Territorial needs assessment for the Port of Ravenna

Final Version 01/02/2021

Deliverable Number D.3.2.5.

DISCLAIMER

Document Control Sheet

Project number:	
Project acronym	SUSPORT
Project Title	Sustainable Ports
Start of the project	July 2020
Duration	30 months

Related activity:	WP3 A 3.2. – Analysis of the current situation on maritime and multimodal freight transport
Deliverable name:	D.3.2.5 Territorial needs assessment for the Port of Ravenna
Type of deliverable	Report
Language	English
Work Package Title	Cross-border planning of port environmental sustainability and energy efficiency
Work Package number	3
Work Package Leader	Intermodal Transport Cluster

Status	Final
Author (s)	Port of Ravenna Authority
Version	1
Due date of deliverable	01/2021
Delivery date	01/02/2021

Contents

Introduction

The scope of TNA is to assess the state-of-the-art situation in terms of various emissions in the port area of Ravenna.

The methodology to assess the port emissions study refers to the UNI EN ISO 14064 standard, which identifies the equivalent carbon dioxide (CO_2eq) as a unit of measurement for the assessment of greenhouse gas emissions, as established by the Convention on Climate Change (UNFCCC).

Description of the port area

port of Ravenna handles about 5.3% of the goods of the Italian Port Systems and is distinguished by the traffic of solid bulk and packaged goods, for which it holds the greatest handling in absolute terms of tons and in relative terms among all Italian ports: 16.3% of solid bulk and 30.1% of various goods in 2017. Thanks to its strategic position in the Adriatic Sea, and above all to one of the most dynamic economic areas in Italy, the port of Ravenna is one of the hubs of reference for national and international ports; the airport is a leader in Italy for trade with the markets of the eastern Mediterranean and the Black Sea and plays an important role for those with the Middle and Far East.

The Port of Ravenna is administered by the Port System Authority of the central-northern Adriatic Sea (AdSP).

The port of Ravenna is the only large Italian port - canal. Currently, in addition to chemical and petroleum products (one third of the methane gas consumed in Italy is produced by the offshore plants of Ravenna), the traffic embarked and unloaded in the port are, in fact, the raw materials and finished products of the ceramic district, the steel products (in particular coils), timber, fertilizers and agri-food production (cereals and flours, for whose handling the airport is a national leader). Ravenna is also an important commercial port for the various goods and containers handled in the two terminals at its disposal, considering the Eastern Mediterranean Sea and the Black Sea as reference basins.

The Port is also relevant for RO-RO services (Roll-on / Roll-off, i.e. ferries for transporting wheeled vehicles with embarkation and disembarkation methods without the aid of external mechanical means), by virtue of the ferry lines of national cabotage especially on the route to Sicily.

18 licensed and 4 non-licensed port companies operate in the Port of Ravenna.

The Port of Ravenna, which reaches the city and extends for more than 11 km in length from Porto Corsini to the city dock, has transformed over time from an industrial port to a predominantly commercial port, distinguishing itself in the transport of solid bulk cargoes which make up approximately 66% of current port traffic.

It is a canal port with a total of 29 private terminals, 14.5 km of operational docks (out of 24 km available) and depths of -10.20 m. (-11.20 m. In the area up to largo Trattaroli). As regards the infrastructural equipment of the port, the overall capacity of the warehouses is 602.258 sq m, for the yards it is 1.323.922 sq m and with regard to tanks / silos it is over 1.256.298 cubic meters. The port of Ravenna is the only large industrial and commercial port in Emilia Romagna and consists of a main channel, the Candiano Canal, about 12 kilometers long and two secondary ones, Baiona and Piombone.

According to what reported on the port's institutional website, the quays of the canals measure

respectively:

• Canale Candiano, from Porto Corsini to the city dock: 11 km

• Piomboni Canal: 2.5 km

• Baiona Canal: 1 km

Access to the port of Ravenna is allowed to ships with a maximum height not exceeding 55 meters (maximum air draft - vertical distance between the waterline and the highest point of the ship, including antennas). This limitation does not apply to ships operating along the quays up to largo Trattaroli and in the Piomboni and Baiona canals. The Port of Ravenna is now a consolidated port and is home to numerous port and shipping service companies.

