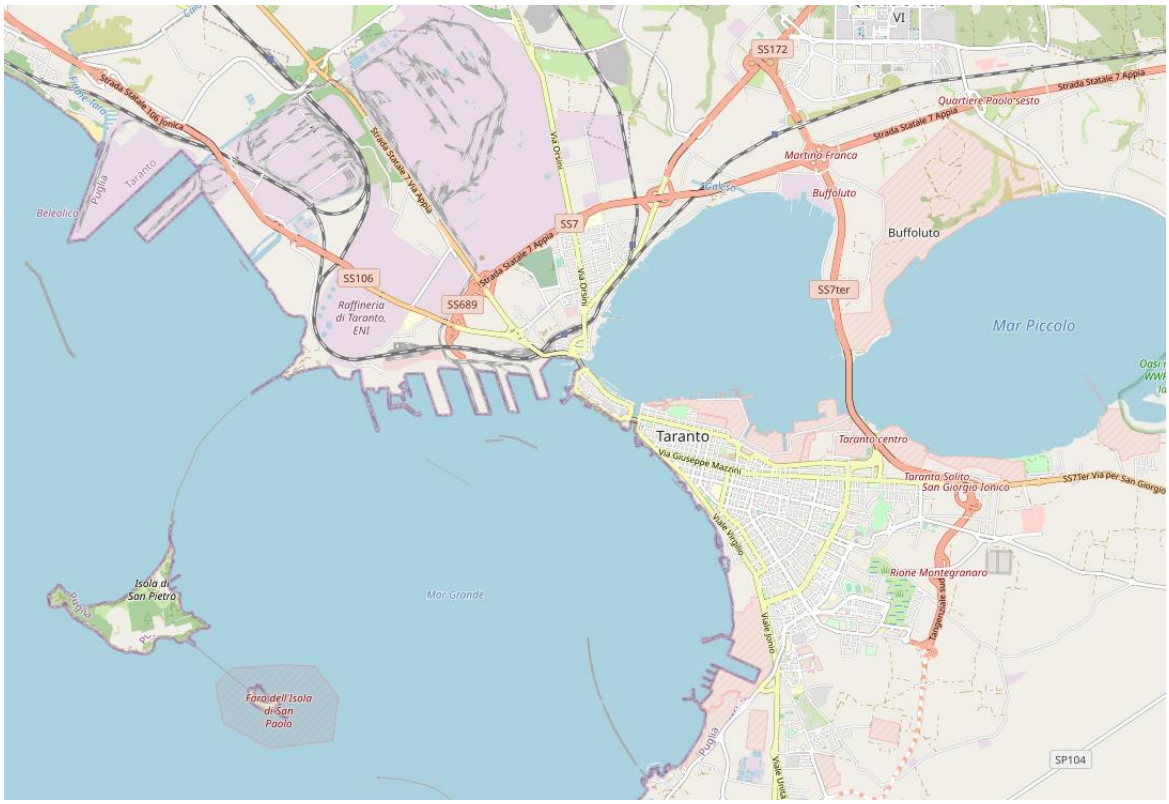
- Background
- Rationale for pilot action
- Pilot action implementation
- Monitoring data
- Stakeholders involved
- Problems and solutions found

1 BACKGROUND

Introduction
This document describes the monitoring of the intervention carried out in the port area, which involves the replacement of 26 HPS (high-pressure sodium) lamps with high-efficiency LED lamps in the Port of Taranto managed the Port Network Authority of Ionian Sea.

General information about the Port of Taranto
In the Heart of the Mediterranean, 172 nautical miles off the routes of Suez and Gibraltar, strategically positioned with respect to the main routes between East and West, the port of Taranto is the ideal hub for commercial traffic between Europe and the rest of the world, as well as for short-range domestic and Euro-Mediterranean traffic.

Located on the northern coast of the Gulf of Taranto, the Port of Taranto consists of a wide bay called Mar Grande and an internal inlet, Mar Piccolo.



