Environmental performance assessment of Adrigreen ports

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Index

Index of figures and Tables

General information about Adrigreen ports

Ancona port

Managing Authority	Central Adriatic Ports Authority
Site	https://porto.ancona.it/en/
Country/EU Member State	Italy
Region/City	Marche/Ancona
Geographical coordinates	Lat:43°37'17,5'' N; Lon: 13°30'12'' E

Further information and description of Ancona port area and surroundings

Ancona total population is about 101,000, with a population density of about 810 people/km2.

Nowadays, Ancona is the terminal of relevant ferry traffic flows, with terminals for Schengen and extra Schengen destinations. The port statistics register more than1 million passengers per year. The port has good connections with the railways station of Ancona (served by high speed trains to the main Italian destinations) and the Marche Airport served by several flights per day to the hub of Munich, plus other European destinations. Road connections are also efficient, and several parking areas are available in the port surrounding area. Car valet service is available to/from the port for long staying customers. The port offers a full range of efficient and cost-effective services for ships, passengers and travel operators.

The natural reserve nearby Ancona port is the Regional Park of Conero Mountain. The Esino River is about 15 km from the port of Ancona. The port of Ancona welcomes its visitors offering a prestigious cultural heritage in the area known as "Porto Antico" including the Trian Arch (115BC) and the Clementine Arch (XVIIIcentury).In addition, very close to the port, the old town of Ancona hosts important monuments and museums.

Nonetheless, a contaminated site of national and regional interest, the Falconara and lower Esino valley High Risk Area of Environmental Crisis (*Area ad Elevato Rischio di Crisi Ambientale Falconara e Bassa Valle dell'Esino or* AERCA-Falconara) was identified by Marche Region through the Administrative Resolution of the Regional Council n. 305/00 then approved and guaranteed by Italian Ministry of the Environment. It includes an area of about 85 km^2, encompassing Ancona and several other municipalities, as well as an area of about 53 km^2 at sea.

The area shows environmental vulnerabilities, such as the presence of instability phenomena in the hilly area exposed to the sea, a strong population density along the entire coastal line and the presence of areas subject to flooding and floods related to the state of the Esino River and its tributaries.

In addition to these morphological problems, there are critical issues in this area related to the presence of production and commercial settlements increasing environmental pressures.

Dubrovnik port

Managing Authority	Dubrovnik Port Authority
Site	https://www.portdubrovnik.hr/dubrovnik-port-authority
Country/EU Member State	Croatia
Region/City	Dubrovnik-Neretva
Geographical coordinates	Lat: 49°39'32''N; Lon: 018°05'09''E

Further information and description of Dubrovnik port area and surroundings

The city of Dubrovnik hosts about 48,000 inhabitants. The distance from the port to the old city is about 2.5km, to Dubrovnik International airport is about 22km, and to the bus station is about 500 m. Nearest natural reserves are Island Mljet (1 hour by boat) and Islan Lokrum (15 minutes by boat). Neretva river is about 90 km by road. The main cultural heritage is represented by Dubrovnik Old City UNESCO heritage, which is 30 minutes walking distance. No contaminated site of national or regional interest is nearby.

Pula port

Managing Authority	Port Authority of Pula
Site	https://www.lup.hr/en/home/
Country/EU Member State	Croatia
Region/City	Istria / Pula
Geographical coordinates	Lat: 44 52.5 N; Lon: 13 50.5 E

Further information and description of Pula port area and surroundings

The city lies on and beneath seven hills on the inner part of a wide gulf and a naturally well-protected port (depth up to 38 m) open to the northwest with two entrances: from the sea and through Fažana channel.

Pula, a seafront city on the tip of Croatia’s Istrian Peninsula, is known for its protected harbour, beach-lined coast and Roman ruins. The port is a kind of backbone of the old town known for Roman ruins as the Amphitheatre, a star-shaped castle Kaštel, Hercules Gate, etc. Pula had a population of 57.460 in 2011, and a population density of 1112 /km².

The concerned port is part of the city centre. Therefore, the port area is well connected with the rest of the city. Taxi and bus stations are in the area of 200 m.

Regarding the natural reserves nearby Pula port, the maritime area of the port is a site protected by the EU NATURA 2000 Directive as Marine Protected Area - both Habitat Directive Sites pSCI, SCI; site: *Akvatorij zapadne Istre* (Marine area of Western Istria, sitecode: HR5000032) and Birds Directive Sites SPA, site: *Akvatorij zapadne Istre* (Marine area of Western Istria, sitecode: HR1000032). Nearby the harbour there is a protected point location HR20001145, site: *Izvor spilja pod Velim vrhom*, pSCI, SCI.

The green areas of the mainland near the harbour are protected by the General Urban Plan of Pula as Monument of Landscape Architecture of Local Importance (e.g., Tito's Park, Valerian Park, Franjo Josip Park, and King Zvonimir Park). Nearby the harbour there is the "green entity of urban importance", a protection category made by the General Urban Plan of Pula. There are no rivers nearby the Port.

