Territorial needs assessments of the Port of Ancona

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Contents

Introduction

This document has been drawn up as specified in the “Methodology for the implementation of the territorial needs assessments (D.3.2.1)” and illustrates the “carbon footprint” (or inventory of GreenHouse Gases, GHG) related to the port of Ancona at the beginning of the SUSPORT project, providing a first assessment of the needs connected to the energy efficiency enhancement and emission reduction.

Description of the port area

The Port of Ancona is located in the middle of the Italian Adriatic coast. The port is spread out over an area of 1.4 million square meters and consists of passenger and ferry terminals, container and general cargo facilities. The port has a key function in the Adriatic-Ionian Macro-Region as a terminal of the international ferry routes to Greece, Croatia and Albania.
In particular, the route Ancona-Igoumenitsa-Patras has become in the years the main route between Greece and Central Europe. Ancona is the first port for the RO/PAX traffic between Greece and Central and Western Europe. Relevant investments are ongoing to improve the container terminal by deepening the port basin to -14 meters and extending the existing 333 meters quay to 600 meters.
The Port of Ancona is one of the 83 strategic ports of call of the European Union and it is included in the Scandinavian Mediterranean and in the Baltic-Adriatic Corridor. It excels in the international ferry traffic, as it is among the first Italian ports in terms of number of passengers.

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

The Port of Ancona is composed by 26 docks with a total length of 4.3 km and surface of 224,000 sqm with 12 areas to stock goods for a total surface of 125,000 sqm.
The port of Ancona is divided into the historic port, which developed close to the city, and the more recently developed commercial port. In the port area are located:

- 4 shipyards for cruise ships and yachts;
- 11 docks, for a total of 7 berths for ferry and cruise ships, for a longitudinal development of 1’632 meters and over 71’000 square meters;

- 9 docks, for a total of 9 berths for ships used for container and bulk cargo traffic (solid goods) for a longitudinal development of over 1'700 meters and over 100'000 square meters of yards;
- one of the main Adriatic fishing fleets;
- the Marina Dorica tourist port;
- 3 berths for liquid goods handling at the service of the Falconara refinery, which handle approximately 4.5 million tons of goods per year.

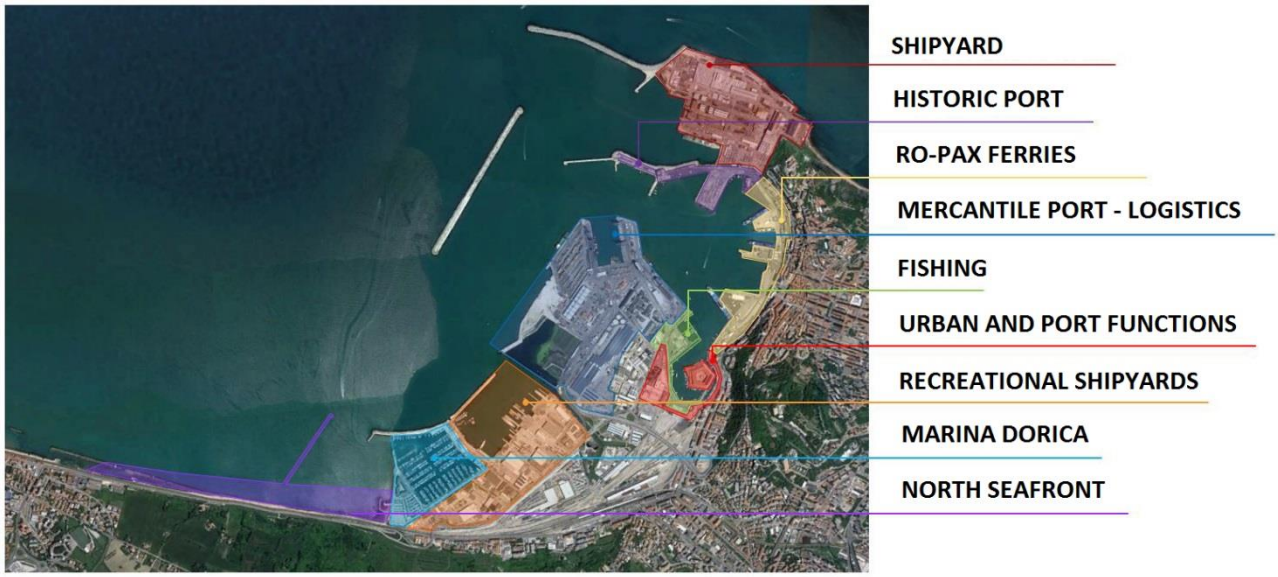

Figure 1 – The port area

Mapping out stakeholders

Environmental sustainability and the improving of air quality in maritime operations represent a horizontal and strategic priority for the definition of development plans at the 6 ports under the competence of Central Adriatic Ports Authority.
The adoption of environmental sustainability initiatives has always foreseen the full involvement of all port stakeholders, including public entities in charge of the environmental authorizations and private operators.

