Project: SUSPORT

Program: Interreg Italy-Croatia

**Document title:**

**Methodology for the implementation of the territorial needs assessments (D.3.2.1)**

**Reference WP:**

WP 3 Cross-border planning of port environmental sustainability and energy efficiency

Activity 3.2 Analysis of port environmental sustainability and energy efficiency

# Index

# Introduction

The objective of this document is to provide SUSPORT project partners with a common methodological framework including all necessary elements aiming at the preparation of the Territorial Needs Assessment (TNA). In particular, TNA will focus on the inventory of GreenHouse Gases (GHG) - also called "Carbon Footprint" - related to the port area.

The TNA will define the state of each port at the beginning of the project and will provide a first assessment of the needs connected to the energy efficiency enhancement and emissions reduction. To this end, it is essential to assess the current status of the port emissions, to map the key stakeholders and combine these outcomes to identify opportunities and risks which might affect the subsequent phases of the project.

The methodology to assess the port emissions study refers to the UNI EN ISO 14064 standard, which identifies the equivalent carbon dioxide (CO2eq) as a unit of measurement for the assessment of greenhouse gas emissions, as established by the Convention on Climate Change (UNFCCC).

The principles to be followed for the preparation of the GHG (Green House Gases) inventory are defined by the UNI EN ISO 14064 standard and are as follows:

- Relevance: the final result of the evaluation must represent an understandable and reliable basis for subsequent decisions.
- Completeness: the completeness of the Carbon Footprint report must include all sources of port emissions within the pre-established boundaries. All important steps and possible exclusions must be reported and justified.
- Consistency: consistency in applying the methodology is important to obtain a meaningful comparison of information related to greenhouse gases over the years. Any change (in data, boundaries, factors, etc.) must be documented transparently.
- Transparency: all issues relating to the carbon footprint report must be documented effectively and consistently, based on verification. Any assumptions or forecasts must be made public and the sources used for the data and methodologies must be indicated.
- Accuracy: the quantification of greenhouse gas emissions must be as realistic as possible, i.e. the level of uncertainties must be reduced as much as possible.

For the realization of the document concerning the TNA, for each port, a document must be drawn up as specified in the present methodology.

# 1. Scope of study

The scope of TNA is to assess the state-of-the-art situation in terms of various emissions in the port area. This initial status will be the base for the development of the next phases and the evaluation of project impacts.

To support overall assessment, the involvement of key stakeholders is essential. Hence, TNA will elaborate a complete mapping of the local stakeholders in terms of their relevance. Moreover, actions for their active involvement shall be agreed and defined.

Energy consumption data relating to the following elements and activities shall be collected and reported in each port:

1) Buildings in the port area;
2) Management and maintenance of common parts in the port area;
3) Port terminals (passenger/freight);
4) Road service mobility within the port;
5) Commercial vessels at anchor;
6) Commercial and service vessels, in the mooring phase;
7) Commercial and service vessels during manoeuvre and navigation in the port;
8) Intermodal road/rail terminals in the port area.

Industrial activities that are not related to maritime transport are excluded from the study, even if located within the area defined by the Port Master Plan.

The various types of consumption and categories of emission sources are as follows:

- Electricity consumption from the energy network
- Boilers or Heat Generators
- Generating Sets or Actuators
- Conditioners or Cooling Groups
- Service Vehicles – e.g. cars belonging to the Port Authority
- Heavy-duty vehicles
- Motorized Marine Vehicles
- Railway tractors
- Fire-fighting systems using greenhouse gases
- Ownership and/or management of berths (marina)
- Production of oily liquid waste (Sludge)
- Production of electricity or heat from renewable sources
- Other Possible Gases for uses other than those previously defined

Ports'main features, stakeholders and the GHG inventory would be combined to analyse the factors having an influence on energy efficiency and emissions in the port area. This target is pursued employing the Strengths Weaknesses Opportunities and Threats (SWOT) analyses.

# 3. Time Frame

When employing the proposed framework methodology, the year before the current one shall be considered. In the present study, carried out in 2020, the **data related to 2019** shall be collected and used.