Nearby Pula port is the 1st-century amphitheatre known as Arena. Two other notable and well-preserved ancient Roman structures in the neighbourhood are the 1st-century AD triumphal arch, the Arch of the Sergii and the co-eval Temple of Augustus. Forum was constructed in the 1st century BC, close to the sea.

Two Roman theatres have withstood the ravages of time: the smaller one (diameter c. 50 m; 2nd century AD) near the centre, the larger one (diameter c. 100 m; 1st century AD) on the southern edge of the city. The city's old quarter of narrow streets, lined with Medieval and Renaissance buildings, are still surfaced with ancient Roman paving stones. The Twin Gates (Porta Gemina) is one of the few remaining gates after the city walls were pulled down at the beginning of the 19th century. The Gate of Hercules dates from the 1st century. Down the Riva about 1km distant from the Port stands the Byzantine chapel of St. Mary

Formosa was built in the 6th century. Just atop of the city there is the star-shaped castle with four bastions. It was built by the Venetians in the 17th century, following the plans of the French military architect Antoine de Ville. There are no contaminated sites nearby the Port.

Materials and methods

The Environmental Assessment document was built to make information anonymous. Thus, the Result and Conclusion sections do not contain any reference to port names but only anonymous abbreviations (namely P1, P2, and P3). Each partner received its own entry and can understand its own environmental performance.

To quantify the environmental performance, the Adrigreen partners were required to provide data and information according to a datasheet provided by the authors of the present study. Datasheet explanations are in the Annexes section.

Port's emissions are divided according to scope and control of the source. In the present study, the greenhouse gases (GHG) emissions considered belong to the following categories according to WPCI's (World Ports Climate Initiative) 2010 Carbon Foot-printing for Ports - Guidance document.

Scope 1: Port Direct Sources. Emissions owned or controlled by the port operator.

Scope 2: Port Indirect Sources. These sources include port purchased electricity for port administration owned buildings and operations.

Moreover, the GHG emissions deriving from drinking water consumption and waste production were evaluated.

The data provided by the ports were not sufficient to assess the carbon footprint. Therefore, the information provided in terms of $CO2$ or equivalent $CO2$ in the Results section are to be intended as GHG performance of the single or cumulated activities of the port.

The greenhouse warming potential of $CH4$ and $N20$ is expressed in terms of $CO2$equivalent (eq), according to the following values (Forster et al., 2007) :

- $CO2$: GHG warming potential equal to 1;
- $CH4$: GHG warming potential equal to 25;
- $N20$: GHG warming potential equal to 298.

Greenhouse gases emissions deriving from electricity consumption

The GHG emissions deriving from electricity consumption at the ports were evaluated considering the emission factors reported in the work by Koffi et al. (2017) (Table 4, and Table 5) as follows:

$$E = \sum_i C_i \times EF_i$$

where E is emission of CO2eq deriving from electricity consumption [t]; C_i is the consumption related to the type of electricity *j* [kWh]; EF_i is the electricity consumption-specific emission factor reported in Table 4 and Table 5.

Based on the emission factors reported in Table 4, the CO2eq emissions were considered none if deriving from electricity produced from a mix of renewable energy sources and electricity generated from wind, photovoltaic, and hydroelectric.

Table 1 National emission factors (EFs) for electricity consumption in Croatia and Italy in 2013: Standard approach based on the IPCC (2006). Adapted from (Koffi et al. 2017).

	EF [t CO2eq/MWh]
Croatia	0.205
Italy	0.344

Greenhouse gases emissions deriving from water consumption

The greenhouse gases emissions deriving from water consumption at ports were calculated as follows:

$$E = W \times EF$$

where E is the emission of CO2eq deriving from water consumption, [kg CO2eq]; W is the volume of drinking water consumed, [Mg]; EF is the emission factor for drinking water equal to 0.579 in Italy, [kg CO2eq /m3] (Dominici Loprieno et al. 2017).

The Authors of the present study could not find any specific GHG emission factor related to drinking water in Croatia. Therefore, it was assumed the same emission factor for drinking water used for Italy (Dominici Loprieno et al. 2017) for calculating the Croatian port's GHG emissions.

Greenhouse gases emissions deriving from waste production

The GHG emissions deriving from waste production at the ports were calculate according to:

$$E_i = W_i \times EF_i$$

where E_i is the emission of CO2eq deriving from i-fraction of waste, [kg CO2eq]; W_i is the *i*-fraction of waste, [Mg]; EF_i is the waste-specific emission factor reported in Table 6, [g CO2eq /kg waste].

Table 2 Emission factor associated to the different fractions of waste produced. Table adapted from Oficina Catalana del Canvi Climàtic (2019).

