

Territorial needs assessment for the Port of Dubrovnik

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Introduction

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

In particular, the objective of this document is to draw up an inventory of Greenhouse Gases (GHG) also known as "Carbon Footprint" and an action plan for their reduction, within the Dubrovnik port area.

This methodology makes it possible to develop a current and prospective assessment of energy requirements, providing the tools to guarantee the environmental sustainability of the port area over time, with the same quality of services offered, through the identification of innovative technical and organizational solutions linked to the supply and use of energy, whatever form it takes.

This energy and environmental plan, in addition to limiting the energy needs of the port area, sets as its objectives the reduction of GHG emissions, with particular attention to CO₂. Reducing GHG emissions from ports is not only a measure to tackle global warming, but also contributes to promoting innovation, implementing energy efficiency, and improving the quality of life in the surrounding areas.

Although emissions in port areas represent only a small part of the total emissions that can be associated with the whole maritime transport logistics chain (which includes land transport to ports, port operations and maritime transport), any reduction of emissions in the port area not only improves local air quality and noise reduction, but also helps to reduce the global climate effect in a synergistic way. In this sense, port area management authorities have an important role to play in engaging actors in the port community to be more environmentally friendly and facilitate through initiatives the implementation of best environmental practices and the encouragement of measures aimed at improving energy efficiency and promoting the use of renewable energy in the port area.



Figure 1. Port of Dubrovnik

Moreover, together with the territorial need assessment carried out by each project partner, this document provides a solid basis for carrying out the action plan for enhancing the environmental sustainability and energy efficiency of the ports in the Programme Area, which provides the framework for the development of the actions carried out by each port involved in SUSPORT project.

Hence, the best practice analysis will help the joint planning of environmental sustainability and port energy efficiency by improving the exchange of experiences between partners and providing a benchmark analysis at European and international level.

Description of the port area

Dubrovnik is situated in the far south of the Republic of Croatia and Dubrovnik-Neretva County. The port of Dubrovnik - Gruž is located on the northern coast of the Gulf of Gruž and the eastern coast of the Bay of Rijeka Dubrovnik and has 1629 m of built coastline and 829 m of undeveloped coastline.

The port of Dubrovnik - Gruž is an important transport hub for local, regional and international maritime passenger traffic of the southern part of the Adriatic. In terms of number of arrivals, the most significant is the traffic of scheduled passenger vessels, while the total number of passengers is dominated by the segment of passengers from cruise ships.

Inland, the Port of Dubrovnik - Gruž is connected to the hinterland by the DC-8 road to the north and the Neuma corridor and south towards Montenegro. It is connected to neighbouring BiH by a 4.3km DC-223 road in the direction of the Ivanica border crossing.