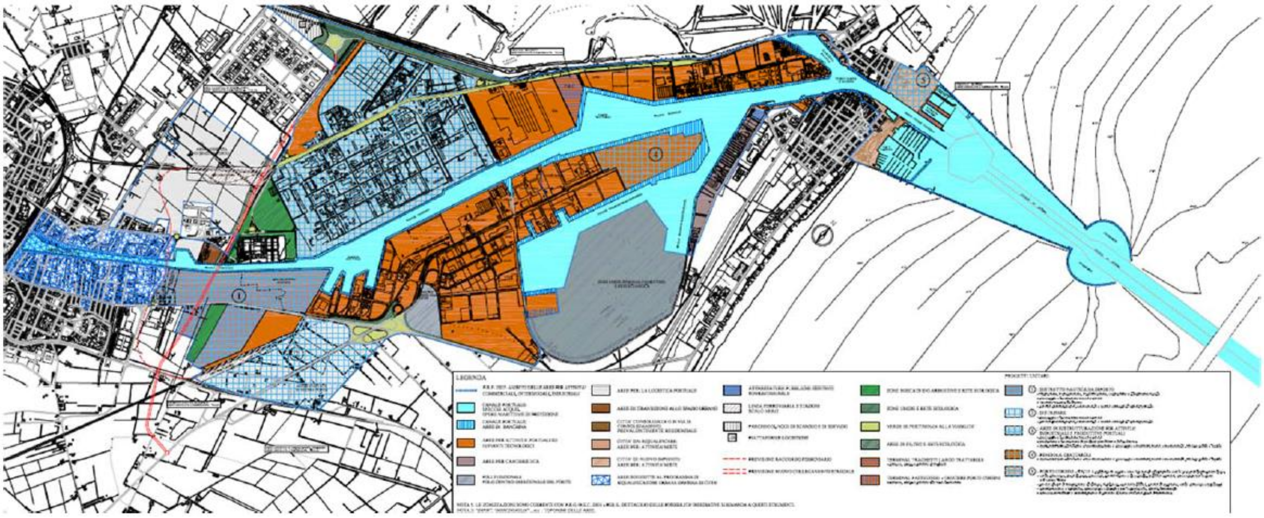

Figure 1: Port's Area

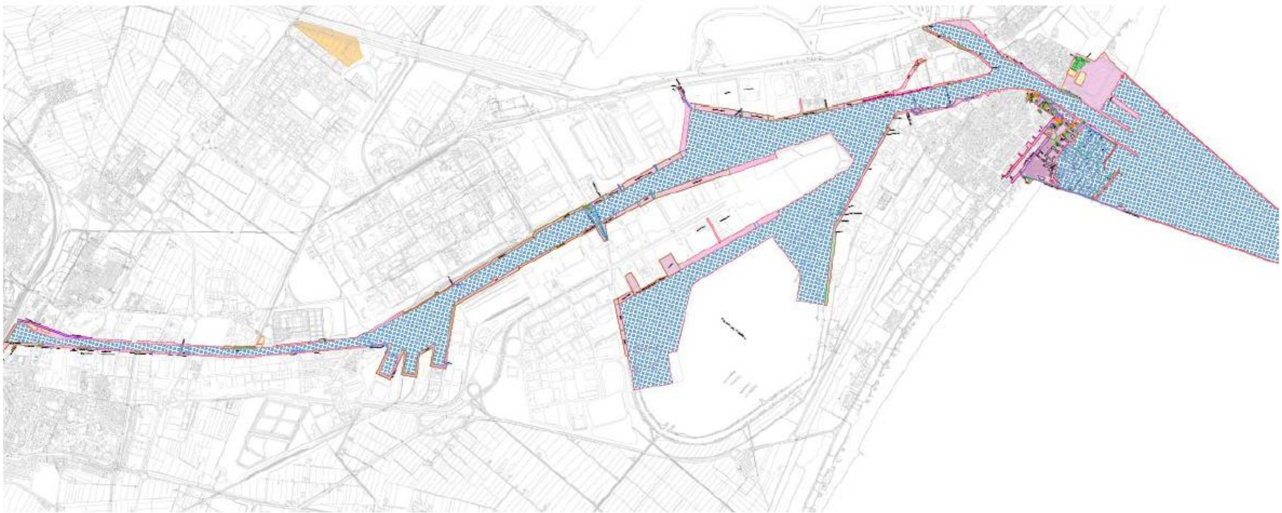

Figure 2: State property area

Mapping out stakeholders

Stakeholders importance mapping

Given that the data useful for calculating the carbon footprint of the Port of Ravenna requires data in the possession of the port authority or dealers, it was decided to involve only these two categories of stakeholders.

		POWER OF INFLUENCE	
		LOW	HIGH
INTEREST	LOW	-	-
	HIGH	Dealers located within the port area.	Autorità di Sistema Portuale del Mare Adriatico centro-settentrionale

Table 1: Stakeholder mapping

Stakeholders involvement strategies

Stakeholder	Role	Importance	Contribution to the project	Benefits	Conflicts	Current Support	Strategies to improve support
Autorità di Sistema Portuale del Mare Adriatico centro-settentrionale	Port Authority	High	Data gathering and data analysis	A complete CFP of the area	None	Participation to data gathering	-
Alma Petroli	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Buzzi	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Coop Portuale Soc. Coop	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Docks Cereali	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
ENEL	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-

EURODOCKS	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Fosfitalia SpA	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Gesmar	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Impresa Compagnia Portuale	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Italterminali Srl	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Marcegaglia	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
La Petrolifera Italo Rumena	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Versalis	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Petra	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
SAPIR	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Terminal Nord	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Bambini Srl	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
TCR	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
YARA	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-

Gruppo Ormeggiatori	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
Nadepovest	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
RavennaTP Srl	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
T&C - Traghetti e Crociere SRl	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
BUNGE	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
CO.FA.RI Soc Coop	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
DOCK ECS	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