# 4. Index of the TNA deliverable

Based on the methodology oulined hereinafter, each port will provide a document with the following index. TNAs from project partners will then be consolidated by Activity Leader (D.3.2.14):

1. Introduction
   a. *Description of the port area (inlcuding port statistics and future scenarios)*
2. Mapping out stakeholders
   a. *Stakeholders importance mapping*
   b. *Stakeholders involvement strategies*
3. Carbon footprint emissions estimation
   a. *Terrestrial emissions*
      i. *Electric energy*
      ii. *Heating*
      iii. *Service vehicles*
      iv. *Port operational vehicles*
      v. *Heavy-duty vehicles*
      vi. *Railway tractors*
      vii. *Other*
      viii. *Overall results*
   b. *Maritime emissions*
      i. *Anchor phase*
      ii. *Manoeuvring phase*
      iii. *Mooring phase*
      iv. *Overall results*
   c. *Emissions summary*
4. SWOT Analysis
5. Conclusions

# 5. Introduction content

The introduction shall present the port area analysed in the TNA and its main statistics related to the year 2019. The introduction shall thoroughly define the TNA context (the port area) and its extension and its interconnection with the onshore infrastructures and with the open sea.

The description of the port area shall include port facilities and cargo handling capability. The port terminal(s) area shall be highlighted in on one or more maps, pointing out the interconnections with different transport modes (railways, main roads, canals, etc.).

Moreover, main statistics about port activities and cargo flows related to the year 2019 shall be reported. It is suggested statistics to follow the ESPO format, which is common to all the ports.

Finally, each port shall describe their current environmental policy.

# 6. Mapping out stakeholders

This section deals with the mapping of major stakeholders in the programme area as a key element for their involvement in the project as well as for project results'dissemination. Each port shall identify key stakeholders in their area and contact them through ad-hoc meetings. An organisation is considered key stakeholder if can be interested in and/or influence the project activities as well as if can affect the project activities or results. Two tables have to be included in the TNA document for each specific port involved in the project. The first table maps stakeholders according to their influence on the project and their level of interest in the project (Tab. 1).

*Tabel 1 – Stakeholders mapping due to importance*

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="2">POWER OF INFLUENCE</td></tr>
<tr><td>LOW</td><td>HIGH</td></tr>
<tr><td rowspan="2">INTEREST</td><td>LOW</td><td>Marginal Stakeholders<br>Importance = Low</td><td>Relevant Stakeholders<br>(e.g. Institutions we would like to involve)<br>Importance = Medium/High</td></tr>
<tr><td>HIGH</td><td>Operative Stakeholders<br>(stakeholders we must involve)<br>Importance = Medium/High</td><td>Key Stakeholders<br>(Essential to project outcomes)<br>Importance = High</td></tr>
</table>

Stakeholders can also be mapped according to their role and the benefit (or conflicts) they involvement could bring. The current involvement and strategies to improve their support should also be taken into consideration, filling Table 2.

*Table 2 – Stakeholders involvement strategy*

| Stakeholder | Role | Importance[1] | Contribution to the project[2] | Benefits[3] | Conflicts[4] | Current support | Strategies to improve support |
|---|---|---|---|---|---|---|---|
| **Name 1** | type | … | | | | | … |
| **Name 2** | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

# 7. Carbon footprint emissions estimation

Since SUSPORT project aims to enhance energy efficiency and reduce emissions in the port areas, a preliminary assessment of the current situation is necessary. In the following, methods are described and suggested to be employed by project partners to estimate the GHG inventory.

## 7.1 Calculation methodology

Based on the data collected from each port area, the processing of the information and the actual emissions calculations shall be carried out following the indications of the IPCC (2006) and EMEP/EEA (2019).

These reference documents provide approximation levels of the calculations, the so-called Tier, which are explained below. The Tier, or calculation levels, defined by the IPCC (2006) and by the EMEP/EEA (2019) are

[1] High, medium, low
[2] Which contribution they provide to the project
[3] Which benefits they get from participating
[4] Potential, existing

three different levels of accuracy of the calculation or estimate of the GHG emissions relating to an area or activity. The simplest and, therefore, the most estimated and least accurate is Tier 1; the most complex and accurate is Tier 3; Tier 2 is a middle ground between Tier 1 and Tier 3.