The port infrastructure is distributed along the northwestern sector of Mar Grande (Porto Mercantile and Porto Industriale) and immediately outside it towards the west (Molo Polisettoriale and 5th Sporgente).

The territorial jurisdiction of the Port System Authority of the Ionian Sea - identified by a Decree of the Ministry of Transport and Navigation dated April 6, 1994, and subsequently expanded by a Ministerial Decree of June 23, 2004, of the Ministry of Infrastructure and Transport - extends from the western Molo of Castello Aragonese to the left bank of the Tara River.

The port area extends over 3,250,000 square meters, of which:

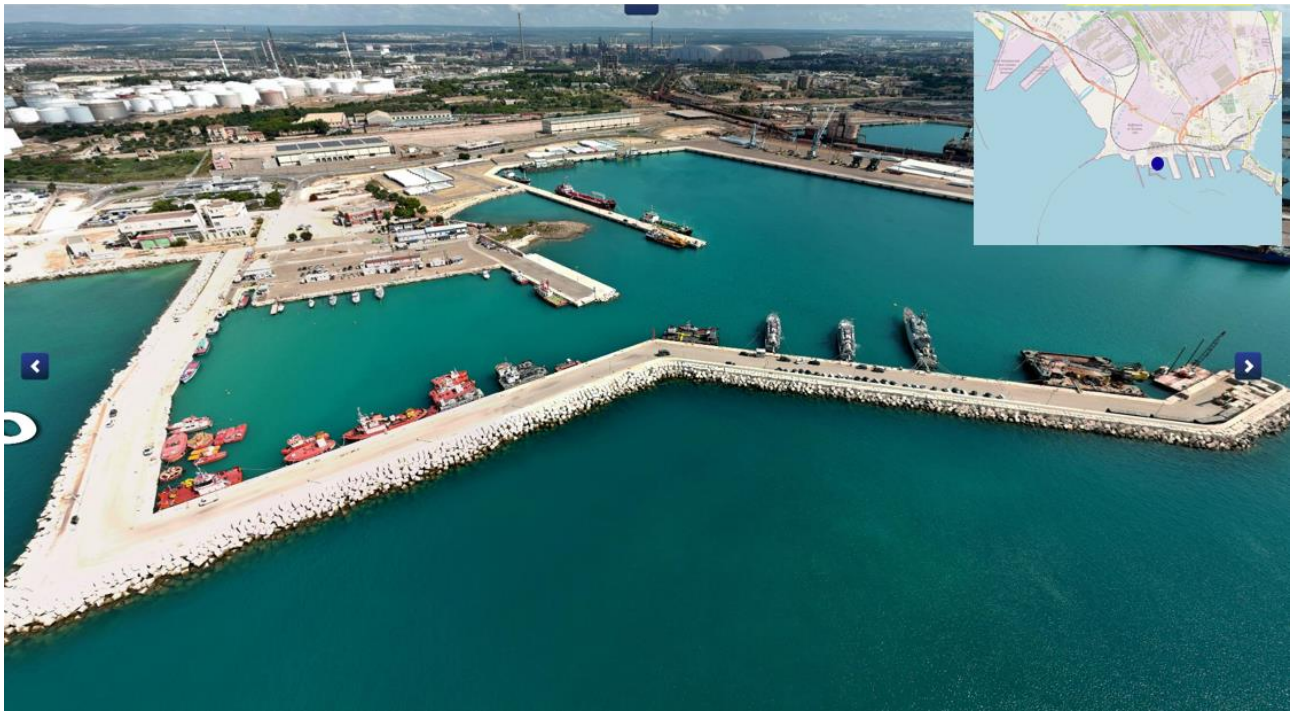
- 550,000 square meters are operational areas.
- 2,200,000 square meters are concession areas.

The total length of the quays is 13,027 meters, of which:

- 3,730 meters are for public use.
- 9,310 meters are under concession.

The functionality of the quays is ensured throughout the year by natural and artificial protections, thanks to minimal tidal variations.