IFA	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
LLOYD Ravenna SpA	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-
NADEP	Dealer	Medium	direct information for TNA	Information of main impacts of the area	None	Participation to data gathering	-

Table 2: Stakeholder involvement strategies

Carbon footprint emissions estimation

In order to collect the data from the port authority and dealers, a check list was prepared which was sent to all identified stakeholders (see section 2 - stakeholder mapping). Each subject was asked for the following information:

- Energy consumption of machinery located on the docks of the port (diesel, electricity)
- Energy consumption for dock lighting (electricity)
- Self-production of energy if the company owns a generation plant (e.g. photovoltaic)
- Company vehicles used in the port areas and km travelled each year (type of vehicle fuel)

The port authority instead provided data relating to:

- Direct energy consumption in the buildings of the port authority (electricity)
- Vehicles used by the port authority, km travelled and kind of fuel used by the vehicles
- Number of trains entering the port area
- Number of heavy-duty vehicles entering the port area
- Number of ships and types of ships that have passed through the port

The port authority has identified other useful data such as distances travelled by trains or ships, as well as the time spent by ships in the port.

Terrestrial emissions

Electric energy

For electricity, the actual consumption of both the port authority and the dealers (tier 3) was considered. They are data that have been identified by each individual company and have been calculated using real data.

To calculate the electricity consumption in the docks, the powers of each individual lighting system and machinery (eg cranes, hoppers, etc.) were measured and multiplied by the number of operating hours in 2019. the result obtained is the annual electricity consumption.

*power of the plant / machinery (in kW) * number of operating hours (h) = kWh consumed*

For the calculation of CO2 emissions, the characterization factors of the IPCC 2013 methodology were used.

For electricity, the factors contained in the international database Ecoinvent 3.6 (compliant with the requirements established by the ISO 14064 standard) were used for electricity produced in Italy (Italian energy mix).

The data used therefore consider both direct and indirect emissions in compliance with the provisions of the ISO 14064 standard and the ISO 14040 and ISO 14044 standards for Life Cycle Assessment (LCA) studies which are the basis for calculating the Carbon Footprint.