The voluntary "Ancona blue agreement", dedicated to the issue of air quality in the port reality, was promoted by Central Adriatic Ports Authority and by the Harbour Master of the port of Ancona as a bridge towards the application of the new Imo-International maritime organization 2020 worldwide regulation on ship emissions, which came into force on January 1, 2020.
The “Ancona Blue Agreement” was signed on November 30, 2018 by the representatives of four companies, Adria Ferries, Jadrolinija, Superfast Ferries-Blue Star Ferries, Snav, and it was valid until 31 December 2019.
According to the agreement, the ship owners and ferry companies, in collaboration with the shipping agencies, committed to operate the main and auxiliary engines of the ships using fuel for marine use with a sulphur content not exceeding 0.1%, from the completion of the mooring manoeuvre in port and up to departure and exit from the port, compared to the 1.5% required by law at that time.
The "Ancona blue agreement" thus anticipated, improving it, the 2020 European directive which provides that all ships, from 1 January 2020, are required to use, when navigating in the open sea, in manoeuvring and inside ports , fuels with a sulphur content of less than 0.5%. If the stop in the port, according to the times previously disclosed to the public, should exceed two hours, once the mooring manoeuvres have been completed, they must use fuels with a sulfur content not exceeding 0.1%.

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

Further actions foreseen by the project are aimed at increasing the awareness of institutions and citizens on the subject through integrated information, as well as communication and education activities to encourage the adoption of correct lifestyles, especially for the most sensitive population groups.
The PIA develops around four issues of strategic interest, which contributes to achieve the project objectives:

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

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

Consequently, the involvement of local stakeholders is ensured on a regular basis through the sharing of the environmental sustainability actions implemented.

Stakeholders importance mapping

		POWER OF INFLUENCE	
		LOW	**HIGH**
INTEREST	**LOW**	Marginal Stakeholders	Relevant Stakeholders
	HIGH	Operative Stakeholders Local community stakeholders	Key Stakeholders Harbor Master of the port of Ancona; Marche Regional Authority Ancona Municipal Authority Shipping lines

Stakeholders involvement strategies

Stakeholder	Role	Importance (high, medium, low)	Contribution to the project	Benefits	Conflicts (potential, existing)	Current support	Strategies to improve support
Harbor Master/Coast Guard	Institution/operative	high	Provision of data on typology of ships and level of emissions	Increased knowledge on the level of pollutant emissions and better monitoring of the compliance of ships emissions during manoevring and mooring phases with international law	Not relevant	High - constant cooperation	Continuous involvement in project activities
Marche Region Authority	Institution/Authorization	high	Provision of available data of air emissions in the territory of Ancona municipality; monitoring of air quality and environmental sustainability actions in its role as responsible for authorization processes	Increased knowledge on the quality of the air in the area of the port of Ancona and on the emissions linked specifically to maritime operations	Potential: stricter controls on environmental emissions	Constant sharing of information	Continuous involvement in ADSPMAC activities related to environmental sustainability
Ancona Municipal Authority	Institution	high	Participation to the data collection for the analysis of environmental pollutants in the territory of Ancona	Increased knowledge on the quality of the air in the area of the port of Ancona and on the emissions linked specifically to maritime operations	Potential: stricter controls on environmental emissions	Constant sharing of information	Continuous involvement in ADSPMAC activities related to environmental sustainability
Shipping lines	End users	High	Provision of data on the typology of ships and of the typology of fuels used	Direct involvemenet and participation in the project of the main actors responsible for most of the polluting emissions in the port of Ancona	Resistency in introducing technologial and organizational changes to reduce the environmental impacts of port operations	Day to day cooperation on core activities	Stronger involvement in Susport project activities
Local community stakeholders	private/associations	High	Providing feedbacks on the environmental sustainability actions put in place in the port of Ancona	Benefiting of improved air quality and reduction of pollutant emissions linked to maritime operations	Potential conflicts on specific aspects linked to the port environmental impact on the city	Constant sharing of information	Stronger involvement in Susport project activities

Carbon footprint emissions estimation

In this chapter a complete overview on the GHG inventory of the port area of Ancona is given. The inventory includes:

- Terrestrial emissions, related to the relevant emission sources on land-side of the port area;
- Maritime emissions, related to the relevant emissions sources on sea-side of the port area.