Waste fraction	EF [g CO2eq /kg waste]
Glass containers	30.5
Lightweight packages	120.09
Paper/cardboard	56.41
Organic municipal solid waste	362.11
Rest fraction (general waste, not sorted collection)	645.18

1. Water Consumption and Management at Adrigreen ports

In terms of absolute water consumption, in 2018 the ports ranked as P1>P2>P3 (Fig.1).

P1 provided water consumption data for the years 2016 and 2018. In order to make proper comparisons, in agreement with P1 Port Authority, the 2017 water consumption was estimated as the average between the values of water consumption in 2016 and 2018.

In 2018, water consumption per port area ranked as P1>P2>P3 (Fig.2). Between 2016 and 2018 the mean water consumption per area of the ports ranked as P1>P2>P3. At P1, the mean value of water consumption per area of the port was well above the overall mean value by 57.5l/m2. At P1, water consumption is likely to be affected by the high consumption of water related to fishing vessels and cargo ships activities. On the contrary, water consumption per area of the port was below the overall mean value by 26.9 and 30.5 l/m2 at P2 and P3 ports, respectively. Such indicators however are somewhat meaningless being the biased values of water consumption at P1 up to two orders of magnitude higher than those at P2 and P3.

Figures 4–6 show comparisons between the port's value of water consumption per port area and the overall mean value of the respective year from 2016 to 2018.

In 2018, water consumption per passenger ranked as P1>P3>P2. Between 2016 and 2018 the mean water consumption per passenger of the ports ranked as P1>P3>P2. At P1, the mean value of water consumption per passenger was above the overall mean value by 63.9 l/passenger. On the contrary, water consumption per passenger was below the overall mean value by 46.8 and 17.1 l/passenger at P2 and P3, respectively. Again, such indicators are somewhat meaningless being the biased values of water consumption at P1 much higher than those at P2 and P3.

At P3, the relatively higher value of water consumption per passenger is likely due to the low number of passengers that does not include the passengers of the several leisure yachts and recreational boats hosted at the port.

Figures 9–11 show comparisons between the values of water consumption per passenger and the overall mean value of the respective year from 2016 to 2018.

No information was provided by P1 about chronic and accidental water contamination.

P2 and P3 reported no episodes of potential chronic water contamination resulting from accidental water discharge during the maintenance of ships. Moreover, P2 and P3 openly reported that they do not use fertilizers or herbicides, insecticides, and pesticides to maintain open air spaces.

P2 port entrusts wastewater handling to specialized concessionaires in accordance with the operational and environmental needs of the port system. P2 does not consider wastewater reuse given the small green areas and the lack of space in the port area to install a wastewater treatment plant.

No runoff water management is done at P2 and P3.

Only P3 reported two potential episodes of accidental contamination resulting from leakage of fuels and sludge in 2017, whereas P2 port reported no episode of accidental contamination in the time period 2016–2018.

P3 and P1 reported that they have no initiatives to reduce water consumption, while P2 has installed a drip irrigation system for green spaces.

P3 reported to have no initiatives aiming to protect marine water from pollution, whereas P2 has oil spill management equipment. At P1, some schemes are in place for the protection of groundwater and marine waters from pollution.

P1 and P2 and their respective water suppliers monitor water consumption. At P2, the local water supplier monitors the quality of surface water and groundwater. On the contrary, P3 reported no monitoring of water consumption and no monitoring of surface water and groundwater quality.

Protection of groundwater from pollution is done with the equipment provided by the local water supplier at P2, whereas P3 reported no protection of groundwater from pollution.

P1 organizes training and education of port staff related to water protection. On the contrary, P2 and P3 do not entrust these activities.