It should be noted that some stakeholders own photovoltaic systems for the self-production of electricity. Self-produced electricity has been considered in the balance of CO2 emissions with its own emission factor (this emission factor only considers indirect emissions generated by the production and maintenance of photovoltaic panels).

The electricity considered in this study therefore concerns only the lighting and operation of machinery located in the state-owned areas of the port (docks) and not also the consumption of electricity carried out within companies. Energy consumption and also self-consumption through the production of electricity from photovoltaic systems were as follows:

Consumption Areas	kWh - 2019
Energy Mix (dealers)	8,790,742.50
Photovoltaic (dealers)	477,074.51
Energy Mix (Port Authority)	1,643,136.38
Photovoltaic (Port Authority)	39,790.00

Table 3: Electric energy consumption areas in 2019

Heating

No fuel oil or methane consumption for heating was recorded.

In the buildings managed by the port authority, methane is not used for space heating (only electricity is already considered in the previous category).

Service vehicles

Service vehicles are used by both dealers and the port authority.

Primary information (tier 3) was collected from the various stakeholders, considering both the type of fuel used by the vehicles and the number of km travelled by these vehicles within the port area in 2019. Also, in this case the IPCC emission factors were used and the database used is Ecoinvent 3.6 for both petrol and diesel vehicles - European representative data.

As for emissions from electricity consumption, direct emissions from fuel combustion and indirect

emissions from vehicle production and maintenance were considered. The calculation was made starting from the number of km traveled by vehicles within the port area. In particular:

vehicle fuel	km traveled in 2019
Diesel (dealers)	1,377,993
Petrol (dealers)	194.421
Diesel (Port Authority)	21,880
Petrol (Port Authority)	14,900

Table 4: Emissions from types of vehicle fuel in 2019

Port operational vehicles

All operational vehicles are diesel powered (wheel loaders, forklifts, excavators, sweepers, cranes, harbor tractors, etc.).

The consumption of diesel in 2019 per single vehicle was provided by each dealer (tier 3) The consumption of diesel in 2019 per single vehicle was provided by each dealer in litres consumed.

The density in kg of the diesel consumed was equal to 0.835 kg / l and the emission factors considered were essentially 2: a production factor of diesel fuel (in kg) and a factor linked to combustion (Ecoinvent 3.6 data) - European representative data.

The diesel fuel for port operational vehicles was overall of: 5,644,049 lt.Diesel fuel, as well as electricity, only concerns vehicles operating in state-owned areas (docks) and not within each individual company.

Heavy-duty vehicles

Some of the goods transported by sea are handled before their shipment or after their arrival through heavy duty vehicles.

More than 63,000 heavy duty vehicles passed through in 2019 and transported more than 3.5 million tons of goods. Both the number of vehicles and the quantity of goods have been supplied by the stakeholders operating in the port area and are to be considered as data tier 3.

For direct and indirect emissions from vehicles (vehicle construction, maintenance, etc.) reference was made to the Ecoinvent 3.6 database - European representative data.

Not all heavy-duty vehicles travel the same distance within the port area, but trying to use a precautionary approach, an average distance of 7 km was considered (maximum distance that can be traveled from the port entrance).

While for the type of vehicle used, Euro 5 vehicles were considered.

Railway tractors

Within the port area it is also possible to transport goods by train. Only a few dealers use the train for freight transport. The trains entering the port in 2019 were more than 3,500, while the goods transported exceeded 1.5 tons. Also, in this case the information was obtained directly from the stakeholders operating in the port and is to be considered tier 3. The maximum distance that the train can travel is 7 km from the entrance to the port. Although the average distance is usually shorter, the maximum distance of 7 km is considered the same.

Direct and indirect emissions (e.g. use of electricity, maintenance, etc.) generated by the train come from the Ecoinvent 3.6 database - European representative data.