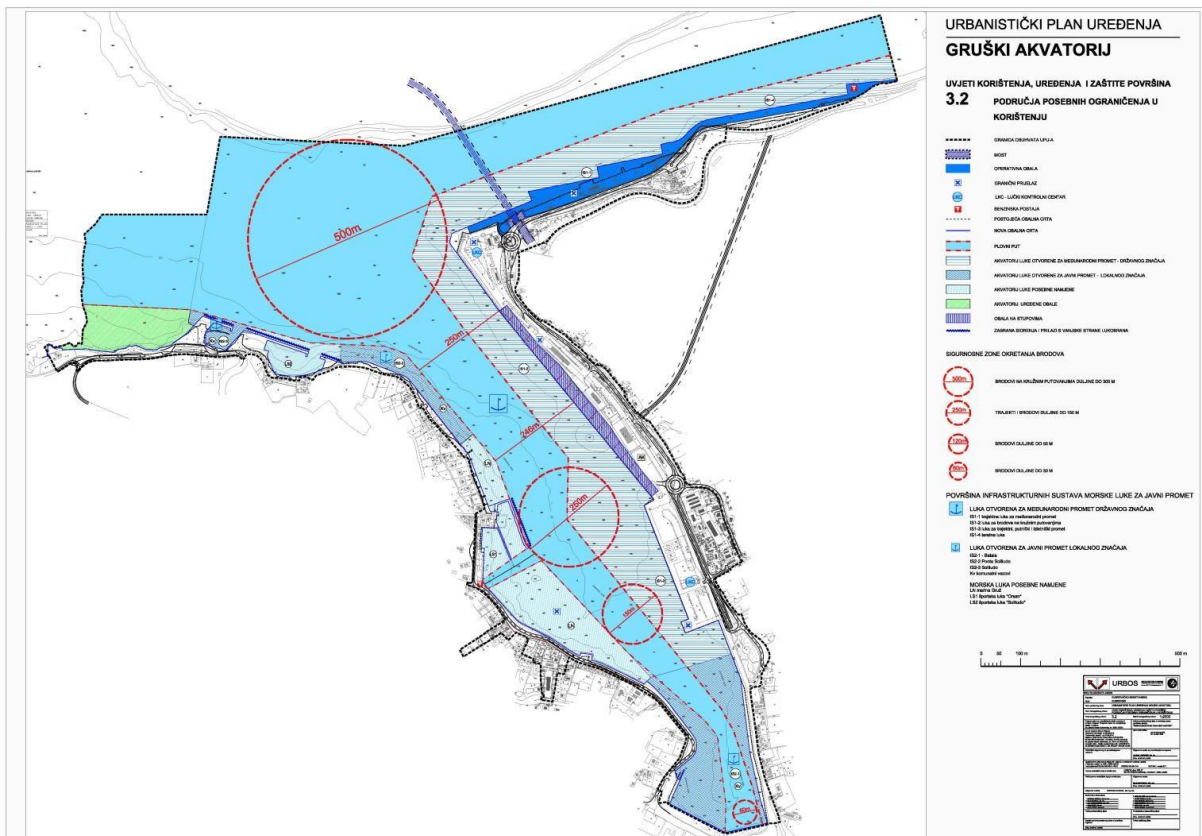


Figure 2. Port area map from urban planning documentation

Legal framework and context

Maritime transport emits around 940 million tonnes of CO₂ annually and is responsible for about 2.5% of global greenhouse gas (GHG) emissions. These emissions are projected to increase significantly if mitigation measures are not put in place swiftly. According to the 3rd IMO GHG study, shipping emissions under a business-as-usual scenario could increase between 50% and 250% by 2050, undermining the objectives of the Paris Agreement. Shipping emissions represent around 13% of the overall EU greenhouse gas emissions from the transport sector (2015).

In 2013, the Commission set out a strategy towards reducing GHG emissions from the shipping industry.

The strategy consists of 3 consecutive steps:

1. Monitoring, reporting and verification of CO₂ emissions from large ships using EU ports
2. Greenhouse gas reduction targets for the maritime transport sector
3. Further measures, including market-based measures, in the medium to long term.

The contribution of the shipping sector to emission reductions consistent with the temperature goals of the Paris Agreement remains an important issue in the EU.

The recent amendment to the EU Emissions Trading System (ETS) Directive, by Directive (EU) 2018/410 of the European Parliament and the Council, emphasises the need to act on shipping emissions as well as all other sectors of the economy. The Directive also states that the Commission should regularly review IMO action and calls for action to address shipping emissions from the IMO or the EU to start from 2023, including preparatory work and stakeholder consultation.

The reduction of CO₂ emissions is one of the main objectives of the EU and the whole objective is transposed through several main Agreements and Directives:

- Paris Agreement (Agreement on taking urgent actions to fight climate change and its impacts.)
- IMO 2020 Sulphur Regulation
- Barcelona Convention for the protection of the Mediterranean
- EU 2030 climate and energy framework

- Sustainable and Smart Mobility Strategy – putting European transport on track for the future
- Clean Power for Transport: A European alternative fuels strategy
- DIRECTIVE (EU) 2018/2001 on the promotion of the use of energy from renewable sources
 - DIRECTIVE 2012/27/EU on energy efficiency
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Mapping out stakeholders

Stakeholders importance mapping

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. The table below maps stakeholders according to their influence on the project and their level of interest in the project

		POWER OF INFLUENCE	
		LOW	HIGH
INTEREST	LOW	<ul style="list-style-type: none"> • General Public Media • 	<ul style="list-style-type: none"> • Ministry of economy and sustainable development • Dubrovnik-Neretva county
	HIGH	<ul style="list-style-type: none"> • HOPS (Croatian transmission system operator) • HEP ODS (Croatian distribution system operator) • Shipping companies Luka Dubrovnik d.d. port concessionaire 	<ul style="list-style-type: none"> • Ministry of the Sea, Transport and Infrastructure • City of Dubrovnik

Table 1. Stakeholders mapping due to importance

Stakeholders involvement strategies

Stakeholders are mapped according to their role and the benefit (or conflicts) their involvement could bring to the project. This also includes their current involvement and strategies to improve their support for project execution.