A brief summary of the entire inventory is given in the last paragraph.

Terrestrial emissions

The methodology for the implementation of the TNA (Territorial Needs Assessments) identifies the following key emission categories for terrestrial emissions:

- Electric energy, that stands for indirect emissions due to electricity consumption;
- Heating, that stands for direct emissions deriving from combustion process;
- Service vehicles, not considered in this report;
- Port operational vehicles, not considered in this report;
- Heavy duty vehicles, that stand for direct emissions from road freight traffic;
- Railway tractors, not considered in this report;
- Other, that includes all other sources of GHG emissions, such as passenger cars, light commercial vehicles and buses.

More details on the specific data sources employed, the adopted calculation tier and the results of the estimation are provided in the paragraphs below. In the final section Overall results, the total estimated emissions coming from terrestrial activities are reported in terms of tons of CO_{2eq}.

Electric energy

The electricity consumption within the port area is mainly due to two types of facilities:

1. Buildings in the port area;
2. Public lighting.

In both cases the estimation of GHG emissions is based on electricity consumption data (Tier 3) taken from the “Documento di Pianificazione Energetico Ambientale del Sistema Portuale” (Port Environmental Energy Plan) published in 2019 by Central Adriatic Ports Authority.
The available data are shown in the following tables.

Building name	Electric Energy Consumption (kWh)		
	2015	2016	Average
Sede autorità di Sistema	334'565	256'074	295'320
Nuova biglietteria	302'911	188'041	245'476
Ex-fiera	n.a.	n.a.	0
Facility 2B	190'417	140'827	165'622
Terminal Crociere	80'821	n.a.	80'821
Tubimar	n.a.	n.a.	0
TOTAL	***908'714***	***584'942***	***787'238***

Table 1 – Electric energy consumption by building in the port area ("Documento di Pianificazione Energetico Ambientale del Sistema Portuale" – Central Adriatic Ports Authority – 2019)

Public lighting system name	Electric Energy Consumption (kWh)		
	2015	2016	Average
IMPIANTO TORRI FARO NUOVA BIGLIETTERIA	39'945	39'902	39'924
IMPIANTO TORRI FARO MANDRACCHIO	75'172	52'600	63'886
IMPIANTO ILLUMINAZIONE ZONA CAPITANERIA	88'047	92'306	90'177
IMPIANTO ILLUMINAZIONE MOLO NORD	84'111	175'025	129'568
IMPIANTO ILLUMINAZIONE MOLO FORANEO	6'547	6'477	6'512
IMPIANTO ILLUMINAZIONE TUBIMAR	70'790	47'147	58'969
CABINA NUOVA DARSENA ILLUMINAZIONE	398'629	n.d.	398'629
ILLUMINAZIONE MOLO S.MARIA	72'577	57'414	64'996
CABINA VIA DA CHIO	80'821	n.d.	80'821
UTENZE STAZIONE MARITTIMA	334'565	256'074	295'320
TOTAL	***1'251'204***	***726'945***	***1'228'800***

Table 2 - Electric energy consumption by public lighting system in the port area ("Documento di Pianificazione Energetico Ambientale del Sistema Portuale" – Central Adriatic Ports Authority – 2019)

In order to transform electric consumptions into tons of $CO_{2,eq}$ the emission factors estimated by ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) are applied:

Pollutant	UM	Ref. Year	Value	Source
CO_2	g/kWh	2019	268.5797	"Emission factors for the production and consumption of electricity in Italy" (ISPRA, 2021)
CH_4	n.a.	n.a.	n.a.	n.a.
N_2O	n.a.	n.a.	n.a.	n.a.

Table 3 – Emission factors for electric energy consumption

Heating

The GHG emissions due to heating systems in buildings in the port area are estimated from data on natural gas consumption (Tier 3) taken from the "Documento di Pianificazione Energetico Ambientale del Sistema Portuale" (Port Environmental Energy Plan) published in 2019 by Central Adriatic Ports Authority.
The available data expressed in Standard Cubic Meter are shown in the following tables.