Overall results

The terrestrial emissions generated in the port of Ravenna in 2019 are the following:

Summary of contributions to the production of greenhouse gases in the terrestrial sector, in the port of Ravenna, in 2019		
Category	**t CO2eq.**	**%**
Electric Energy	3,671.86	17.9
Service Vehicles	55.68	0.3
Operational Port Vehicles	12,388.00	60.4
Heavy Vehicles	3,981.37	19.4
Railway Tractors	407.25	2.0
Total	**20,504.16**	**100**

Table 5: Summary of contributions to the production of greenhouse gases in the terrestrial sector, in the port of Ravenna. In 2019

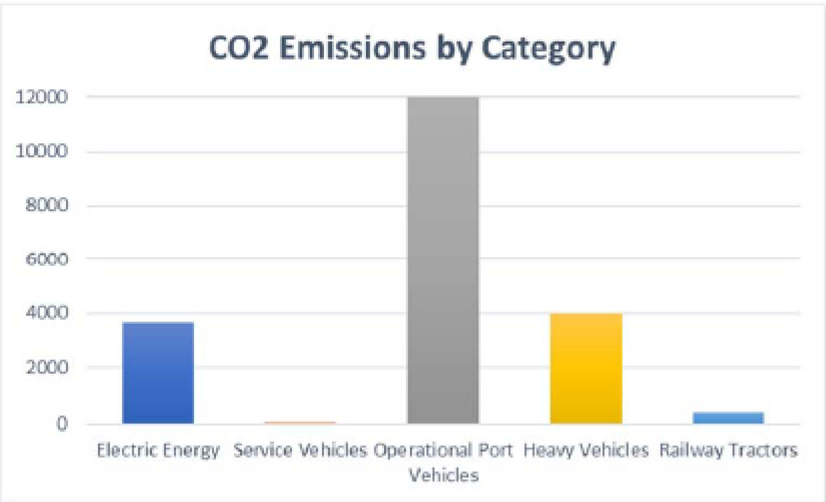

Figure 3: CO2 Emissions by category

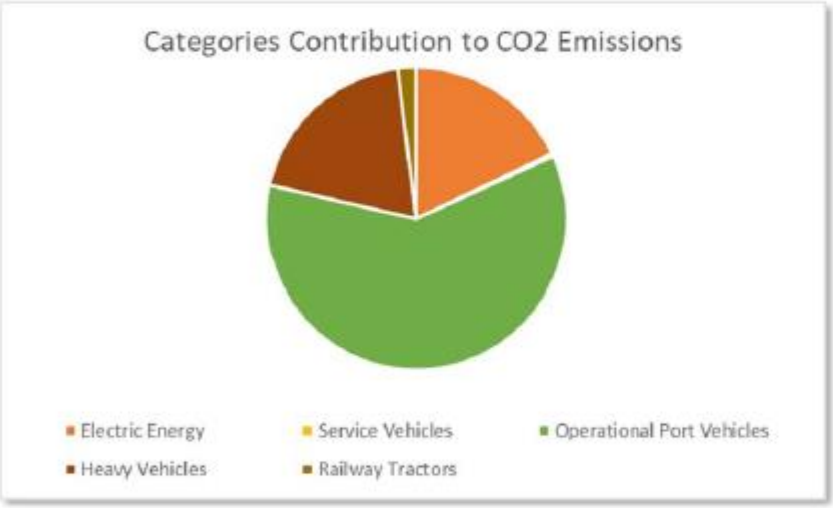

Figure 4: Categories contribution to CO2 Emissions

Maritime emissions

Anchor phase

In the port of Ravenna, ships are unlikely to remain at anchor outside before entering. It was decided not to consider this item on its own in the study as it is negligible and difficult to quantify, therefore the possible time at anchor has been merged with the mooring phase.

Manoeuvring phase

For the emissions generated by the ships in maneuver, the methodology provided by the SUSPORT project was used in the document: Methodology for the implementation of the territorial needs' assessments (D.3.2.1).

The formula for calculating fuel consumption during maneuvering was used:

$$FC(t){=}cl{\cdot}SFOC\ (gkWh){\cdot}P(kW){\cdot}tm(h)/106$$

The table presented in the methodology containing IMO 2014 data was used for the value of SFOC.

The ships entering the port in 2019 were 2,676.