STAKEHOLDER	ROLE	IMPORTANCE	CONTRIBUTION	BENEFITS	CONFLICTS	SUPPORT	STRATEGY
General public	Marginal	LOW	-	Awareness about the project and the final results	None	Unformal support	Inform about the project trough media coverage
Media	Marginal	LOW	-	Information transfer about the project and activities	None	Unformal support	Inform in all project phases
HOPS	Operative	HIGH	Directly involved in technical preparation of the project	Technical risk dissemination	None	Formal support	Part of the Project development unit
HEP ODS	Operative	MEDIUM	Directly involved in technical preparation of the project	Technical risk dissemination	None	Formal support	Part of the Project development unit
Shipping companies	Operative	MEDIUM	Information about future expectations and standardization	Project development according to future boat standards and risk dissemination	None	Unformal support	Inform about project development

Luka Dubrovnik d.d.	Operative	MEDIUM	No contribution	Experience in operation and maintenance for risk dissemination	None	Unformal support	Inform in all project phases
Ministry of economy and sustainable development	Relevant	MEDIUM	No contribution	Political risk dissemination	None	Unformal support	Inform in all project phases
Dubrovnik-Neretva county	Relevant	MEDIUM	No contribution	Political risk dissemination	None	Unformal support	Inform in all project phases
Ministry of the Sea, Transport and Infrastructure	Key	HIGH	Directly involved in preparation of the project	Maximal project support	None	Formal support	Part of the Project development unit
City of Dubrovnik	Key	HIGH	Directly involved in preparation of the project	Maximal project support	None	Formal support	Part of the Project development unit

Table 2. Stakeholders involvement strategy

Carbon footprint emissions estimation

To determine the greenhouse gas emissions in the port area all relevant data has been collected from the stakeholders and usage of the port has been analysed in detail.

Terrestrial emissions

Electric energy

In the table and figure below we can see electricity consumption declared by users and confirmed with those invoices supplied directly by the electricity utility company.

MONTH	DAY USAGE (kWh)	NIGHT USAGE (kWh)	TOTAL (kWh)
01/2019	85.825	46.267	132.092
02/2019	74.966	39.655	114.621
03/2019	77.040	42.469	119.509
04/2019	69.648	41.409	111.057
05/2019	63.938	44.942	108.880
06/2019	75.041	55.929	130.970
07/2019	83.563	59.724	143.287
08/2019	87.028	63.432	150.460
09/2019	74.398	56.225	130.623
10/2019	59.929	42.245	102.174
11/2019	41.198	26.472	67.670
12/2019	41.246	25.250	66.496
TOTAL	833.820	544.019	1.377.839

Table 3. Electricity consumption

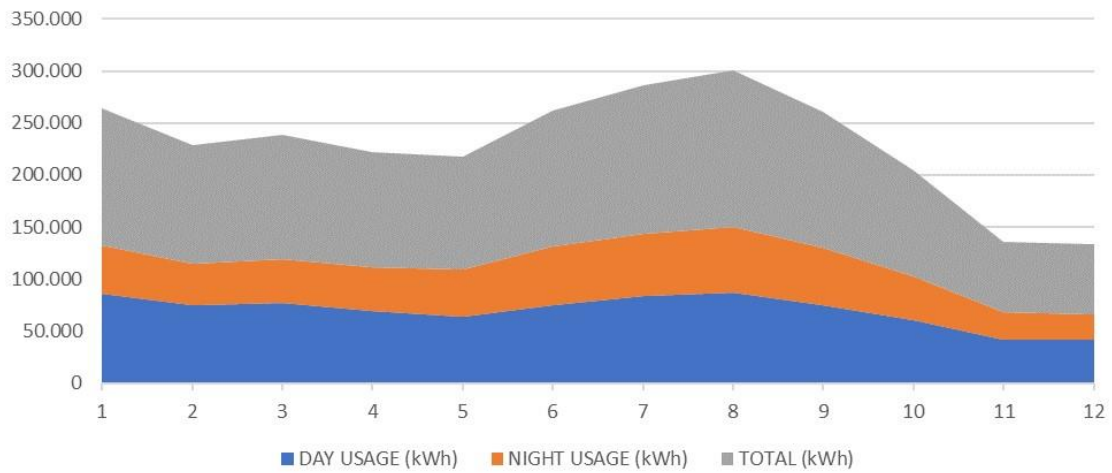


Figure 3. Electricity consumption graph

Specific CO₂ emission factor per total electricity production in Croatia is 0.33 g/kWh. Based on total electricity consumption and emission factor, total CO₂ emissions from electricity consumption is **455 tons**.

