Territorial needs assessments of the Ports of Trieste and Monfalcone

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Contents

Introduction

This document illustrates the "carbon footprint" for the ports of Trieste and Monfalcone created within the SUSPORT project, co-financed by the Interreg Italy-Slovenia Program, based on the common methodology developed by WP Leader (D.1.3.2.1).

The port areas to which the analysis refers (see also the graphic representation in the histogram in figure 1) are the following:

1. Scope 1: refers to all direct greenhouse gas emissions by all parties operating within the port area and carrying out activities related to maritime transport or other port-type activities having a direct contractual relationship with AdSP MAO, including transport of products and goods within the port area. Therefore, all industrial production activities and emissions due to the consumption of electricity are excluded.
2. Scope 2: it includes the indirect emissions of greenhouse gases occurring outside the port area, or those due to the consumption of electricity taken from the national grid, by AdSPMAO to serve its own functional needs.
3. Scope 3: it includes all indirect emissions not falling within scope 1 and 2, that is: the electricity consumption due by users operating in the port area, which have been calculated, while the home-work trips of employees and production activities have not been taken into consideration.

The amount of electricity self-produced by the users themselves through renewable sources (photovoltaic systems) was deducted from the electricity consumption due by users operating in the port area. Therefore, the development of greenhouse gases in Area 3 is, in fact, about 23% lower.

Mapping out stakeholders

In order to determine the greenhouse gas emissions in the port area, a data collection system was used for all port users through the implementation of a specific online questionnaire developed on the Open-Source platform called "Limesurvey". This system allowed each participant to access a personalized private area, within which the different types of plant, vehicle or equipment possessed, potentially capable of releasing greenhouse gases, in addition, of course, to the consumption of fuels and energy carriers related to them.

To ensure completeness in the collection of data, a specific questionnaire was prepared and sent aimed exclusively at the category of road hauliers. This questionnaire is much simpler than the one sent to all other port users and is aimed at collecting data on commercial heavy goods vehicles (type, consumption, number of accesses); all referred to the year 2019 and in the two port areas of reference.

It should also be noted that the process of collecting all this information took place with the aid of a "Technical Support" for the compilation activated by the MAO AdSP itself, which operated through direct meetings, public dissemination presentations, by telephone and by e-mail in close connection with port users.

The statistics relating to the participation of all the subjects invited to fill in the questionnaire are shown below in table format.

Users interviewed	Responding users	% complete
1022	816	79.8%

Table 1 - Percentage of replies

Individual questionnaires sent	Individual questionnaires received (complete)	% complete
1183	957	80.9%

Table 2 - Percentage of completion of the questionnaires sent

Analysing the participation of users divided by type, the following results are found:

Type of Users	Users interviewed	Participating users	Percentage of reply
Dealers and tenants	223	173	77.6%
Institutional supervisory and control bodies	29	22	75.9%
Subjects who carry out port services and operations pursuant to Ex Articles 16 of Law 84/1994 and subsequent amendments or ex art. 68 of the Navigation Code	667	595	89.2%

Table 3 - percentage of replies divided by type of users interviewed

With regard to the total number of questionnaires, it should be noted that some of them were only partially completed, as shown below:

Type of Users	Questionnaires sent	Completed questionnaires	Partially completed questionnaires	Percentage of completion *(Complete questionnaires)*	Percentage of reply *(Even partially)*
Dealers and tenants	349	279	46	79.9%	93.1%
Supervisory and control bodies	65	62	2	95.4%	98.5%
Subjects who carry out port services and operations pursuant to Ex Articles 16 of Law 84/1994 and subsequent amendments or ex art. 68 of the Navigation Code	769	616	54	80.1%	87.1%

Table 4 - percentage of completion (even partial) of the questionnaires, broken down by type of user

In relation to users who did not participate in the survey, the estimated values for the production of greenhouse gases attributed were estimated on average to be 2% higher than the values obtained from the completed questionnaires. The overall calculated values are shown in the following table:

	t CO2eq	Percentage
Estimated emission from non-participating users:	3,492.25	2.0%
Total issue (net of estimated values):	169,371.6	98.0%
Total issue (including estimate of non-participants):	172,765.4	100.0%