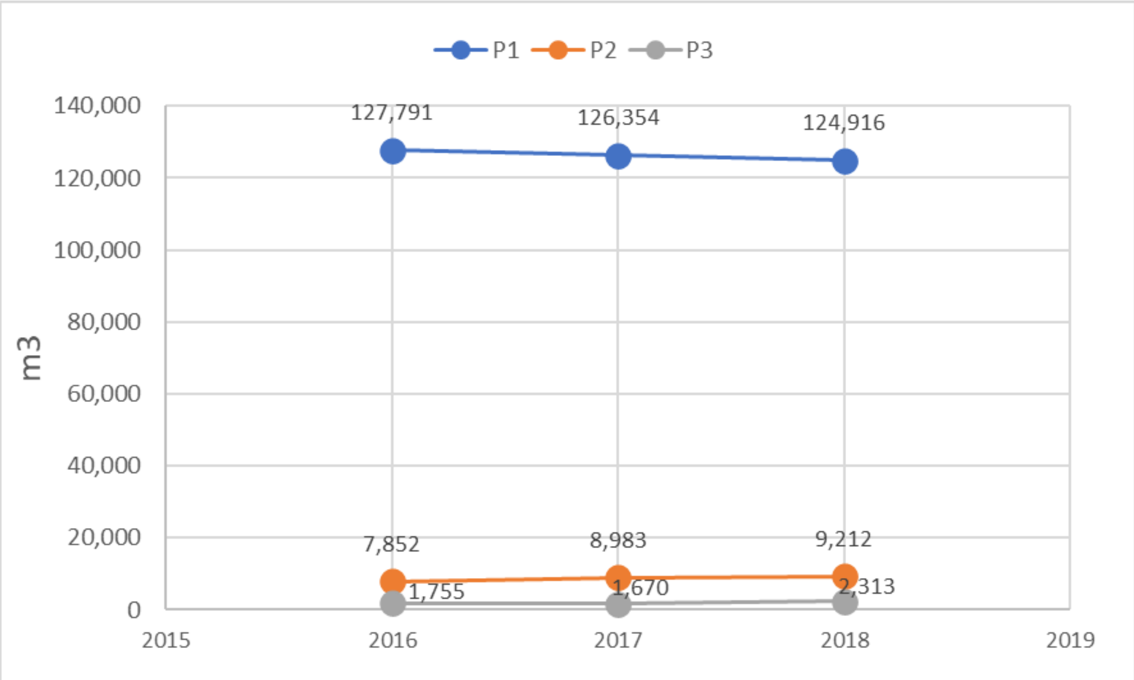

Figure 1 Ports' total water consumption not including leakages, incidents, and flushing.

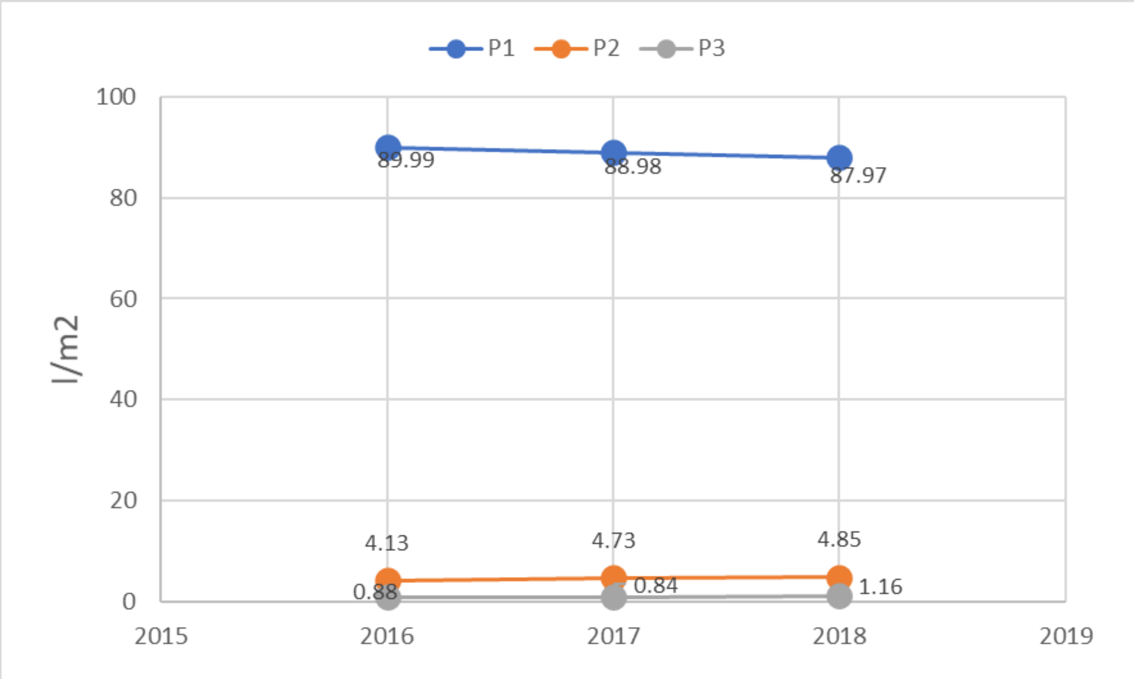

Figure 2 Ports' water consumption per port area not including leakages, incidents, and flushing.