Depending on the "level of importance" of the emission source, "Key Categories" are identified for each subject, which defines the maximum level of Tier reachable according to the data availability. In the case of the present study, each emission source attributable to a certain port user shall be treated as a "Key category", trying, as far as possible, to collect the data in the most complete and precise way possible.

The EMEP/EEA (2019) states that:

In the case of the Tier 1 calculation level, a simple linear correlation is applied between the activity data and the emission factor. The activity data is derived from already available statistical information (energy, production, traffic counting, etc.). The emission factor chosen for Tier 1 must represent the "typical" or "medium" process conditions.

In the case of the Tier 2 calculation level, the same (or similar) activity data is used (statistical, estimated or average), but more specific emission factors are used (by state or geographical area for example). These factors must be chosen taking into account specific information related to the given nation or geographical area being considered and which concern, for instance, process conditions, fuel quality, emissions abatement technologies, etc.

The Tier 3 calculation level is more accurate than the previous ones as it includes the consumption data directly recovered from the activities under analysis, i.e. detailed information on consumption and fuels, or complex estimation models. The processes leading to the definition of the issue are described with accuracy and in detail.

The EMEP/EEA (2019) methodology prefigures two possible procedures for estimating emissions into the atmosphere: top-down ("from top to bottom") and bottom-up ("from bottom to top").

The top-down approach starts from the wider spatial scale (e.g. national) and descends to lower levels (regions/provinces/municipalities), using some surrogate variables chosen from the statistical indicators available for the spatial scale of interest, which must be as much as possible related to the emission process considered (e.g. for macro-sector activities: Combustion - Energy and transformation industry, fuel consumption is generally used as a surrogate variable).

The bottom-up approach, on the other hand, starts from the analysis of the local production reality and moves on to that related to higher aggregation levels. In this second case, for example, the emission produced in an industrial district is reconstructed for all the chimneys and other widespread sources relating to each production plant.

### 7.1.1 Methodology for calculating the emission of greenhouse gases deriving from combustion

The formula used to calculate the emissions is the following:

$$Emission_{(g,s,c)} = AD_{(s,c)} \cdot EF_{(g,s,c)}$$

which assesses the emission (quantity) of gas "g", produced by a certain source or emission source "s", from fuel "c".

The $AD$ or Activity data value is the information relating to the activity (more simply the total consumption or the energy produced), referring to a certain time extension within which the activity under analysis takes place, of a certain fuel "C", used by the source or emission source "s".

The $EF$ coefficient or Emission Factor quantifies the emission (or removal) of the gas "g" analyzed, referring to the $AD$ activity taken into consideration, the source "s" and for a certain fuel "c". These coefficients are measured, updated and collected in tables made available by various institutes such as ISPRA, IPCC and EMEP/EEA. The Emission Factors approximate the oxidation coefficient of carbon to 1. This approximation is acceptable, considering that on average the quantity of non-oxidised carbon represents less than 1% of the total.

In particular, the IPCC (2006) states: "*Guidelines for National Greenhouse Gas Inventories" read: "CO2 emissions depend almost entirely on the carbon content of the fuel, although a small amount of carbon is un-oxidized (less than 1%) ... During the combustion process, most carbon is immediately emitted as CO2 regardless of combustion technology… By default the 2006 IPCC Guidelines assumes a complete combustion process (100% carbon conversion or oxidation fraction is 1)* ".

Having verified that almost all the $EF$ coefficients present in literature are provided in terms of tons of CO2eq per TJ (Tera Joule) of fuel (instead of the quantity of fuel) it is necessary to use the $PCI$ (Lower Calorific Value) as well as the standard densities $\rho$ for liquid and gaseous fuels, to preliminary transform the data related to the consumption of a certain fuel into energy produced by its combustion.