Heating

Heating and cooling are based on electricity and GHG emissions are calculated in the previous section.

Service vehicles

Below we have a list of service vehicles used by the Port authority Dubrovnik.

NUMBER	CAR MODEL	YEAR	POWER	EU NORM	CO ₂ EMISSION
1	FORD MONDEO	2005	92 kW	EURO 4	182 g/km
2	OPEL CORSA	2009	66 kW	EURO 4	124 g/km
3	SEAT LEON	2018	85 kW	EURO 6	109 g/km
4	ŠKODA OCTAVIA	2018	110 kW	EURO 6	118 g/km
5	PIAGGIO LIBERTY	2006	3 kW	-	75 g/km
6	PIAGGIO FLY	2016	3 kW	-	48,3 g/km

Figure 4. Service vehicles in the port

Estimation of the usage inside port operational boundaries has been made and overall CO₂ emission of service vehicles is **0,3 tons**.

Port operational vehicles

Port of Dubrovnik-Gruž is mainly cruise port and many terrestrial emissions are related to road vehicles operating inside port boundaries. Below we can see number of entries of different vehicles inside port boundaries.

VEHICLE TYPE	2018.	2019.
BUS	24.251	24.698
MINIBUS	1.076	1.613
COMBI	1.535	1.811
PASSENGER CAR	75.314	77.711

OTHER	3.337	4.983
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Figure 5. Port operational vehicles entries in the port

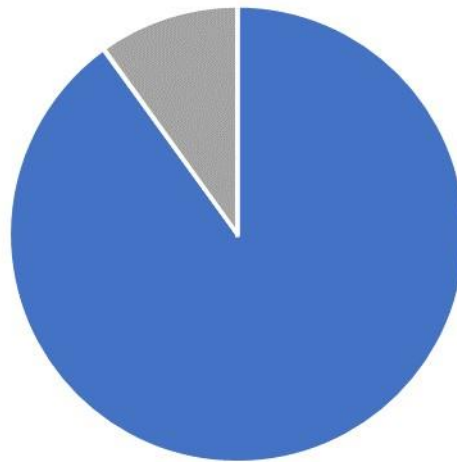
Based on the estimation of their milage inside port boundaries and estimation of their standby use while waiting inside port boundaries, overall CO2 emission of operational vehicles is **50,2 tons**.

Overall results

area

NUMBER	CONTRIBUTOR	TONNES CO2 EQV	PERCENTAGE
1	Electric energy	454,7	90,0%
2	Service vehicles	0,3	0,1%
3	Port Operational vehicles	50,2	9,9%
4	Heavy-duty vehicles	0,0	0,0%
5	Other	0,0	0,0%
	Total	505,2	100%

Table 4. Main terrestrial GHG contributors in the Dubrovnik port



■ Electric energy
 ■ Service vehicles
 ■ Port Operational vehicles
 ■ Heavy-duty vehicles
 ■ Other

Figure 6. Terrestrial emissions graph

Maritime emissions

According to the data from the lists of cruise ship entering the port of Dubrovnik Gruž, there were 423 cruise ship dockings in the port of Dubrovnik Gruž.

Ship	HVSC	Entries	Length (m)
AIDAaura	NO	2	202
AIDAblu	NO	31	253
ARTANIA	NO	1	231
ARCADIA	NO	2	285
AURORA	NO	2	272
OCEANA	NO	10	261
ORIANA	NO	4	260
ARTEMIS	NO	4	58