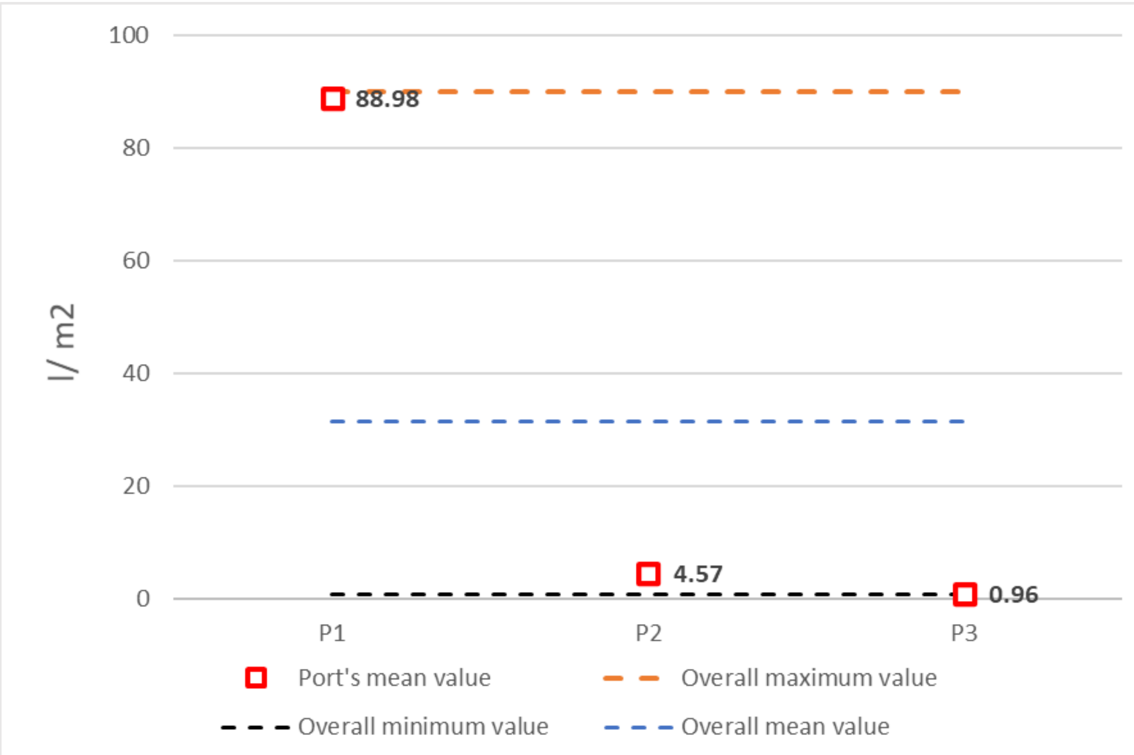

Figure 3 Ports' mean water consumption and overall maximum, minimum and mean water consumption values per port area in the time period 2016–2018 not including leakages, incidents, and flushing.

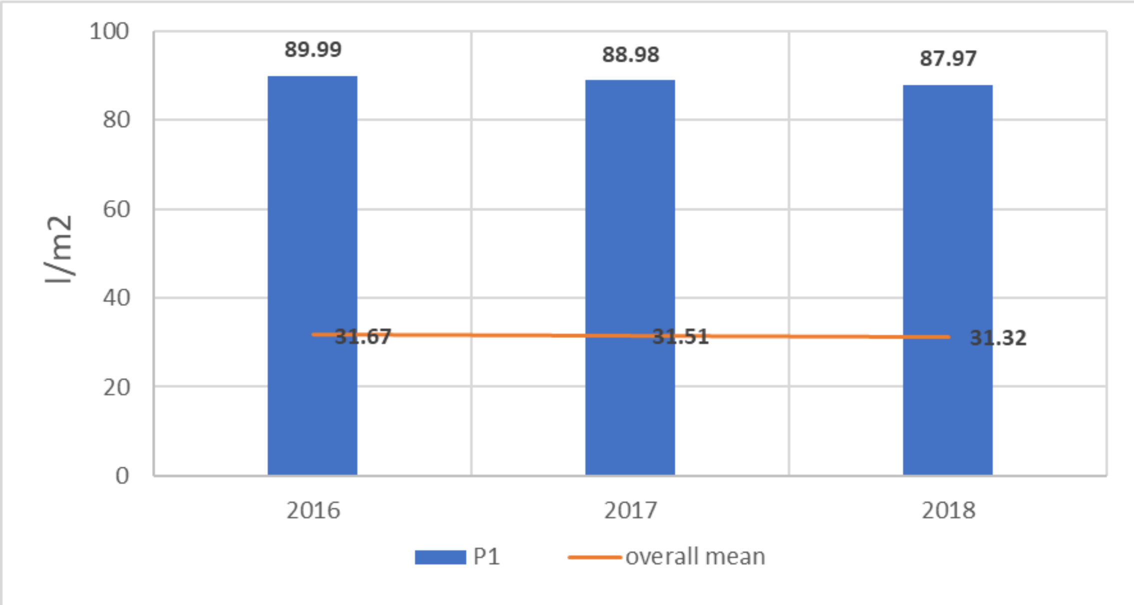

Figure 4 P1 Port's water consumption per port area not including leakages, incidents, and flushing.