In fact, to obtain the energy expressed in TJ, it is necessary to multiply the quantity of a certain fuel consumed, expressed in kg or tons, by the $PCI$ (Lower Calorific Value), expressed in TJ per tonne.

The density and Lower Calorific Value parameters shall be also taken from official ISPRA or IPCC publications.

From the multiplication of $AD$ expressed in TJ by the corresponding $EF$ coefficients, expressed in tons of CO2eq per TJ for each of the three gases produced (Carbon Dioxide, Methane and Nitrous Oxide), the emission value (quantity) of the 3 is obtained gases considered referring to the type of fuel, the specific emission source and the reference period.

These quantities of greenhouse gases emitted are converted into CO2eq through the $GWP$ (Global Warming Potential) indices taken from IPCC (2014). Therefore, the calculated amount of CO2eq represents the total greenhouse gas emission caused by the consumption of fuels in the geographical (port area) and time (the year 2019) considered.

This method shall be used for all emissions due to combustion, parameterizing the consumption data with the corresponding $EF$ referring to the specific emission source.

### 7.1.2 Methodology for calculating the direct emission of greenhouse gases

As for the greenhouse gas emissions not deriving from combustion, but caused for example by leaks of refrigerant gases or gases contained in fire extinguishing systems, the information shall be collected on the refills of gas carried out at the aforementioned plants in 2019, with an indication of the gas actually used. Each refill obviously corresponds to a similar quantity of dispersed gas.

In this case, the calculation is even simpler as it is sufficient to multiply the quantities of gas released into the atmosphere by its characteristic $GWP$ (Global Warming Potential) index (IPCC, 2014). In the case of gas mixtures, the corresponding $GWP$ index is obtained with the weighted average of the $GWP$ of the individual gases making up the mixture in proportion to the weight of each of them.

### 7.1.3 Methodology for calculating the emission of greenhouse gases from electricity consumption

The electricity consumption declared by users and connected to the respective supply points shall be compared with those supplied directly by the company that supplies the electricity. In the event of deviations of more than 10% between what has been declared by users and what has been detected by the electricity supplier company, the consumption declared by the individual port user will be replaced with that supplied by the local distributor in order to correct any errors in the insertion of the consumption data at the time of declaration by the user.

In order to transform the electricity consumption into t CO2eq, information and sources employed by energy suppliers should be usefully adopted to feed the GHG inventory. They should be reported in an annex of the TNA. Alternatively, estimation should be made based on the regional or national energy sources adopted for electric generation.

### 7.1.4 Methodology for calculating the emission of greenhouse gases from road freight traffic

The calculation of the emissions due to freight trucks transited in the port area in 2019 is carried out by collecting information on the number of transits from multiple sources and comparing the values obtained in order to validate them.

The number of transits is multiplied by an estimated average route inside the port to reach the relevant passage; in relation to the emission Factor measured in kg of greenhouse gas per km and the Tank-to-weels parameter called $eT$. The emission factor can be found in ISO EN 16258: 2013 (Methodology for the calculation and declaration of energy consumption and greenhouse gas emissions (GHG) of the transport services, freight and passengers). The $eT$ is the emission due only to the consumption of the vehicle, without considering the production and supply of fuel assuming the use of diesel fuel in a form not mixed with biofuels.

An estimated percentage of 5.6% shall, then, be added to the result of the calculation of the emissions carried out with the criteria referred to in the previous paragraph with respect to the calculated total, due to the stops and manoeuvres of the trucks in the port area (Jääskeläinen, 2017).

### 7.1.5 Methodology for calculating the emission of greenhouse gases from ship traffic

The data necessary for the calculation of the Carbon Footprint can be acquired and processed through Activity Data estimates supported by real information relating to the movements of the ships in the port area, for instance, through the PCS or the port pilots. Thus, collected data shall be processed for the purpose of a detailed and disaggregated calculation of all the emissions due to each ship category, considering also the fuel type. In what follows, some useful information and methods are suggested to support project partners.