The maximum draft of the Port of Taranto is -25 meters, made possible by the depth of the seabed of the IV Sporgente of the port itself.
The intervention was carried out in the so-called Darsena Servizi, an area of the Port of Taranto primarily intended for mooring the nautical vehicles of the Military Bodies of the state and for mooring technical-nautical services.



Reasons for the implementation of the pilot

The replacement of existing lighting fixtures with LED fixtures brings significant advantages. It is known that, at the same level of illumination, LED technology can achieve energy savings ranging from 50% to 80%.

The light emitted by sodium lamps is yellow, which does not correspond to the peak sensitivity of the human eye. As a result, colours are not accurately reproduced, and more light is needed to ensure safe visibility. LEDs, on the other hand, emit white light, which provides safe illumination for road users (reducing reaction times to unexpected events) with lower energy consumption. White light also penetrates fog more effectively, making vehicles more visible. Additionally, LEDs improve the quality of images captured by security cameras.

The Color Rendering Index (CRI) indicates the fidelity of colour reproduction. Sodium lamps have a CRI of 20, while LED lamps have a CRI of 80.

The idea of combining LED technology with street lighting is also based on recent scientific discoveries in the field of perception. Studies on visibility with white light are based on the fact that, depending on the luminance, we either use or do not use all the perceptual apparatus of our eyes. The results indicate that light sources with a predominant spectrum in the blue range, such as LEDs, are preferable without requiring high levels of luminance. High-pressure sodium lamps have a spectrum centered in the red range, which is far from the peak sensitivity of the human eye.

Therefore, it can be stated that with sodium lamps, the luminous power needs to be increased by 50% to ensure safe visibility.

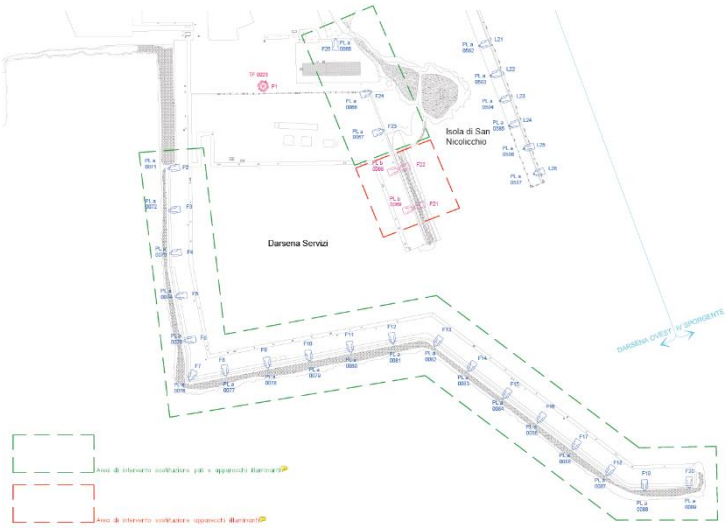
Sodium lamps, being omnidirectional, distribute light in all directions, and a reflector is required to recover half of the light. The final luminous efficiency is 50% of the emitted light. LEDs, on the other hand, are directional by design and emit a well-defined beam at 90 degrees, with an efficiency of 90 lumens per watt (at 350mA power supply), minimizing light pollution. LEDs can be paired with secondary optics to narrow the light beam.

In conclusion, sodium lamps are inferior to LED lamps in terms of light quality, projection efficiency, and light pollution. The lifespan of LED systems is estimated at 50,000-100,000 hours (10-20 years, 12 hours per day), compared to 4,000-5,000 hours (11-14 months) for high-pressure sodium lamps.

The maintenance costs of LED lighting fixtures are estimated to be one-tenth of those of sodium installations currently in use.

LED systems have a higher initial cost compared to traditional solutions. However, considering their longer lifespan, energy savings, and minimal maintenance, there is a net savings of 50% to 80%.