The types of ships that have stopped in the port are:

- Asphalt/Bitumen Tanker
- Bulk Carrier
- Chemical Tanker
- Chemical/Products Tanker
- CO2 Tanker
- Container Ship (Fully Cellular)
- Crew/Supply Vessel
- Crude Oil Tanker
- Crude/Oil Products Tanker
- General Cargo Ship
- General Cargo Ship (with Ro-Ro facility)
- Heavy Load Carrier
- LPG Tanker
- LPG/Chemical Tanker
- Open Hatch Cargo Ship
- Passenger Ship
- Passenger/Cruise
- Passenger/Ro-Ro Ship (Vehicles)
- Products Tanker
- Ro-Ro Cargo Ship
- Vegetable Oil Tanker
- Vehicles Carrier

The number of ships entering the port by type are as follows:

Type of Ship	Number
Asphalt/Bitumen Tanker	8
Bulk Carrier	506
Chemical Tanker	35
Chemical/Products Tanker	481
CO2 Tanker	4
Container Ship (Fully Cellular)	428
Crew/Supply Vessel	1
Crude Oil Tanker	2
Crude/Oil Products Tanker	2
General Cargo Ship	799
General Cargo Ship (with Ro-Ro facility)	3
Heavy Load Carrier	2
LPG Tanker	96
LPG/Chemical Tanker	11
Open Hatch Cargo Ship	6
Passenger Ship	1
Passenger/Cruise	32
Passenger/Ro-Ro Ship (Vehicles)	30
Products Tanker	7
Ro-Ro Cargo Ship	170
Vegetable Oil Tanker	10
Vehicles Carrier	42

Table 6: Number and type of ships entering the porty

All the data were provided by the port authority and on the basis of the data analysed the average manoeuvring time of the ships entering was equal to 2.5 hours. For the power of the ships the 2014 IMO study was considered. The average age of the fleet is 11 years based on a study carried out in European ports. Considering the average data of ships entering Italian ports, the supply of ships was also evaluated: Marine Diesel and Fuel Oil (HFO-MGO) or LNG. Only 3% of the fleet uses LNG, while the remaining 97% uses HFO or MGO. The emission factors always come from the IMO 2014 study, and specifically: 3.114 gr CO_2/gr fuel (for HFO and MGO) and 2.750 gr CO_2/gr fuel for LNG. In addition, there are boats to support the port area (tugs, mooring boats, pilot boats, waste management boats and water cleaning). For these boats, the overall fuel consumption was considered and is part of the maneuvering phase. Consumption estimated on the basis of previous records are as follows:

Type of Ship	lt of fuel
tugs	2.006.282
Mooring boats	19.569
Pilot boats	10.000
Waste and water cleaning boats	104.919

Table 7: Emissions estimated on type of Ship

Mooring phase

The following document was also considered for the calculation of the emissions of the mooring phase: Methodology for the implementation of the territorial needs' assessments (D.3.2.1). The same formula used in the maneuvering phase was used for fuel consumption during this phase. For the SFOC value of boiler and auxiliary engine, the methodology table from IVL 2004 was considered. Mooring time, based on the data provided by the port authority, is estimated on average in 90 hours. The emission factors are the same as those used for the manoeuvring phase.

Overall results

The maritime emissions generated in the port of Ravenna in 2019 are the following:

Summary of contributions to the production of greenhouse gases in the maritime sector, in the port of Ravenna, in 2019		
Category	**t CO2eq.**	**%**
Anchored Ships	-	-
Ships Manoeuvring	32,261.46	37,0
Moored Ships	54,836.33	63,0
Total	**87,097.79**	**100**

Table 8: Summary of contributions to the production of greenhouse gases in the maritime sector, in the port of Ravenna. In 2019