Table 5 - Emissions and percentages of the extrapolation with estimated by non-participating users

Terrestrial emissions

This chapter reports the results of the study carried out on the greenhouse gases emitted as a result of direct and indirect land-based consumption in the ports of Trieste and Monfalcone in 2019

Summary of contributions to the production of greenhouse gases in the terrestrial area of the ports of Trieste and Monfalcone		
	t CO2 eq	**%**
Electric energy	11,774.1	34.1%
Heating	2,767.9	8.0%
Service vehicles	3,373.7	9.8%
Port Operational vehicles	13,532.0	39.2%
Heavy-duty vehicles	1,693.5	4.9%
Railway Tractors	940.3	2.7%
Other	443.2	1.3%
Total	**34,524.8**	**100%**

Table 6 - Quantity of Greenhouse Gases (in t CO2eq) emitted in the terrestrial area in the ports of Trieste and Monfalcone

The source of the data and the calculation methods of the various emission categories are summarized below:

- Electricity: collection of the declarations of the electricity meter readings in the various PODs (sampling points) of the various users.
- Heating: calculations made on the data provided by users regarding the consumption of fuels burned in heat generators for air conditioning in the workplace.
- Means of service: calculations based on the declarations of users referring to the consumption of fuel for transport, in the port area.
- Port Operational Heavy Vehicles: means the means used in carrying out port activities properly so-called such as: stackers, excavators, forklifts, port tractors, etc. Also in this case, we relied on the statements provided by users through the questionnaire.
- Heavy Vehicles TIR: this category includes emissions due to trucks passing through the port area. The value was calculated in line with the port areas identified according to the criteria set out in the introductory section of this contribution.
- The railway engines surveyed are 6. These vehicles support the logistics and movement of goods within the Port up to the connection with the national railway network.
- The "Other" field includes emissions due to: Current generators or actuators, refills of air conditioners, consumption of other gases not previously included (Methane and LPG for domestic use) and consumption deriving from any companies that manage secondary activities in the field of a concession pursuant to Art. 45 bis of the Navigation Code.

Maritime emissions

Greenhouse gas emissions deriving from maritime traffic in the port area can be divided as follows:

- emissions from commercial maritime traffic (large tonnage vessels).
- emissions from service and support vessels (pilots, firefighters, moorers, tugs, maritime police, etc.).
- emissions from medium and small sized sailing and motor boats.

Below are the results of the study concerning greenhouse gas emissions due to commercial maritime traffic in relation to the ports of Trieste and Monfalcone.

In this study, the following were assessed separately:

- the emissions deriving from the manoeuvring phase of the ships, that is the path from the dams (which delimit the port area towards the open sea) up to the arrival at mooring and subsequent reverse journey of restart of the ship;
- the emissions produced during the actual mooring phase of the ship on the quay, necessary to allow the handling of loading and unloading of goods and / or trailers and / or the transit of passengers.

Total ships by type			
	Trieste	Monfalcone	Tot
General cargo ships	180	568	748
RO-RO ships	660	147	807
RO-RO PAX ships	16	/	16
Bulk Carrier Ships	50	138	188
Passenger Ships	70	/	70
Tank Ships	515	/	515
Container ships	595	4	599
Other	5	4	9
Total	**2.091**	**861**	**2,952**

Table 7 - Number of ships that called at the Port of Trieste and Monfalcone (2019)

The following table summarizes the emission of greenhouse gases expressed in both absolute quantitative terms, i.e. in t CO2eq, and percentages, relating to commercial maritime traffic and divided between the manoeuvring and mooring phases.

Summary of the contributions to the production of greenhouse gases in the maritime sector, of the ports of Trieste and Monfalcone in 2019		
Ship emissions divided by:	**t CO2eq**	**%**
Maneuvering phase	22,820.3	16.7
Mooring phase	114,160.2	83.3
Total	**136,980.5**	**100**

Table 8 - Greenhouse gas emissions of ships in the manoeuvring and mooring phases (excluding port service vessels)

SWOT Analysis

Below is the picture relating to the SWOT analysis with respect to the main solutions currently implemented and those envisaged for the environmental sustainability and energy efficiency of PNAEAS, developed taking into consideration what emerged in the light of the carbon footprint whose contents were addressed and described in the previous contribution.