2 RATIONALE FOR PILOT ACTION



Prior to the implementation of the pilot intervention, the intervention area was identified within a compatible extension with the budget of the SMARTPORT Project. This concerns the area in the Service Dock, which consists of 24 lighting poles and 26 lamps.

Figure : Plan of the operation area in the Service Dock.

Figure: Pre-intervention existing poles and Lamps

The existing lamps were high-pressure sodium (HPS) lamps with a power rating of 250 watts.

For the specific area, an energy consumption monitoring was conducted prior to the pilot intervention by analyzing the individual bills associated with the delivery point (POD) to which the relevant installations are connected. The specifications of the analyzed POD are shown in the following figure.

Dati Fornitura	Data Supply
Le stiamo fornendo energia in **VIA PORTO MERCANTILE 999 - 74123 TARANTO (TA)** POD: **IT001E89011830 -** Codice fornitura: **1166201088** Tipologia del cliente: **USI DIVERSI IN BASSA TENSIONE** Contratto: **CONSIP EE19 VARIABILE 12 MESI - MULTIORARIA** Codice offerta: **000592ENVFL01XXAXP0000--CSP19V12** Tensione di Alimentazione: **380 V - BASSA TENSIONE** Potenza Disponibile: **200,0 kW**	We are supplying energy to you at **VIA PORTO MERCANTILE 999-74123 TARANTO (TA).** POD: **IT001E89011830** Supply Code: **1166201088** Customer Type: USI DIVERSI IN BASSA TENSIONE **(Various Uses in Low Voltag**e) Contract: CONSIP EE19 VARIABILE 12 MESI - MULTIORARIA (CONSIP EE19 Variable 12 Months - **Multitariff**) Offer Code**: 000592ENVFL01XXAXP0000--CSP19V12** Supply Voltage: **380 V - LOW VOLTAGE** Available Power: **2000 kW**

The delivery point supplies various electrical installations in the area, not only the public lighting installations that are the subject of the pilot project. Therefore, the monitored energy consumption is significantly higher than just the energy consumption from the replaced lamps.

The total power consumed by the lamps before the implementation of the pilot project is 6.5 kW, which corresponds to the power of each lamp (250 W) multiplied by the number of replaced lamps.

Assuming an average daily operating duration of 12 hours for the lamps, the estimated daily electricity consumption is 78 kWh, and the monthly consumption is 2340 kWh.

Below are the monthly monitored consumption values for the period from January 2021 to January 2023, before the implementation of the pilot project, divided into F1, F2, and F3 time-of-use tariff bands.

	F1 (kWh)	F2 (kWh)	F3 (kWh)	Tot. (kWh)
Jan-21	1892	2561	6094	10547
Feb-21	1721	2421	5122	9264
Mar-21	1872	2483	4910	9265
Apr-21	1734	2189	5217	9140
Maj-21	857	1500	3943	6300
Jun-21	1248	1494	3812	6554
Jul-21	1301	1828	3950	7079
Aug-21	1261	1963	4359	7583
Sep-21	1015	2140	4379	7534
Oct-21	1009	2056	4639	7704
Nov-21	1770	2316	4945	9031
Dec-21	7949	5382	12396	25727
Jan-22	1812	2356	5703	9870
Feb-22	1700	2205	4524	8430
Mar-22	1706	2425	5036	9167
Apr-22	702	832	1994	3528
Maj-22	672	1197	3126	4996
Jun-22	1219	1336	3242	5797
Jul-22	1619	1701	3598	6918
Aug-22	1186	1547	3577	6311

Sep-22	897	1682	3561	6140
Oct-22	1015	1760	3795	6570
Nov-22	1486	1920	4101	7507
Dec-22	1300	1902	4466	7668
Jan-23	1447	2092	4818	8358

From this pre-intervention monitoring, it is evident that the energy consumption of the existing lamps is significantly lower than the consumption recorded by the POD. Therefore, this difference represents the portion of energy consumption resulting from other uses connected to the same delivery point.