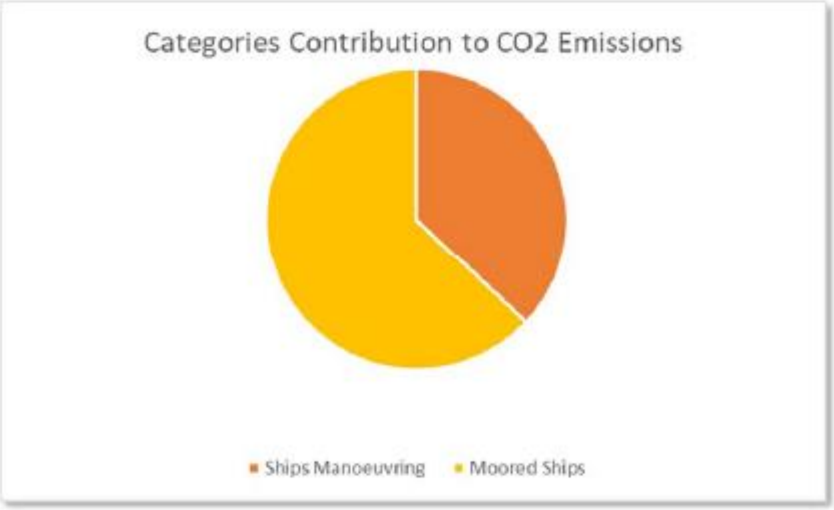

Figure 5: Categories contribution to CO2 Emissions

Emissions summary

The overall results are as follows:

Table of the overall percentage ratios of all GHG Emissions from the Port of Ravenna in 2019		
Category	**t CO2eq.**	**%**
Electric Energy	3,671.86	3.4
Service Vehicles	55.68	0.1
Operational Port Vehicles	12,388.00	11.5
Heavy Vehicles	3,981.37	3.7
Railway Tractors	407.25	0.4
Ships Manoeuvring	32,261.46	30.0
Moored Ships	54,836.33	51.0
Total	**107,601.95**	**100**

Table 9: Overall percentage ratios of all GHG Emissions in the Port of Ravenna, in 2019

As can be seen in the table, about 80% of the emissions generated are due to the maneuvering and mooring of ships. This is attributable to the large amount of fuel consumption of the ships and the number of hours that are in the mooring phase.

Among the most significant terrestrial emissions we have operational port vehicles (cranes, hoists, etc.). These vehicles are mainly diesel-powered and generate more CO2 emissions than other electricitypowered vehicles or other cleaner carburants.

On the other hand, the emissions due to the lighting or operation of electrical equipment and the power supply of heavy-duty vehicles are of lesser impact.