In order to provide a summary framework consistent with the integrated approach used to enhance the environmental sustainability of the port system, the strengths and weaknesses in achieving environmental sustainability objectives in a unitary whole will be considered in the SWOT analysis.

With regard to the involvement of stakeholders foreshadowed at the drafting date of the project proposal in which the organization of ah-hoc meetings was established, it should be noted that due to the persistence of the global health emergency it has not been possible at the moment to implement these activities, which they will be implemented, if the health framework allows it, during the summer of 2021.

For this reason, in the development of the SWOT analysis presented below, previous experiences acquired in the dialogue with the stakeholders will be used, in particular as regards the work of collecting data on the carbon footprint which, as reported in the previous contribution, involved the whole port community also through the administration of a specific on-line questionnaire developed by PNAEAS.

SWOT analysis	Positive	Negative
Internal	Strategic position as an international hub for intermodal flows between the maritime routes and the European Adriatic-Baltic and Mediterranean corridors; Innovative integrated vision in the path towards the energy transition already recognized as a driving force for the competitiveness and sustainability of the System; Numerous projects in progress and green evolutions planned for tangible and intangible port infrastructures at all levels of the System; High potential for reducing emissions linked to the actions identified by PNAEAS in terms of expected environmental benefits.	High complexity of the integration process of the port areas under the responsibility of PNAEAS; Existence of a plurality of activities and stakeholders active in the port area towards which PNAEAS has the right to support / support the adoption of green solutions (non-binding power on their behaviour); Large transport infrastructures (railways, roads) adjacent to urban areas with a high population concentration; High investments are required. Impact of the port on air pollution and GHG
External	Availability of advanced technologies and "intelligent" devices (ICT) for the optimization of transport systems and for the best management of energy supply; Strong political sensitivity at international, European and national level on environmental policies and towards the prospect of strengthening cooperation between key public and private stakeholders. Incentives and regulatory measures aimed at accompanying the	Changes in traffic with consequent impact on management and forecasting capacity; Shortcomings in the process of adopting internationally recognized and validated standards;

Table 9 - SWOT analysis

Conclusions

Below is a summary table of the total greenhouse gas emissions, both direct and indirect, broken down by category and activity.

The "other" field includes: refills of air conditioners, power generators or actuators, consumption due to any companies that manage secondary activities under a concession pursuant to Art. 45 bis of the Navigation Code and other greenhouse gases, not falling within the categories covered by the questionnaire.

Table of the overall percentage ratios of all GHG emissions from the ports of Trieste and Monfalcone in 2019		
Category	**t CO2eq**	**%**
Electric energy	11,774.1	6.8
Heating	2,767.9	1.6
Service vehicles	3,373.7	2.0
Port Operational vehicles	13,532.0	7.8
Heavy-duty Vehicles	1,693.5	1.0
Naval means of port service	8,652.2	5.0
Railway Tractors	940.3	0.5
Other	443.2	0.3
Anchor phase	1,260.2	0.7
Ships in maneuver	14,168.0	8.2
Ships at berth	114,160.2	66.1
TOTAL	**172,765.4**	**100**

Table 10 - Summary table of direct and indirect emissions from the Ports of Trieste and Monfalcone, divided by categories and activities, for the year 2019

On the basis of the analyses carried out, the first consideration concerns the importance of the most impacting activity in terms of greenhouse gas emissions, which is that deriving from the stationing of ships on the quay, representing 66.1% of the total emissions of CO2eq in the port area.

Another predictable result of the study is that the greatest emissions occur in areas where port activity is most intense.

Focusing on the total greenhouse gas emissions in the terrestrial area recorded in 2019, they amounted to 34,524.8 tCO2eq and represent about 20% of the overall emissions in the port area of Trieste and Monfalcone.