3 PILOT ACTION IMPLEMENTATION

The intervention involved the replacement of 26 high-pressure sodium lamps with high-efficiency LED lamps.

The intervention was carried out in early February 2023 as part of the "Global service for the management of land services and assets under the jurisdiction of the Port System Authority of the Ionian Sea" entrusted to the temporary consortium Castiglia Srl/Giovanni Putignano & Figli Srl. An Order for Works, numbered 02/A4, was issued to the contracting temporary consortium, addressing the "Relamping of external lighting areas of the Port," which includes, among other things, the replacement of lamps for the pilot project..

The person in charge of the procedure (RUP – Responsabile Unico del Procedimento) has informed the contracting temporary consortium that part of the works specified in the Public Lighting Relamping Project for the external areas of the Port (as per Work Order No. 02/A4 dated 16.11.2022), particularly those planned for the pier of the Darsena Servizi, are funded by the INTERREG SMARTPORT fund, with a total amount of **€50,985.67** net of the offered discount.

This amount includes:

- Supply and installation of 22 conical-shaped poles made of hot-dip galvanized and painted S275JOH laminated steel according to UNI EN 10219.
- Supply and installation of 22 wall-mounted cup-type fixing systems made of galvanized steel.
- Supply and installation of 26 NITEKO ICONA-M-130 W LED road luminaires.
- Supply of necessary materials and wiring for the completion of the intervention.

Technical Features

Main features	
Applications	**Street lighting**: urban and extra-urban streets,roundabouts, parking
Device type	LED street lighting fixture
Mounting type	Head-pole, mast arm
Mast arm	Head-pole: -15° ÷ +15° (increments of 5°) | Mast arm: -15° ÷ + 15° (increments of 5°)
Protection rating	IP66 | IK09
	Electrical protection: **EOS Protection System**
	Chemical protection: **VOC Free**
Actual power	**80 ÷ 120 W**
Nominal luminous flux	**11.524 ÷ 22.690 lm** (@ T_J=85°C, I_F<500mA)
Device luminous efficacy	**100 ÷ 145 lm/W** (@ TJ=85°C, IF<500mA)
Temperature	Operating temperature: **-40°C ÷+50°C** | Storage temperature: -40°C ÷+80°C
Warranty	20 years or 100,000 hours
I.P.E.A.	**IPEA A++** in compliance with DM 27/09/2017 (C.A.M.)
Reference standards	EN 60598-1:2015 + A1:2018 | EN 60598-2-3:2003 + A1:2011 | IEC TR 62778:2014 | IEC 62471

	CISPR 15:2013 + AMD1| IEC 61547:2009 | IEC 61000-3-2:2018| IEC 61000-3-3:2013 + AMD1
	EN 55015:2013 + AMD1 | EN 61547:2009 | EN 61000-3-2:2014 | EN 61000-3-3:2013
Patents and certifications	CE, RoHS, ENEC, IP66, IK09, Photobiological Safety, EOS Free, VOC Free
Optical features	
Photometric distributions	Asymmetric, elliptic, rotational symmetric, for pedestrian crossings
Light source	HI power LED
Colour temperature	**2.200K | 2.700K | 3.000K | 4.000K | 5.000K | 5.700K**
Colour Rendering Index	CRI >70 | CRI >80 | CRI> 90
LED modules	Independent and replaceable
Optics	Replaceable, in PMMA
Light source efficiency	135 ÷ 210 lm/W (@ TJ=85°C, IF<500mA)
Light source life	>100,000 hours (L90B10 @ TJ=85°C, IF<400mA)
Electrical features	
Power supply	Standard: **175 ÷264 V a.c. | 50 / 60 Hz**
	Optional: **120 ÷277 V a.c. | 50 / 60 Hz**
LED power current	**I_F<500mA**
Driver	Performance: η> 90 % | Power factor: PF > 0.97 (Active PFC)
Insulation class	Standard: Class II | Optional: Class I
Electrical connection	Safety knife connector
Electrical protection	Common mode: **10 kV** | Differential mode: **6 kV**
	Additional electrical protection with SPD device: **10 kV** (C.M.) | 10 **kV** (D.M) | 10 **kA**
Mechanical features	
Materials	BODY: die-cast aluminium with built-in heat sink
Materials	SCREEN: 4 mm transparent tempered glass
Dimensions	Head-pole mounting: **598 x 289 x 226 mm** | Mast arm mounting: 705 x 289 x 118 mm
Weight	7.2 kg
Exposure to the wind	Lateral: 0.04 m² | 15° Frontal tilt: 0.07 m² | Base: 0.15 m²
Colour	Standard: RAL 9023 (pearly dark grey)| Optional: On Request