Usually, freight ships adopt slow-speed 2-stroke main engines directly connected to the shaft line and propeller. These engines usually adopt Heavy Fuel Oil (HFO). In addition, they are equipped with auxiliaries including medium/high-speed 4-stroke engines for electric generation and steam boilers. The auxiliaries often adopt Marine Diesel Oil (MDO). Passenger ships differ, since have higher power demand even at berth due to passenger accommodations. Usually, the main engines of passenger ships are medium-speed 4-stroke engines using HFO or MDO. Most of recent cruise vessels adopts a diesel-electric propulsion system where electric motors are connected to the shaft lines and electric generation is assured by medium-speed diesel engines. Finally, small service boats might use lighter fuels, such as diesel, and usually have does not present emissions while are moored but only during operation.
The Emission factors in kg of greenhouse gas per fuel tonne can be found in IMO (International Maritime Organization) documents (IMO, 2014 – section 2.2.7) for different gases, fuel type and engine speed. Recently, the adoption of Liquefied Natural Gas (LNG) as maritime fuel is increasing. In the Mediterranean sea, the LNG bunkering facilities are mainly still under development. However, if any LNG powered vessel visited the port under analysis in 2019, the emission factors for LNG shall be adopted. Emissions factors for LNG can be found in IVL (2019).
The emissions factors shall be multiplied by the fuel consumption in the port area. If available, the actual fuel consumptions in the port area should be used applying the top-down approach. For instance, for service vessels directly operated by the port or a port subcontractor, bunkering records provide the most accurate metric to evaluate emissions (considering the ship engine(s) type as stated in IMO, 2014).
For commercial ships, data regarding actual fuel consumption in a specific port area are usually not available. Hence, it is necessary to estimate the fuel consumption from operations' records applying the bottom-up approach. Starting from data about commercial ship traffic in the port, the time spent at anchor $t_a$, moored at berth $t_b$ and in manoeuvring $t_m$ shall be determined for each ship entering the port in 2019. Moreover, for manoeuvring phases, the actual speed $V$ and draught $T$ of the vessel shall be also determined or estimated. Moreover, the essential ship data shall be acquired from databases (e.g. IHSF technical specifications), including the installed power (main engine Maximum Continuous Rating $MCR$), and the maximum speed $V_{max}$ and draught at maximum speed $T_{max}$. If these data are not available, another known condition characterised by a reference engine power $P_{ref}$ at a reference speed $V_{ref}$ and draught $T_{ref}$ can be used instead. If no data regarding a specific ship are available, $V_{ref}$ and $P_{ref}$ shall be taken as the mean values related to ship type and deadweight class provided by IMO (2014) – Annex 2. In such a case (Jalkanen et al., 2009):

$$V_{ref} = design\ speed\ (kn) \qquad P_{ref} = 0.80 \cdot Installed\ Power\ (kW)$$

For a ship in manoeuvring phase the actual propulsion engine power can be estimated according to the Admiralty formula:

$$P(kW) = P_{ref} \cdot \left(\frac{T}{T_{ref}}\right)^{\frac{2}{3}} \cdot \left(\frac{V}{V_{ref}}\right)^{3}$$

In order to obtain the fuel consumption $FC$ due to propulsion in manoeuvring phase, the actual engine power $P$ shall be multiplied by the specific fuel consumption $SFOC$ and the manoeuvring time $t_m$ at a defined speed:

$$FC(t) = \frac{c_l \cdot SFOC\ \left(\frac{g}{kWh}\right) \cdot P(kW) \cdot t_m(h)}{10^6}$$

where $c_l$ is a correction factor taking into account the $SFOC$ increment at low engine loads. For diesel-electric propulsion systems, $c_l = 1$. For diesel-mechanic propulsion systems, according to Jalkanen et al. (2012) the $c_l$ can be modelled as parabolic:

$$c_l = 0.455 \cdot load^2 - 0.71 \cdot load + 1.28 \quad \text{with} \quad load = \frac{P(kW)}{MCR(kW)}$$

Table 6 provides the baseline values of $SFOC$ for marine propulsion engines due to their age that can be applied if technical data of installed engines are not available.