The most relevant emission category in this area is represented by heavy port operating vehicles they produce 13,532 tCO2eq and representing the39.2% of terrestrial emissions, or 7.8% of total emissions. This category includes different types of vehicles such as port stackers (Reach Stacker), port tractors, fifth wheels, diesel forklifts, lifters and any other vehicle used for carrying out the port activity that takes place on the quay including the handling and loading / unloading of goods.

The means of service, understood as cars and trucks, used for the transport of equipment, consumables and workers, also determine a moderate emission of greenhouse gases corresponding to 3,373.7 t CO2eq or 2% of the overall total for 2019 ports of Trieste and Monfalcone. In 2019 for the Port of Trieste alone, this category caused 2,618.7 t CO2eq.

The remaining share of direct emissions in the terrestrial area, therefore excluding the consumption of electricity (indirect consumption), equal to 11,774.1 t CO2eq, corresponding to 34.1% of the land part, is due to the operation of boilers, TIR for freight and railway transport. These direct emissions added together amount to 5,401.7 t CO2eq and represent 20.2% of the emissions occurring ashore, or 3.1% of the overall emissions of the Ports of Trieste and Monfalcone.

With regard to heating systems, the data collected show that there are still 42 plants that use gas (mostly methane) as fuel and 19 plants where the consumption of diesel oil is still present, in the ports of Trieste and Monfalcone. Diesel plants are generally of the more obsolete type and remain in areas not yet served by the methane gas distribution network.

The other categories such as the refills of air conditioners, the consumption of electricity generators (groups portable or fixed generators, or cooking gas represent negligible values both in relation to other emissions (0.3% of the total), and in terms of absolute values (443.2 t CO2eq) and are difficult to reduce.

If we also consider the emissions deriving from the ships in manoeuvre, those of the service boats and port support (tugs, pilot boats, boats of the control bodies such as the Maritime Police, up to

the firefighters, etc.) and the emissions due to yachting tourism, the percentage of emissions originating from maritime traffic rises to 80% of the total, corresponding to an overall quantity of greenhouse gases emitted equal to 138,240.6 t CO2eq.

In the following map (figure 13), the ratio between the direct emissions in absolute value caused by the ships in the various moorings of the Ports of Trieste and Monfalcone in 2019. The value (coloring) obtained measures the average emission for each ship in each berth.

The representation shows that the most significant emissions are those related to the moorings of the tankers positioned at the Mineral Oils Free Point serving the Transalpine Pipeline.

Secondly, considering the absolute values, the second most impactful mooring is that of Pier VII where the container ships dock.

On the other hand, if we consider the emissions subdivided by the number of calls represented by the following map (*figure* 14), the mooring with the highest values is the one in correspondence with the Bersaglieri wharf, where the large cruise ships are stationed, followed by the moorings served by tankers.

Summary of total emissions - direct and indirect - broken down by sector (activities on land and ships at mooring) in CO2 eq				
SECTORS	**Ground activities**	**Ships at Mooring**	**Total Sector**	**%**
Sector 1: PORTO VECCHIO	1,327.2	162.5	1,489.7	1.0%
Sector 2: CITY SHORES	2,832.4	10,393.6	13,226.1	9.2%
Sector 3: PORTO NUOVO	13,152.2	30,998.3	44,150.6	30.6%
Sector 4: SCALO LEGNAMI	4,239.9	2533.7	6,773.7	4.7%
Sector 5: PORTO PETROLI	3,149.7	58,845.9	61,995.6	43.0%
Sector 6: MUGGIA	779.0	/	779.0	1.0%
Sector 7: MONFALCONE	5,227.9	10,521.6	15,749.5	23.7%
TOTAL:	**30,708.3**	**113,455.8**	**144,164.0**	**100%**

Table 11 - Total GHG emissions, both direct and indirect, referring to the land part plus ships at berth

The area including Moli V, VI and VII (sector 3) and therefore substantially the whole area of the New Free Zone, represents the sector with the highest emissions, considering both direct and total emissions (13,152.2 t CO2eqin 2019). If we also take into account the emissions of ships at berth (44,150.5 tCO2eq in 2019), this area is surpassed by sector 5 comprising the Free Point of Mineral Oils and the Navigable Canal area.