Building name	Natural Gas Consumption (Scm)			
	2014	2015	2016	Average
Sede autorità di Sistema	10'109	9'148	6'018	8'425
Ex-fiera	n.a.	n.a.	n.a.	0
Facility 2B	27'097	27'189	25'577	26'621
TOTAL	***37'206***	***36'337***	***31'595***	***35'046***

Table 4 – Natural gas consumption by building in the port area ("Documento di Pianificazione Energetico Ambientale del Sistema Portuale" – Central Adriatic Ports Authority – 2019)

In order to transform the electricity consumption into tons of $CO_{2,eq}$ the following emission factors are applied:

Pollutant	UM	Ref. Year	Value	Source
CO_2	kg/Scm	2019	1.9793	"Emission factors for the production and consumption of electricity in Italy" (ISPRA, 2021)
CH_4	g/Scm	2015	8.644×10^{-2}	Estimation based on National Emission Inventory
N_2O	g/Scm	2015	3.458×10^{-2}	Estimation based on National Emission Inventory

Table 5 – Emission factors for natural gas consumption

CH_4 and N_2O emission factors are estimated comparing emissions of CO_2, CH_4 and N_2O from non-industrial combustion plants powered by natural gas in Ancona province, taken from the last disaggregation of the national inventory at the provincial level published by ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale).

Heavy-duty vehicles

The calculation of emissions due to heavy duty vehicles is based on the number of transits in the port area recorded by Central Adriatic Ports Authority in 2019 (Tier 2). Two types of transits are considered:

- Heavy duty trucks embarking ships or disembarking from ships;
- Heavy duty trucks carrying goods or containers to be loaded on ships or unloaded from ships (freight/container traffic).

The available data and the results of the estimation of the overall distance travelled by heavy duty trucks in the port area are shown in the following table. The distance travelled by freight/container traffic is increased by 5.6% ("adjusted distance") as indicated in the "Methodology for the implementation of the territorial need assessments", paragraph 7.1.4.

Type of trucks	Number of transits			Estimated average route (km)			Notes	Estimated overall distance (km)	Adjusted overall distance (km)
	Embarkations	Disembarkations	*Total*	Embarkations	Disembarkations	Other			
TIR to/from Greece	50'357	53'086	*103'443*	1.8	1.8		Via Mattei-Facility 2A (Banchina Nazario Sauro)	186'197	186'197
TIR to/from Croatia	2'940	3'295	*6'235*	3.4	2.3		EMBARKING: Via Mattei- Facility 2B/Cantiere Navale Fincantieri	17'575	17'575
TIR to/from Albania	11'992	9'864	*21'856*	3.4	2.3		DISEMBARKING: Via Mattei- Sede ADSP	63'460	63'460
TIR to/from Italy	1	0	*1*	1.8	1.8		Via Mattei-Facility 2A	1.8	1.8
Trailer to/from Greece	6'121	5'384	*11'505*	1.8	1.8		Via Mattei-Facility 2A (Banchina Nazario Sauro)	20'709	20'709
Trailer to/from Croatia	0	0	*0*	3.4	2.3		EMBARKING: Via Mattei- Facility 2B/Cantiere Navale Fincantieri	0.0	0.0
Trailer to/from Albania	423	411	*834*	3.4	2.3		DISEMBARKING: Via Mattei- Sede ADSP	2'384	2'384
Trailer to/from Italy	0	0	*0*	1.8	1.8		Via Mattei-Facility 2A	0.0	0.0
Freight traffic	n.a.	n.a.	*25'556*			2.7	Via Mattei-Nuova Darsena/Via Vanoni-Via Mattei	69'001	72'865
Container traffic	n.a.	n.a.	*213'924*			2.7	Via Mattei-Nuova Darsena/Via Vanoni-Via Mattei	577'595	609'940
TOTAL			***383'354***					***936'922***	***973'132***

Table 6 – Number of transits and estimated overall distance travelled by heavy duty trucks in the port area

The estimation of GHG emissions is carried out using values extracted from the database of the average emission factors of road transport in Italy, published by ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) in 2018, as shown in the following table.

Vehicle type	Pollutant	UM	Ref. Year	Value	Source
Heavy duty trucks	CO_2	g/km	2018	675.451	Database of the average emission factors of road transport in Italy (ISPRA, 2018)
	CH_4	g/km	2018	0.021	
	N_2O	g/km	2018	0.028	

Table 7 – Emission factors for distance travelled by heavy duty trucks

Other

The emissions due to passenger cars, light commercial vehicles and buses are included in this category. The estimation method used for these sources is the same used for heavy duty vehicles, based on the number of transits in the port area recorded by Central Adriatic Ports Authority in 2019 (Tier 2). The available data and the results of the estimation of the overall distance travelled by vehicle type in the port area are shown in the following table.