ATHENA	NO	20	58
AZAMARA QUEST	NO	3	180
CELEBRITY CONSTELLATION	NO	7	294
CELEBRITY ECLIPSE	NO	1	317
BRAEMAR	NO	1	195
CARNIVAL HORIZON	NO	2	321
COSTA DELIZIOSA	YES	36	294
COSTA neoRIVIERA	NO	1	216
CROWN PRINCESS	YES	3	290
SEA PRINCESS	YES	1	261
CRYSTAL ESPRIT	NO	13	86
CRYSTAL SERENITY	NO	1	250
GOLDEN IRIS	NO	1	164
HORIZON	NO	9	207
KONINGSDAM	YES	3	299
OOSTERDAM	YES	12	285
LA BELLE DE L'ADRIATIQUE	NO	22	110
MARINA	NO	1	239
RIVIERA	NO	6	239
SIRENA	NO	1	180
MEIN SCHIFF 2	NO	12	262
MSC Lirica	NO	28	274
MSC Poesia	YES	24	293
MSC Sinfonia	NO	19	274

NAUTICA	NO	1	180
NORWEGIAN SPIRIT	NO	10	268
NORWEGIAN STAR	YES	22	294
OCEAN DREAM	NO	1	204
PAN ORAMA II	NO	2	49
TO CALLISTO	NO	20	49
Ship	HVSC	Entries	Length (m)
QUEEN ELIZABETH	NO	2	294
QUEEN VICTORIA	NO	3	294
RHAPSODY OF THE SEAS	NO	11	279
RUNNING ON WAVES	NO	3	63
SEA CLOUD	NO	3	109
SEA DREAM I	NO	1	104
SEA DREAM II	NO	2	104
SEABOURN OVATION	NO	1	211
SEVEN SEAS EXPLORER	NO	1	223
SEVEN SEAS VOYAGER	NO	4	207
TBC 2	NO	13	264
THOMSON CELEBRATION	NO	26	214
VIKING ORION	NO	1	228
VIKING SKY	NO	2	228
VIKING STAR	NO	7	228
VIKING SUN	NO	4	228

Table 5. List of cruise ships docking in Port of Dubrovnik

The following table provides data from the Tier I-III standard, which prescribes permissible emission limits for harmful gases during the combustion of ordinary diesel (LFO - light fuel oil) with a Sulphur content of up to 0.1%.

Polluter	2012. Year (g/kWh)	2020. Year (g/kWh)
SO ₂	0,4	0,4
NO _x	8,6	2,2
CO ₂	600	600

Table 6. Permissible emission limits of marine diesel

Manoeuvring phase

According to data about average manoeuvring time during stay in the port and average fuel consumption of the cruise ships during manoeuvring, total manoeuvring CO₂ emission has been calculated **5.742 tons**.

Mooring phase

According to the data for permitted limit emissions of harmful gases during the combustion of marine diesel for 2012, and according to the data on passenger ships - cruise ships that docked in the port of Dubrovnik - Gruž and the time of their retention at the port, the quantities of discharged harmful substances into the surrounding air during the stay of ships on berth in the port and the operation of diesel engines were calculated. Total CO₂ emissions in mooring phase is **30.603 tons**.

Overall results

NUMBER	CONTRIBUTOR	TONNES CO2 EQV	PERCENTAGE
1	Anchored ships	0	0%
2	Ships manoeuvring	5.742	16%
3	Moored ships	30.603	84%
	Total	36.345	100%

Table 7. Main maritime GHG contributors in the Dubrovnik port area

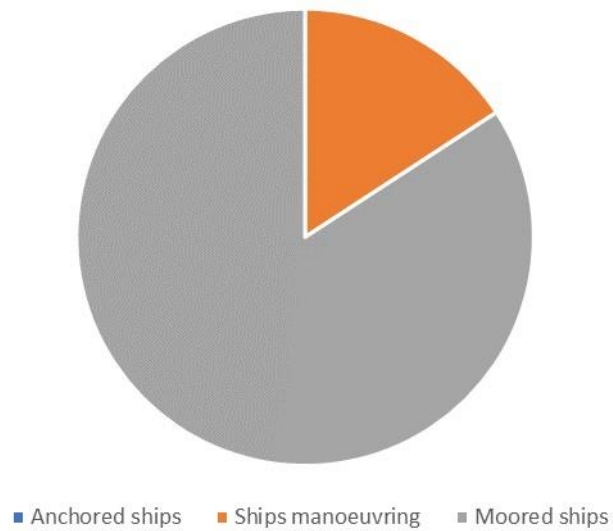


Figure 7. Maritime emissions graph

Emissions summary

NUMBER	CONTRIBUTOR	TONNES CO2 EQV	PERCENTAGE
1	Electric energy	454,7	1,2%
2	Service vehicles	0,3	0,0%
3	Port Operational vehicles	50,2	0,1%
4	Heavy-duty vehicles	0	0,0%
5	Other	0	0,0%
7	Anchored ships	0	0,0%
8	Ships manoeuvring	5.742	15,6%
9	Moored ships	30.603	83,0%
	Total	36.849,8	100,0%