The latter is not very emissive if we consider only the "land part" (3149.7 t CO2eq in 2019), while, it reaches the absolute first place among the various sectors if we also consider the emissions of ships at berth: 61,995.6 t CO2eq in 2019. This is caused by the high emissions caused by tankers which are very energy-intensive in the ground pumping phase of hydrocarbons and also by the high number of annual touches at the Transalpine Pipeline terminal that connects the port of Trieste to central Europe and is managed by the Italian Society for the Transalpine Pipeline SpA - SIOT.

The Port of Monfalcone, in terms of direct emissions, excluding ships, generates a quantity of Greenhouse Gas equal to approximately half of Sector 3 of the Port of Trieste (the most impacting for direct emissions from the land part), or 5227.8 t CO2eq. Also including direct emissions from ships, the Port of Monfalcone produces lower emissions than sectors 5 and 3 of the Port of Trieste. This confirms the intense activity carried out by the Port of Monfalcone on the land side but also highlights a reduced activity on the sea side (commercial shipping traffic) when compared with that relating to Sectors 3 and 5 of the Port of Trieste.

Sector 2 (Customs Port and City Shores) is contiguous to the historic center of the city of Trieste, and consists essentially of the city waterfront overlooked by the heart of the city center, "Piazza Unità d'Italia". It includes the Molo dei Bersaglieri, where cruise ships mainly moor, which generate very significant greenhouse gas emissions during the stop and remain moored in the port for several hours. Sector 2 contributes about 9% of total emissions to greenhouse gas emissions: in 2019 it amounted to 13,226.1 tCO2eq.

Sector 4, which is more peripheral, includes the Punto Franco Scalo Legnami, the latter being the industrial metallurgical site called Ferriera di Servola and not directly related to port activity. Merchant ships such as bulk carriers and Ro-Ro arrive at the Punto Franco Scalo Legnami, which are more frequent but stop for shorter times. In this sector, emissions in 2019 amounted to 6,773.7 t CO2eq.

Finally, Sectors 1 and 6, comprising respectively the promenades of Barcola and Muggia, located immediately east and west of the city of Trieste, are the two areas with lower emissions. In these sectors there are almost no moorings for ships, and the activity carried out is mostly of a tourist

nature - pleasure boating with the presence of some marinas and a storage yard in Muggia. The emissions recorded in 2019 were 778.9 and 1,489.6 tons of CO2eq.

It should also be noted that all emissions not attributable to a specific sector of the port area include all the activities of companies that carry out port activities by virtue of being registered in the appropriate registers pursuant to ex art. 16 L. 84/94 subsequent amendments, and pursuant to art. 68 of the Navigation Code, those of pleasure craft and those of service and support vessels such as tugs. By their nature, these types of emissions are not attributable to a particular port area. The absolute value of these direct emissions is equal to 10,713.5 t CO2eq and constitutes approximately 7.0% of the total emissions of the Port of Trieste.

The study as a whole confirms that the activities that generate the greatest emissions in absolute value are precisely the ships at mooring and, “Land side”, the traffic of heavy port operating vehicles.

In conclusion, the data and analyzes of the Carbon Footprint of the MAO AdSP for 2019 confirmed a good performance of the System Authority in terms of greenhouse gas emissions, considering the intense port activity carried out compared to other Italian ports. and in the world.

The present “criticalities” are in fact common and similar to those of the other ports in which the electrical connection systems for the ships on the quay have not yet been implemented and made operational.

Figure *13: representation on a "Traffic Light" type color scale, from Green (lower values) to Red (higher values) of the emissions in absolute value of the ships in the various moorings of the Ports of Trieste and Monfalcone*

Figure 14: representation on a "Traffic Light" type color scale, from Green (lower values) to Red (higher values) of the ratios between the direct emissions in absolute value caused by the ships in the various moorings of the Ports of Trieste and Monfalcone considering the number of ships docked in 2019