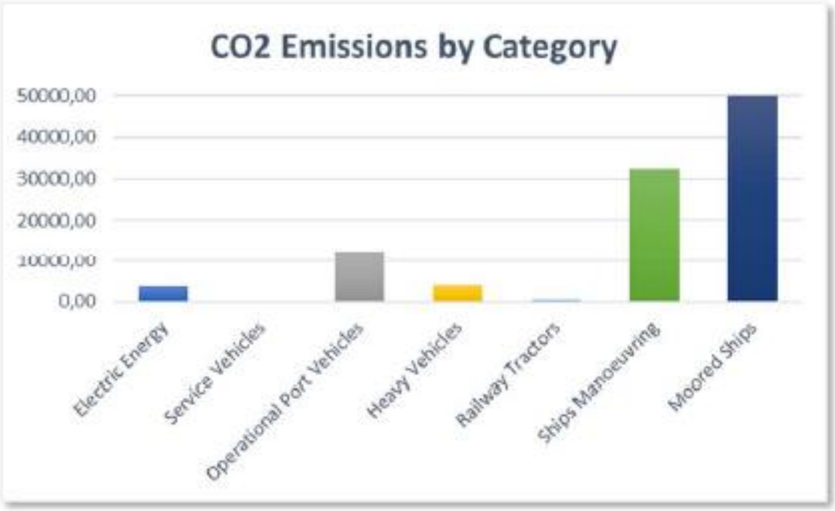

Figure 6: CO2 Emissions by Category

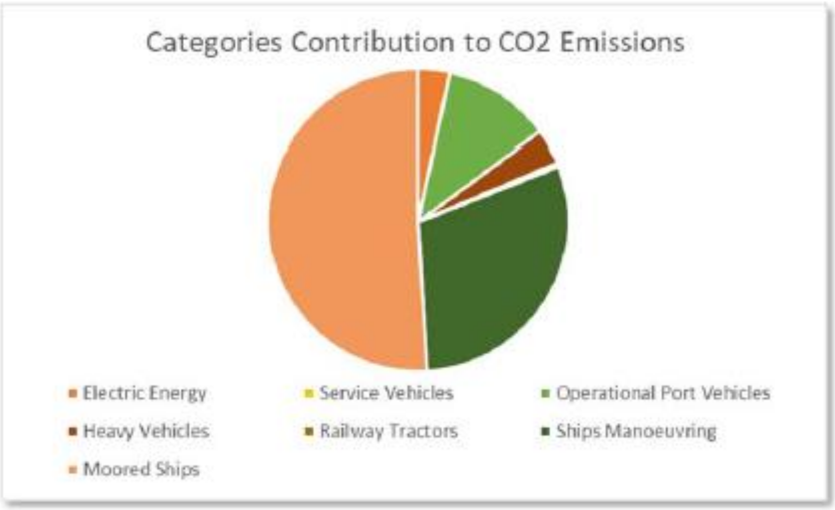

Figure 7: Categories contribution to CO2 Emissions

SWOT Analysis

	Positive Impact	Negative Impact
Internal Factors	STRENGTHS	WEAKNESSES
	1. Several stakeholders of the Port of Ravenna own photovoltaic systems for the self-production of electricity. Such facilities should be supported and other stakeholders encouraged to use them. 2. The service vehicles in the port area do not travel great distances and the impact is reduced. It could still be reduced if hybrid or electric vehicles are used.	1. Most of the operational port vehicles are powered by diesel fuel (fuel which has a higher impact than other fuels). Being machines with a long useful life and very expensive, they could not be replaced as a whole but eventually every time the useful life of one of them ends with another not fueled by diesel.
External Factors	OPPORTUNITIES	THREATS
	1. The average age of the fleet of ships is 11 years and the engines are less polluting than older ships. LNG as a fuel is starting to appear in the supply of ships and its use should be encouraged. 2. Part of the goods handled arriving or leaving the port travels by train. This means of transport should be encouraged as far as possible, i.e. where the infrastructure exists to transport the goods to the final recipient.	1. Most of the emissions generated come from ships at berth. Even if the impact that authorities and stakeholders may have on these emissions is minimal, emission reduction policies could be implemented at the managers of incoming ships or a reduction in the average time at berth with the engines running. A valid alternative could be cold ironing, since it would allow the engines of ships at berth to be turned off. 2. Most of the goods leaving or entering the store arrive by truck (more polluting means of transport than the train). If it is not possible to use a different means of transport, policies of replacing older means of transport with new ones that are less polluting could be encouraged at transport companies.

Conclusions

As already seen in the presentation of the results of the carbon footprint of the Port of Ravenna, the main CO2 emissions are attributable to the maneuvering and mooring phase of the ships entering the port. Port authorities and other port stakeholders have a small margin of impact in deciding how to reduce these emissions. Actions for the reduction of these emissions must involve authorities and subjects at the highest level (eg as European and International bodies). However, communication policies at the local level can be considered as a first step towards reducing maritime emissions.

Other imported emissions concern operational port vehicles since most of them are powered by diesel. As already explained in the SWOT Analysis, these machines have a long useful life and high costs, therefore their replacement with machines with reduced emissions could be not very effective, especially at an economic level. Therefore, one might think of starting to replace some with more efficient ones as they reach the end of their life.

Finally, the emissions completely under control by the port authority or by the port stakeholders concern those deriving from the use of service vehicles or the consumption of electricity in the docks. Although the overall emissions of these two sources are not among the highest, the implementation of improvement actions could give immediate and significant results for the port area. One of these would concern the replacement of diesel vehicles with other hybrids or electric ones, or the implementation of some initiative in the docks that allows to reduce the consumption of electricity, such as cold ironing that could provide shoreside electrical power to a ship at berth while its main and auxiliary engines are turned off. Cold ironing permits emergency equipment, refrigeration, cooling, heating, lighting and other equipment to receive continuous electrical power while the ship loads or unloads its cargo.