		Number of transits			Estimated average route (km)				
Vehicle type	**Destination /Origin**	**Embarkations**	**Disembarkations**	***Total***	**Embarkations**	**Disembarkations**	**Other**	**Notes**	**Estimated overall distance (km)**
Passenger cars	Greece	100'162	92'981	*193'143*	1.8	1.8		Via Mattei-Facility 2A (Banchina Nazario Sauro)	347'657
	Croatia	21'211	22'300	*43'511*	3.4	2.3		EMBARKING: Via Mattei- Facility 2B/Cantiere Navale Fincantieri DISEMBARKING: Via Mattei- Sede ADSP	123'407
	Albania	12'374	12'519	*24'893*	3.4	2.3			70'865
Buses	Greece	1'513	1'174	*2'687*	1.8	1.8		Via Mattei-Facility 2A (Banchina Nazario Sauro)	4'837
	Croatia	490	615	*1'105*	3.4	2.3		EMBARKING: Via Mattei- Facility 2B/Cantiere Navale Fincantieri	3'081
	Albania	0	0	*0*	3.4	2.3			0

Vehicle type	Destination /Origin	Number of transits			Estimated average route (km)			Notes	Estimated overall distance (km)
		Embarkations	Disembarkations	*Total*	Embarkations	Disembarkations	Other		
								DISEMBARKING: Via Mattei- Sede ADSP	
Light Commercial Vehicles	Greece	n.a.	n.a.	*5*			3.6	Via Mattei-Facility 2A (Banchina Nazario Sauro)	18
	Croatia	0	0	*0*	3.4	2.3		EMBARKING: Via Mattei- Facility 2B/Cantiere Navale Fincantieri	0
	Albania	1'277	2	*1'279*	3.4	2.3		DISEMBARKING: Via Mattei- Sede ADSP	4'346
TOTAL				***266'623***					***554'212***

Table 8 - Number of transits and estimated overall distance travelled by passenger cars, buses and light commercial vehicles in the port area

The estimation of GHG emissions is carried out using values extracted from the database of the average emission factors of road transport in Italy, published by ISPRA (Istituto Superiore per la Protezione e la Ricerca Ambientale) in 2018, as shown in the following table.

Vehicle type	Pollutant	UM	Ref. Year	Value	Source
Passenger cars	CO_2	g/km	2018	167.111	Database of the average emission factors of road transport in Italy (ISPRA, 2018)
	CH_4	g/km	2018	0.010	
	N_2O	g/km	2018	0.005	
Buses	CO_2	g/km	2018	730.221	
	CH_4	g/km	2018	0.078	
	N_2O	g/km	2018	0.018	
Light Commercial Vehicles	CO_2	g/km	2018	248.926	
	CH_4	g/km	2018	0.002	
	N_2O	g/km	2018	0.006	

Table 9 – Emission factors for distance travelled by passenger cars, buses and light commercial vehicles

Overall results

The estimated emissions coming from terrestrial activities in the port area are reported in the following table.

Summary of contributions to the production of greenhouse gases in the terrestrial sector, in the port of Ancona, in 2019		
Category	**t CO_{2eq}**	**%**
Electric energy	541.47	39.4%
Heating	69.80	5.1%
Service vehicles	-	0.0%
Operational port vehicles	-	0.0%
Heavy vehicles	666.07	48.4%
Naval port service (e.g. pilot/tug)	-	0.0%
Railway tractors	-	0.0%
Other (passenger cars, LDVs, buses)	98.40	7.2%
TOTAL	**1'375.74**	**100%**

Table 10 – Terrestrial emissions in the port area by category

About half of the terrestrial emissions are due to heavy-duty vehicles, as shown in the next figure. Electric energy consumption is also responsible for an important part of these emissions while the categories “Heating” and “Other” have a reduced role in terms of emissions.