4 MONITORING DATA

As previously mentioned, the pilot intervention was carried out in the first ten days of February 2023.

The following image shows the LED lamps in the switched-on mode installed as part of the pilot project. In the distance, you can notice the difference between the white-coloured LED lamps and the yellow-coloured lamps of the traditional high-pressure sodium (HPS) technology.

The power of each installed LED lamp is 130 W, therefore the total power estimated is 3.38 kW, with a daily consumption of 40.56 kWh and a monthly electricity consumption of 1217 kWh.

	Number of lamps	**Power**	**Total power usage**	**Duration**	**Daily consumption**	**Monthly consumption**
		W	kW	h	kWh	kWh
Ante\Before	26	250	6,50	12	78	2340
Post\After	26	130	3,38	12	41	1217

Therefore, with the pilot intervention, an estimated monthly energy saving of approximately 1123 kWh is achieved, equivalent to about 48% of pre-intervention consumption.

In energy efficiency projects for end-use electricity, the environmental benefit comes from the avoided emissions associated with energy savings. Taking into account auxiliary consumption and network losses, the standard value of the unit benefit for CO2, NOx, and PM2.5 in 2015 is 620.4 gCOeq avoided per kWh.

Thus, in this case, the monthly energy saving of 1123 kWh, and therefore an annual saving of 13,476 kWh, results in an environmental benefit associated with the replacement of LED lamps of over 8 tons of CO2 equivalent emissions avoided per year.

In the aside image, you can see the previously existing pole and lamp that were subsequently removed (on the left), as well as the pole and LED lamp installed as part of the Smart Port Project (on the right).

5 STAKEHOLDERS INVOLVED

Several stakeholders were involved prior, during and after the pilot installation:

- **Port Network Authority**: Responsible for managing and operating the port; the Authority has been involved in the project as they have jurisdiction over the dock area and may have specific requirements or regulations regarding lighting installations; moreover, the Authority is (Lead) Partner in the SMARTPORT project;
- **Facility Management**: The department and team responsible for the maintenance and management of the dock facilities. They have provided insights into the current lighting system, maintenance needs, and potential benefits of upgrading to new lamps;
- **Environmental Department**: as the project aims to improve energy efficiency or reduce environmental impact, the environmental department or sustainability team has been involved. They have provided guidance on eco-friendly lighting options, energy-saving measures, and potential environmental benefits;
- **Contractors:** Professionals with expertise in electrical installations and lighting systems. They have assessed the feasibility of the project, provided cost estimates, and handled the procurement of installation of the new lamps and all ancillaries;
- **Service Dock Users** such as
    - **Military Bodies**: The armed forces can use the Service Dock for mooring their naval vehicles, such as military vessels, boats, or other naval units;
    - **Technical-Nautical Services**: Specialized operators in the nautical sector, such as naval maintenance companies, boat repair workshops, and vessel maintenance facilities, can use the Service Dock as an operational base for their activities;
    - **Rescue and Surveillance Services**: Rescue and maritime surveillance forces, such as the Coast **Guard and Fire Brigade** can use the Service Dock for their boats or as a starting point for search and rescue operations or maritime traffic control;
    - **Logistics Operators:** service boats can use the Service Dock as a point of receipt or delivery of goods or as a base for loading and unloading operations of ships;
    - **Fiscal Police** use the Service Dock as a base for their boats or as a starting point for maritime customs fiscal control.
- **Power supply company** that had been involved for the Point of Delivery Energy Consumption.
- **Schools**: students can access the area during visits and benefits on the interventions can be shared.