*Table 6 –SFOC baseline values for propulsion engines in g/kWh (IMO, 2014)*

| **Engine age** | | $SFOC\ (g/kWh)$ | |
|---|---|---|---|
| | **Slow-speed** | **Medium-speed** | **High-speed** |
| Before 1983 | 205 | 215 | 225 |
| 1984-2000 | 185 | 195 | 205 |
| After 2001 | 175 | 185 | 195 |

In all the operation modes (anchor, manoeuvring and moored) the auxiliaries emissions shall be also considered, including the one coming from auxiliary engines and auxiliary boilers. The power demand depends upon the operation mode, the ship type and its deadweight. Auxiliaries' power demands can be taken from IMO (2014) – Annex 1. Then, to obtain the related fuel consumption, the power demand shall be multiplied by the operation duration $t_i$ and $SFOC$, taken from Table 7 and assumed independent from engine load ($c_l = 1$).

*Table 7 –SFOC values for auxiliary systems in g/kWh (IVL, 2004)*

| **Engine age** | | $SFOC\ (g/kWh)$ | |
|---|---|---|---|
| | **HFO** | **MDO** | **High-speed** |
| Gas turbine | 305 | 300 | 225 |
| Steam boiler | 305 | 300 | 205 |
| Auxiliary engine | 225 | 225 | 195 |

## 7.2 TNA content

The GHG inventory included in TNA shall be composed by 3 subsections:

- Terrestrial emissions: related to the relevant emissions sources on land-side of the port area;
- Maritime emissions: related to the relevant emissions sources on sea-side of the port area (emissions from all the ships and boats within the port area during anchor, manoeuvring and mooring phases);
- Emission summary: including an overall summary of all the emissions for the considered port.

### 7.2.1 Terrestrial emissions

Concerning onshore activities in the port area, the following key emissions categories shall be considered in the GHG inventory:

- Electric energy
- Heating
- Service vehicles
- Port operational vehicles
- Heavy-duty vehicles
- Railway tractors
- Others: including the emissions due to power generators or actuators, recharges of air conditioners, consumption of gas not previously entered (Natural gas and LPG for domestic use)

In order to employ an effective common methodological approach, a subsection should be included in the TNA for each key category to ensure comparable results among partners. Subsections should include:

- A description of the specific data sources employed;
- A description of methods and tools for data collection (if deemed more effective, they can be also reported in annexes);
- The specification of the adopted calculation tier as defined by IPCC (2006);
- A description of all the methodological assumptions and parameters employed (e.g. type of gases, emission factors, average routes inside the port areas, activity values, etc.);

In the final section “Overall results” the estimated emissions coming from terrestrial activities shall be reported in terms of t CO2eq and in percentage (e.g. Tab. 3).

*Table 3 - Sample of table mapping overall terrestrial emissions*

| **Summary of contributions to the production of greenhouse gases in the terrestrial sector, in the port of XXXXX, in 2019** | | |
|---|---|---|
| **Category** | **t CO2eq** | **%** |
| Electric energy | | |
| Heating | | |
| Service vehicles | | |
| Operational port vehicles | | |
| Heavy vehicles | | |
| Naval port service (e.g. pilot/tug) | | |
| Railway tractors | | |
| Other | | |
| **TOTAL** | | |

### 7.2.2 Maritime emissions

Concerning maritime activities in the port area, the following key emissions categories shall be considered in the GHG inventory:

- Ship waiting time at sea: emissions related to the ships while anchored nearby the port and waiting for access;
- Ships manoeuvring: emissions deriving from the manoeuvring phase of the ships up to their arrival at berth and subsequent inverse departure of the ship;
- Moored ships: the emissions produced during the actual mooring phase of the ship at berth, including waiting and cargo loading and unloading operations (e.g. goods and/or trailers and/or the transit of passengers, etc.).