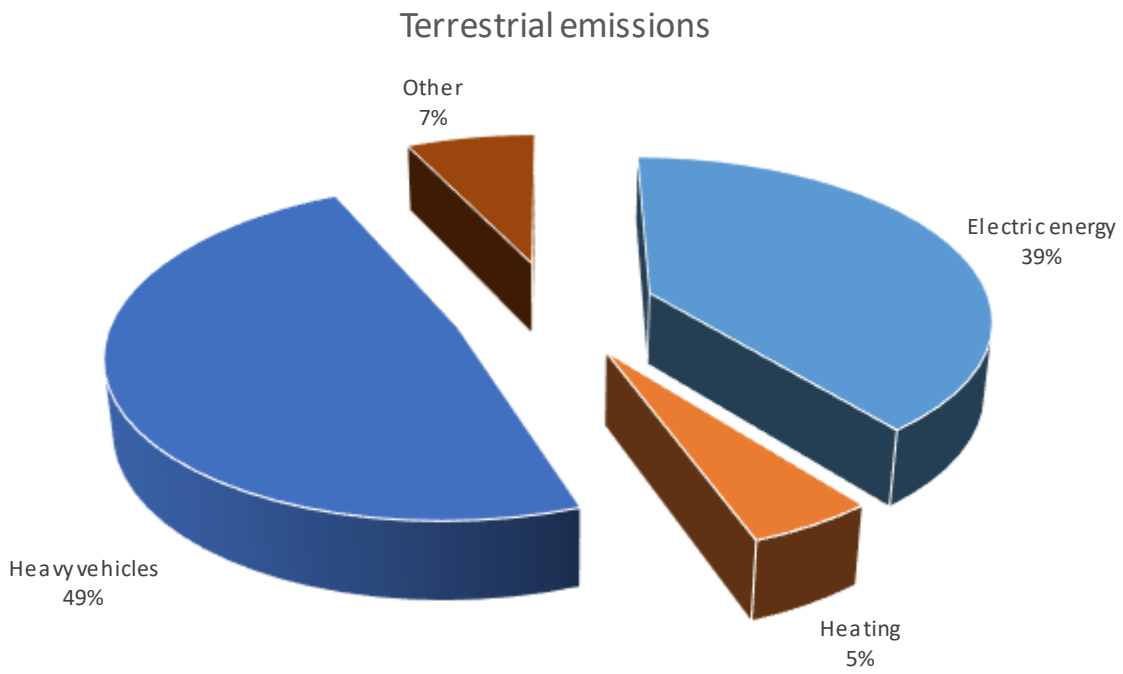

Figure 2 – Percentage distribution of terrestrial emissions by category

Maritime emissions

The methodology for the implementation of the TNA identifies the following key emission categories for maritime emissions:

- Emissions related to the ships anchored nearby the port and waiting for access, not considered in this report;
- Emissions deriving from the manoeuvring phase of the ships up to their arrival at berth and subsequent inverse departure, considered in this report;
- Emissions produced during the mooring phase of the ships at berth, considered in this report.

The calculation of emissions due to ship traffic is based on data collected by Central Adriatic Ports Authority about each ship at berth during the year 2019 (Tier 3): ship name, gross tonnage (GT), mooring/unmooring date and time. Each ship has been classified in the categories set out in the

"EMEP/EEA air pollutant emission inventory guidebook 2019" (1.A.3.d Navigation) to the aim of estimate fuel consumption by category and related emissions during each phase[1]. A brief summary of the main data used to estimate emissions is shown in the following table.

Ship category	Number of ships	%	Total GT	Estimated Total Main Engine Power (kW)	Estimated Total Auxiliary Power (kW)
Liquid bulk ship	52	2.7%	92'768	72'852	21'856
Dry bulk carriers	35	1.8%	163'418	93'828	28'148
Container	331	17.2%	5'911'994	4'826'992	1'206'748
General Cargo	6	0.3%	13'745	9'954	2'289
Ro Ro Cargo	1'209	62.6%	39'051'636	17'606'872	4'225'649
Passenger	54	2.8%	2'901'223	1'915'810	306'530
Fishing	0	0.0%	0	0	0
Other	243	12.6%	1'518'045	1'282'800	448'980
Tugs	0	0.0%	0	0	0
TOTAL	**1'930**		**49'652'829**	**25'809'108**	**6'240'200**

Table 11 - Number of ships that called at the Port of Ancona, total gross tonnage and estimated power by category

The installed main engine power is estimated as a function of the gross tonnage, using statistical 2010 world fleet data from Table 3-12 of the technical guidebook mentioned above, while auxiliary engine power is estimated in proportion of the main engine power using statistical 2010 world fleet data from Table 3-13 of the same document.

[1] **Each vessel that docked at the port more than 4 times in 2019 has been classified in the categories showed in** *Table* ***11*** using data given by the Port Authority and/or obtained from www.vesselfinder.com, covering more than 91% of the total moorings. The remaining vessels have been classified in the "Other" category.

More details on the specific assumptions and emission factors considered for each phase and the results of the estimation are provided in the paragraphs below. In the final section Overall results the estimated emissions coming from terrestrial activities are reported in terms of tons of CO_{2eq}.