Table 8. Overall GHG emissions

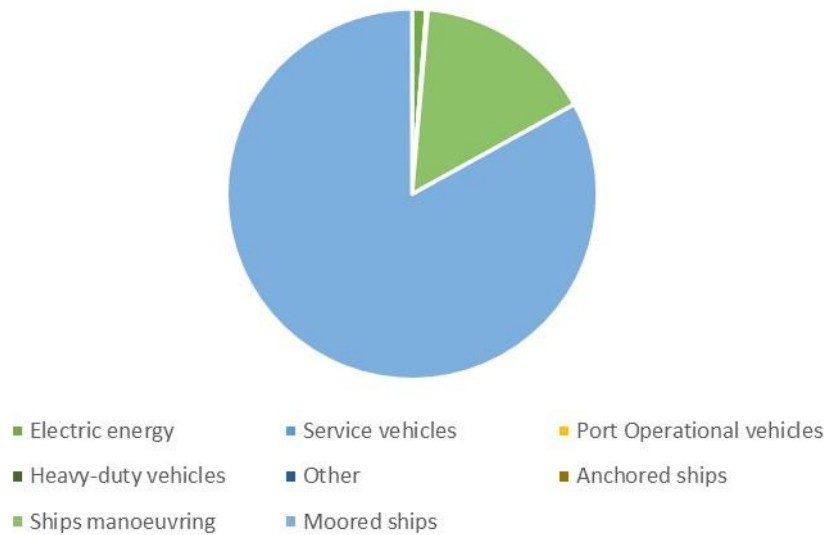


Figure 8. Overall emissions graph

SWOT Analysis

SWOT analysis 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

	Positive Impact	Negative Impact
Internal factors	STRENGTHS	WEAKNESSES
	<ul style="list-style-type: none"> • High Voltage Shore Connection (HVSC) project in development • Photovoltaic power plant for own consumption in development • Renovation of the main office building in development • Port area outdoor LED lighting in development • E-mobility car charging system project in development <p>Full support from the local and state level for the implementation of the projects</p>	<ul style="list-style-type: none"> • Most of the maritime GHG emissions come from cruise ships at berth • Most of the terrestrial GHG emissions come from the transport busses and cars related to cruise ships passengers • Port is situated in the city and has limited connections and possibilities for inner energy resources <p>Awareness from other stakeholders using port area</p> <p>High population concentration</p>
External factors	OPPORTUNITIES	THREATS
	<ul style="list-style-type: none"> • Other users in the port area are encouraged to use new means of transportation of goods and people • Using new smart technologies for better transport and area usage optimization IT Model for predictive port emissions • Maritime traffic EU and international regulations on GHG emissions 	<ul style="list-style-type: none"> • Relatively small area with an exponential increase of requests for port usage • Increased interest for port usage by cruise ships, operating shuttle buses and visitors in general <p>Economic instability directly caused by the COVID19</p>

Conclusion

Overall CO₂ emissions for the Port of Dubrovnik-Gruža are 36.850 tons. It is clearly visible that most of the emissions are related to cruise ships manoeuvring and mooring in the port, and terrestrial emission count only for the 1,4% of the total emissions.

NUMBER	CONTRIBUTOR	TONNES CO ₂ EQV	PERCENTAGE
1	Electric energy	454,7	1,2%
2	Service vehicles	0,3	0,0%
3	Port Operational vehicles	50,2	0,1%
4	Ships manoeuvring	5.742	15,6%
5	Moored ships	30.603	83,0%
	Total	36.849,8	100,0%

Table 9. Overall GHG emissions summary

Considering that Port authority Dubrovnik already started to prepare High voltage shore connection project and maximizing usage of renewable energy sources inside operational area of the port gives as a clear footage of what are main concerns and target areas. Tackling with maritime emissions in ports is a crucial element of making ports sustainable and friendly to the nearby surrounding.

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