For each key category, a subsection should be included in the TNA providing relevant information, namely: A description of the specific data sources employed;

- A description of methods and tools for data collection (if deemed more effective, they can be also reported in annexes);
- The specification of the adopted calculation tier as defined by IPCC (2006);
- A description of all the methodological assumptions and parameters employed (e.g. type of gases, emission factors, average or effective routes/times inside the port areas, activity values, etc.);

Moreover, the analyses shall include and report both:

- Emissions from commercial maritime traffic (Passenger/Freight);

- Emissions from service and support vessels (Pilots, Firefighters, Moorers, Tugboats, Maritime Police, Bunkering vessels, etc.).

In the final section "Overall results" the estimated emissions coming from waterborne activities shall be reported in terms of t CO2eq and in percentage (e.g. Tab. 4).

*Table 4 - Sample of table mapping overall maritime emissions*

| **Summary of contributions to the production of greenhouse gases in the maritime sector, in the port of XXXXX, in 2019** | | |
|---|---|---|
| **Category** | **t CO2eq** | **%** |
| Anchored ships | | |
| Ships manoeuvring | | |
| Moored ships | | |
| **TOTAL** | | |

### 7.2.3 Emissions summary

The final section shall include a summary table reporting the total emissions of greenhouse gases, both direct and indirect, divided by category and activities referred to in points 3 and 4, with the total of t CO2eq per category and the percentage of the total (Tab. 5). Moreover, it shall include analysis of data and considerations on the values obtained in GHG inventory for the considered port.

*Table 5 - Sample of table mapping overall port area emissions*

| **Table of the overall percentage ratios of all GHG Emissions from the Port of XXXXXX in 2019** | | |
|---|---|---|
| **Category** | **t CO2eq** | **%** |
| Electric energy | | |
| Heating | | |
| Service vehicles | | |
| Operational port vehicles | | |
| Heavy vehicles | | |
| Naval port service (e.g. pilot/tug) | | |
| Railway tractors | | |
| Other | | |
| Anchored ships | | |
| Ships manoeuvring | | |
| Moored ships | | |
| **TOTAL** | | |

# 8. SWOT Analysis' Content

SWOT analysis (Pickton and Wright, 1998) serves to identify key internal and external factors perceived as important to achieving project objectives as they stem from the current situation and previous project activities. All relevant elements are divided into two main categories:

1. Internal factors — *Strengths* and *Weaknesses*
2. External factors —*Opportunities* and *Threats*

Internal factors deal with aspects related to the organization carrying out the SWOT analyses, in the present case the single port. The analysis may view the internal factors as strengths or as weaknesses depending upon their effect on the project objectives. Factors are derived from the previous steps of territorial need assessments, such as the examination of the programme area, the greenhouse gas inventory, stakeholder involvement and their feedback.
The external factors may include stakeholders, technology, regulations and policies, cultural aspects, infrastructure, market demands. The results are presented in the form of a matrix (Table 3). The matrix is not merely a list to be compiled: important factors should be examined in detail reporting how they can foster or hinder the project objective implementation.

*Table 3 - Sample of SWOT matrix*

| | **Positive Impact** | **Negative Impact** |
|---|---|---|
| **Internal factors** | **STRENGTHS** | **WEAKNESSES** |
| | 1. First factor<br>2. …<br>… | 1. First factor<br>2. …<br>… |
| **External factors** | **OPPORTUNITIES** | **THREATS** |
| | 1. First factor<br>2. …<br>… | 1. First factor<br>2. …<br>… |

In the present case, the SWOT analysis should deliver factors involved in reaching main project objectives, thus enhancing energy efficiency and emission reduction in port facilities, focusing on the most interesting technologies to be applied in each specific port area. It is recommended to avoid too general and unuseful analysis, preferring technical aspects supported by qualitative/quantitative assessments coming from previous sections of TNA.
If deemed important, ports can report available feasibility studies related to the project objectives.

## 9. Conclusions

The conclusions section shall recap the main outcomes of the carbon footprint and SWOT analyses. Conclusions shall highlight the most relevant emission categories, also considering the pros and cons coming from SWOT analyses. From these outcomes, the main local needs connected to energy efficiency enhancement and emission reduction shall be briefly summarised in order to involve the key stakeholders in the project and in the exploitation of its results.

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