Manoeuvring phase

The emissions during the manoeuvring phase are estimated considering the average manoeuvring time expressed by ship category provided in the "EMEP/EEA air pollutant emission inventory guidebook 2019" (1.A.3.d Navigation, Table 3-10), equal to 1 hour for each ship category except of fishing ships and other ships (0.8 and 0.7 h, respectively). The fuel consumption is estimated on the basis of load factors provided by Table 3-15 and specific fuel consumption expressed in g of fuel per kWh, calculated for each ship category from Table 3-10 ("Specific Fuel Consumption for different engine types/fuel combinations and vessel trip phases") and Table 3-7 ("Percentage of installed Main Engine power by engine type/fuel class (2010 fleet)").
The estimation of GHG emissions is carried out using emission factors by engine speed/type and fuel type provided in the "Third IMO (International Maritime Organization) Greenhouse Gas Study" (2014), section 2.2.7, as recommended in the methodology for the implementation of the TNA.

Mooring phase

The emissions during the mooring phase are estimated considering the real mooring time calculated from data collected by Central Adriatic Ports Authority about each ship at berth during the year 2019. The fuel consumption is estimated on the basis of load factors provided by Table 3-15 and specific fuel consumption expressed in g of fuel per kWh, calculated for each ship category from Table 3-10 ("Specific Fuel Consumption for different engine types/fuel combinations and vessel trip phases") and Table 3-7 ("Percentage of installed Main Engine power by engine type/fuel class (2010 fleet)").
The estimation of GHG emissions is carried out using emission factors by engine speed/type and fuel type provided in the "Third IMO (International Maritime Organization) Greenhouse Gas Study" (2014), section 2.2.7, as recommended in the methodology for the implementation of the TNA.

Overall results

The estimated emissions coming from maritime activities in the port area are reported in the following table.

Summary of contributions to the production of greenhouse gases in the maritime sector, in the port of Ancona, in 2019		
Category	**t CO_{2eq}**	**%**
Anchored ships	-	0.0%
Ships manoeuvring	3'576.01	13.1%
Moored ships	23'797.57	86.9%
TOTAL	**27'373.58**	**100%**

Table 12 - Maritime emissions in the port area by category

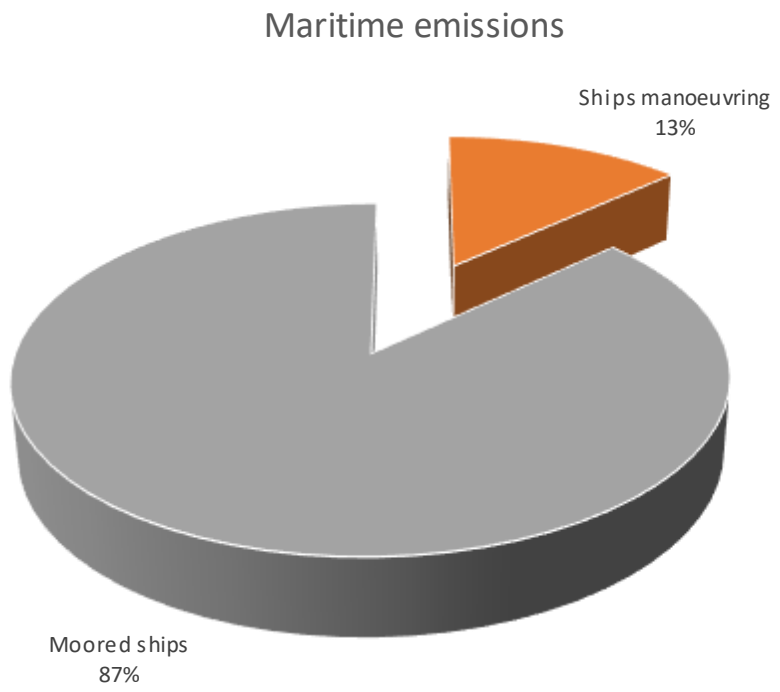

Figure 3 - Percentage distribution of maritime emissions by category

Emissions summary

The total emissions of greenhouse gases related to the port of Ancona are shown in *Table* ***13***. The overall emissions are mainly due to ships at berth, responsible for almost 83% of the total amount, and, generally, maritime emissions represent more than 95% of total emissions. Road traffic in the port area is responsible for less than 3% of total emissions while direct and indirect emissions related to buildings and public lighting plants represent almost 2% of total emissions.