6 PROBLEMS AND SOLUTIONS FOUND

During this re-lamping piloting process, various **technical aspects** had to be handled:

- General Maintenance Plan: fitting the intervention into a general maintenance plan of a big port (such as Port of Taranto) can pose the most impeding difficulties that have been faced and solved such
    - *Resource Allocation*: adding an intervention to a maintenance plan has required allocating additional resources such as time, manpower, equipment
    - *Prioritization:* the maintenance plan prioritizes activities based on factors like criticality, risk, and cost. Introducing a new intervention has required reevaluating the prioritization of existing tasks and determining how to fit the intervention in the overall plan
    - *Scheduling:* timing of the intervention had to consider equipment availability, production schedules, and downtime windows to minimize disruptions, considering that the intervention required specialized expertise or external contractors
- **Lamp selection:** Choosing suitable LED lamps for the context and specific requirements can be complicated. Factors such as energy efficiency, light quality, lifespan, base type, and compatibility with the existing infrastructure need to be considered; this aspect has been tackled with a proper identification of the area and definition of the energy model
- **Retrofitting**: Adapting the new LED lamps to the existing system may require electrical or structural modifications. Adjustments to supports, connections, and accessories may be necessary to ensure proper installation; for example, we had to install new poles
- **Incompatibility with existing infrastructure**: Some lighting systems may have wiring, transformers, or flow regulators that are incompatible with the new LED lamps. This requires a thorough evaluation of the existing infrastructure and may involve additional modifications or replacements. actually, we choose as first choice to install the new LED on two existing towers but the infrastructure required repairs and exceptional maintenance not compatible with the pilot timeline
- **Disruptions in lighting**: Temporary shutdowns of lighting in specific areas may be necessary during the re-lamping process. This can cause temporary inconveniences for users or activities in the affected zone. Communication to users and work performed during daylight time has mitigated the disruption
- **Regulations and compliance**: Compliance with local regulations and standards related to lighting, such as energy efficiency and safety regulations, is necessary. Obtaining all required authorizations and certifications for the installation of new

LED lamps is important; regulations (UNI ISO) have been depicted in the energy model report

- **Waste management:** Proper disposal of old lamps and replaced components must adhere to environmental regulations. The contractor followed the appropriate waste management and adherence to disposal procedures
- **Future maintenance:** After the installation of new LED lamps, an adequate maintenance program may be required to ensure their continued performance and longevity. Future maintenance is included in maintenance plan

For the **administrative** point of view, some points are important:

- **Authorizations** are important especially in case of new installations; in the case of our pilot action, we were replacing the old lamps and the Service Dock was under the direct control of Port Network Authority of the Ionian Sea
- **Utility Coordination:** in some cases, you may need to coordinate with utility companies responsible for underground utilities (e.g., electricity, gas, water) in the proposed installation area. This is to ensure that the new lamp poles won't interfere with existing underground infrastructure, and to determine any necessary relocations or adjustments. In our case the chosen area was not affected by such problems even though due to new poles the required investigations were performed
- **Communication**: notification regarding the installation of new infrastructure. This involved informing all users of service dock and addressing any concerns or feedback

Other aspects that should be consider

- **Budget:** a re-lamping process can be very expansive all cost for the lamp should be consider has the cost of the lamps (lighting device) can be a minor to the over all costs. A detailed definition of cost component of the intervention was provided by the supplier
- **Public Tender:** in same case a public tender is required and this can affect the project timing due to the public procurement regulation. In the case of Port Network Authority of Ionian Sea, the current maintenance contract was leveraged to carry out the installation of the required equipment for the pilot action.

Port Network Authority of the Ionian Sea

Port of Taranto

ARPA PUGLIA

LUKA BAR

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