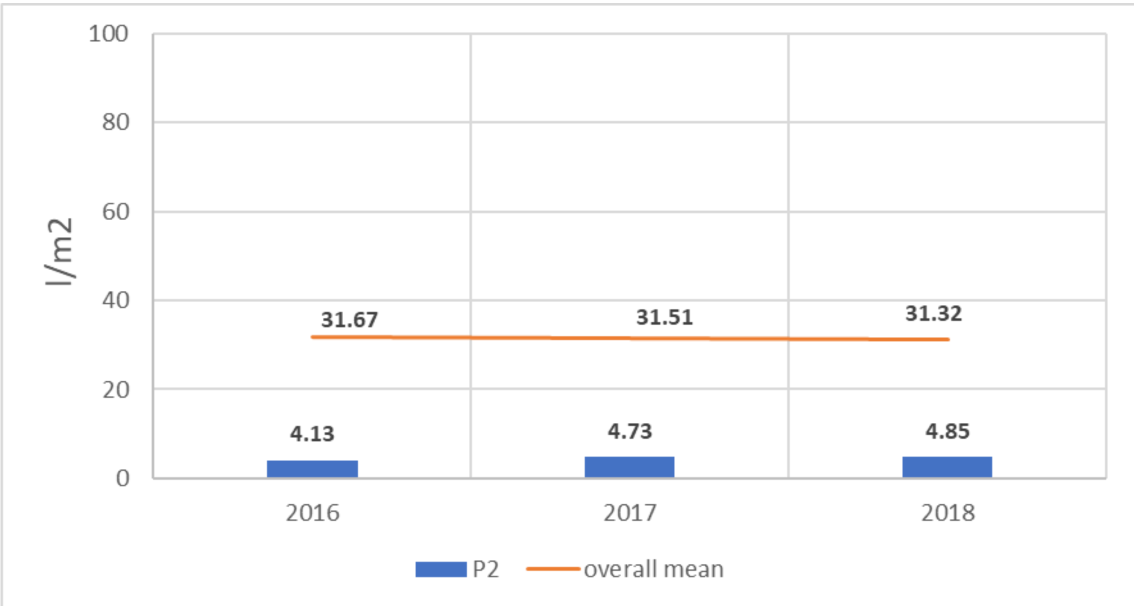

Figure 5 P2 Port's water consumption per port area not including leakages, incidents, and flushing.

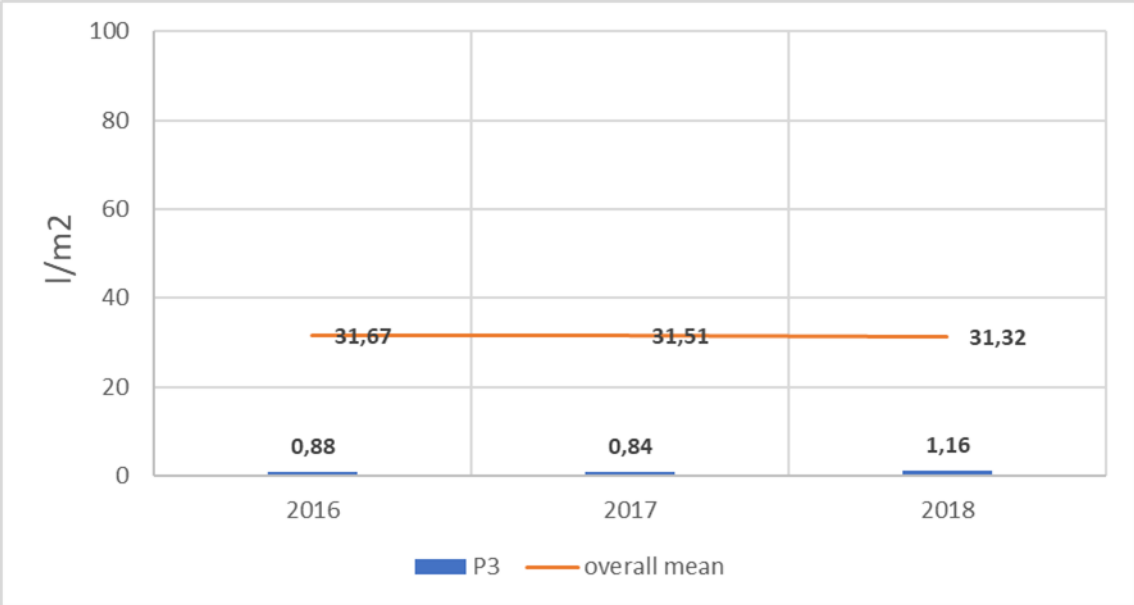

Figure 6 P3 Port's water consumption per port area not including leakages, incidents, and flushing.