Table of the overall percentage ratios of all GHG Emissions from the Port of Ancona in 2019		
Category	**t CO_{2eq}**	**%**
Electric energy	541.47	1.9%
Heating	69.80	0.2%
Service vehicles		0.0%
Operational port vehicles		0.0%
Heavy vehicles	666.07	2.3%
Naval port service (e.g. pilot/tug)		0.0%
Railway tractors		0.0%
Other	98.40	0.3%
Anchored ships		0.0%
Ships manoeuvring	3'576.01	12.4%
Moored ships	23'797.57	82.8%
TOTAL	**28'749.32**	**100%**

Table 13 - Summary table of direct and indirect emissions from the Port of Ancona, divided by categories and activities, for the year 2019

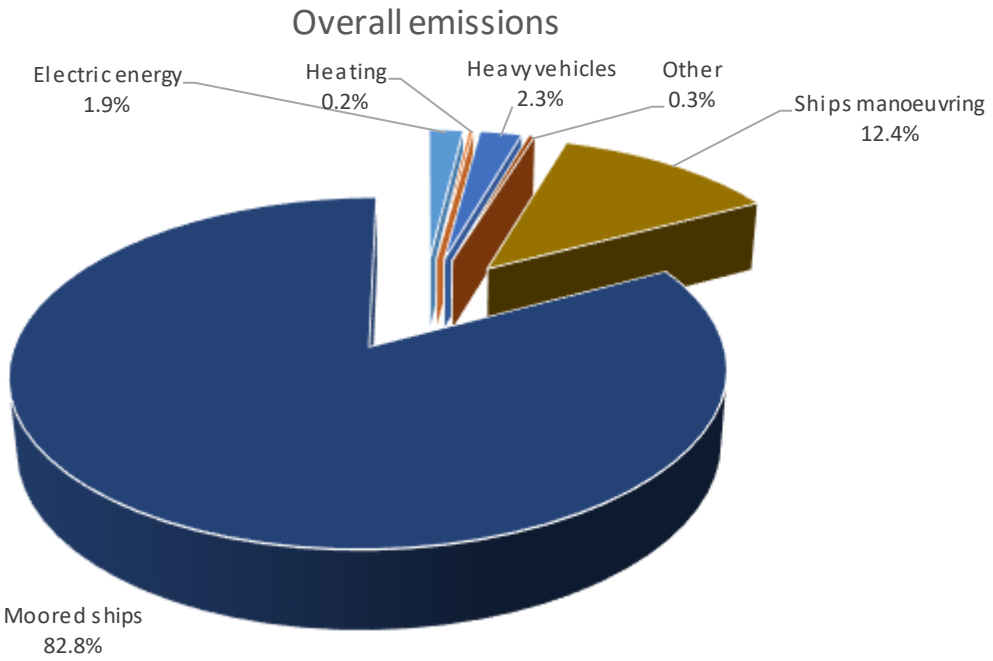

Figure 4 - Percentage distribution of total emissions by category

SWOT Analysis

In the table below, a SWOT analysis is given, identifying key internal and external factors that may be taken into account to achieve the project objectives.

	Positive Impact	Negative impact
Internal factors	**STRENGHTS**	**WEAKNESSES**
	1. Strategic role and position of the port on the Italian Adriatic coast 2. Port Environmental Energy Plan published in 2019 (DPEASP – Documento di Pianificazione Energetico Ambientale del Sistema Portuale)	1. Direct/indirect emissions due to port facilities represent only the 2% of total emissions
External factors	**OPPORTUNITIES**	**THREATS**
	1. Cold ironing of Ancona's port could represent an important opportunity for reducing air pollutant emissions and GHGs emission if electricity is at least partially produced with renewables	1. More than 80% of total emissions of the port are due to ships at berth, that are not under the control of the port authority

Conclusions

In this section the main outcomes of the carbon footprint and SWOT analyses are summarized.
The overall emissions are mainly due to ships at berth, responsible for almost 83% of the total amount, and, generally, maritime emissions represent more than 95% of total emissions. Road traffic in the port area is responsible for less than 3% of total emissions while direct and indirect emissions related to buildings and public lighting plants represent almost 2% of total emissions.
One of the possible solutions that could reduce the amount of emissions of ships at berth, also discussed in the Port Environmental Energy Plan published in 2019 (DPEASP – Documento di Pianificazione Energetico Ambientale del Sistema Portuale), is the electrification of the docks dedicated to the mooring of ships (the so called “cold ironing”). Auxiliary diesel generators that power cargo handling equipment and other ship’s services while in port are the primary source of air emissions from ships at berth; cold ironing mitigates harmful emissions from diesel engines by connecting a ship’s load to a shore-based source of electrical power, such as cogeneration systems or renewable energy plants (e.g. photovoltaic systems), that could drastically reduce the indirect emissions due to electricity consumption. As discussed, this solution could lead to a significant reduction of the atmospheric pollutants emission, of GHGs emission, if partially covered with renewables, and finally also of acoustic impact.