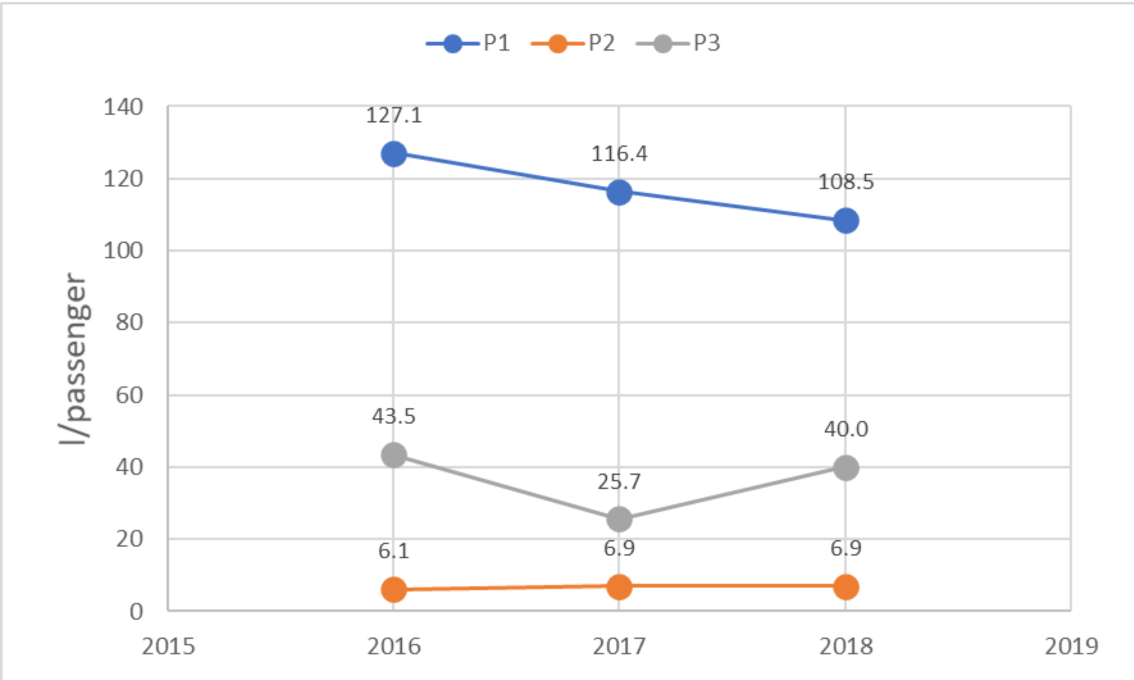

Figure 7 Ports’ water consumption per passenger not including leakages, incidents, and flushing.

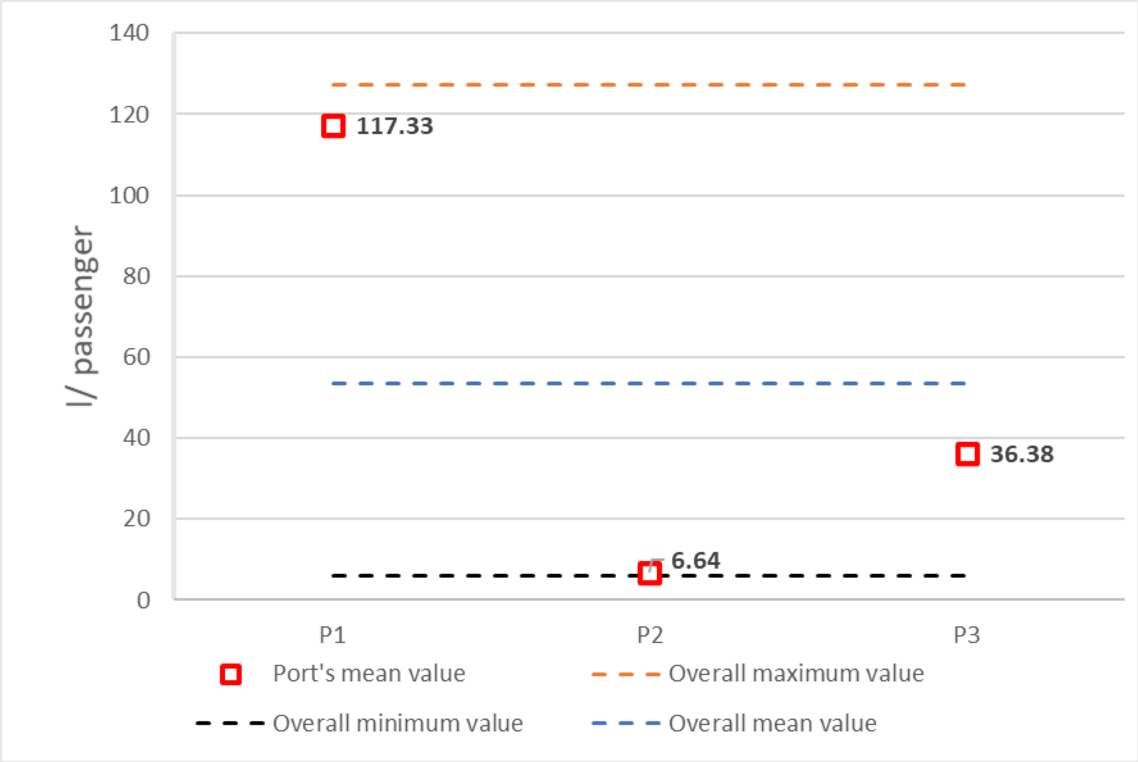

Figure 8 Ports' mean water consumption and overall maximum, minimum and mean water consumption values per passenger in the time period 2016–2018 not including leakages, incidents, and flushing.

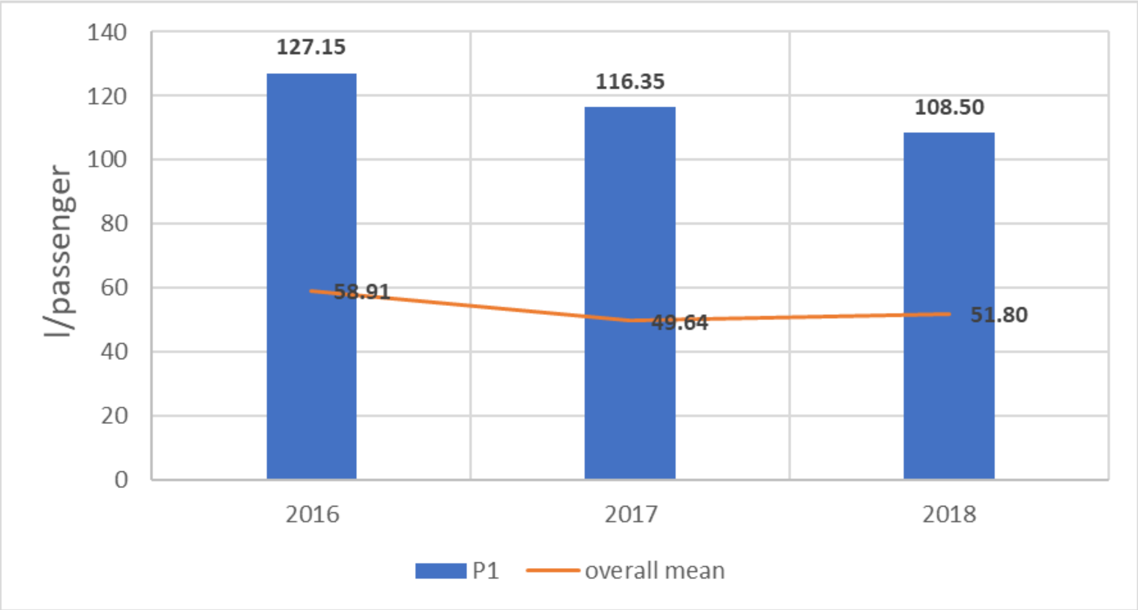

Figure 9 P1 Port's water consumption per passenger not including leakages, incidents, and flushing.

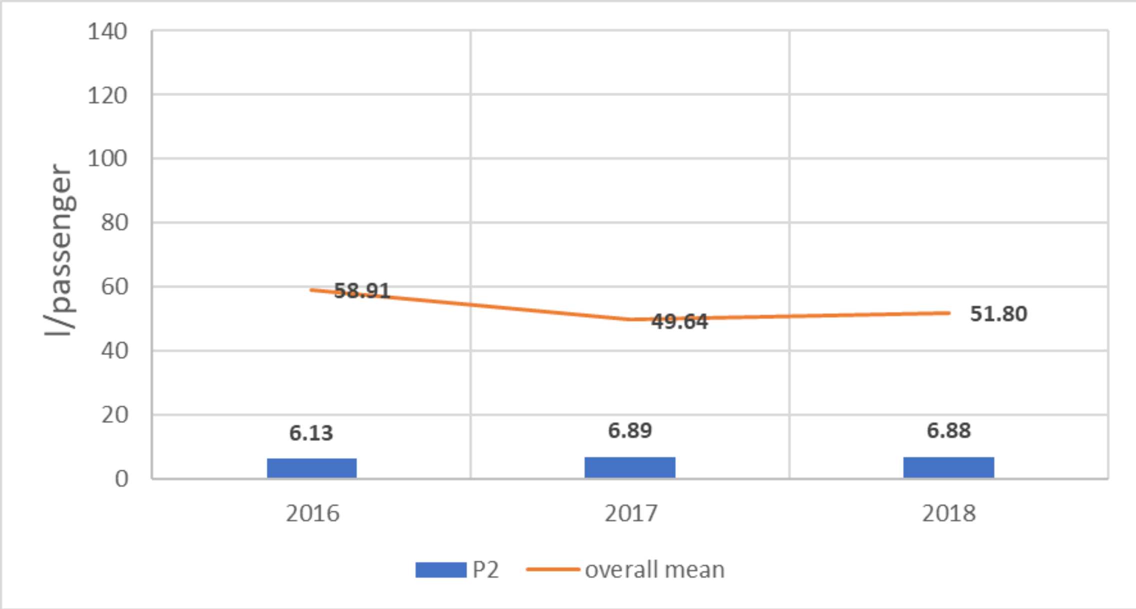

Figure 10 P2 Port's water consumption per passenger not including leakages, incidents, and flushing.

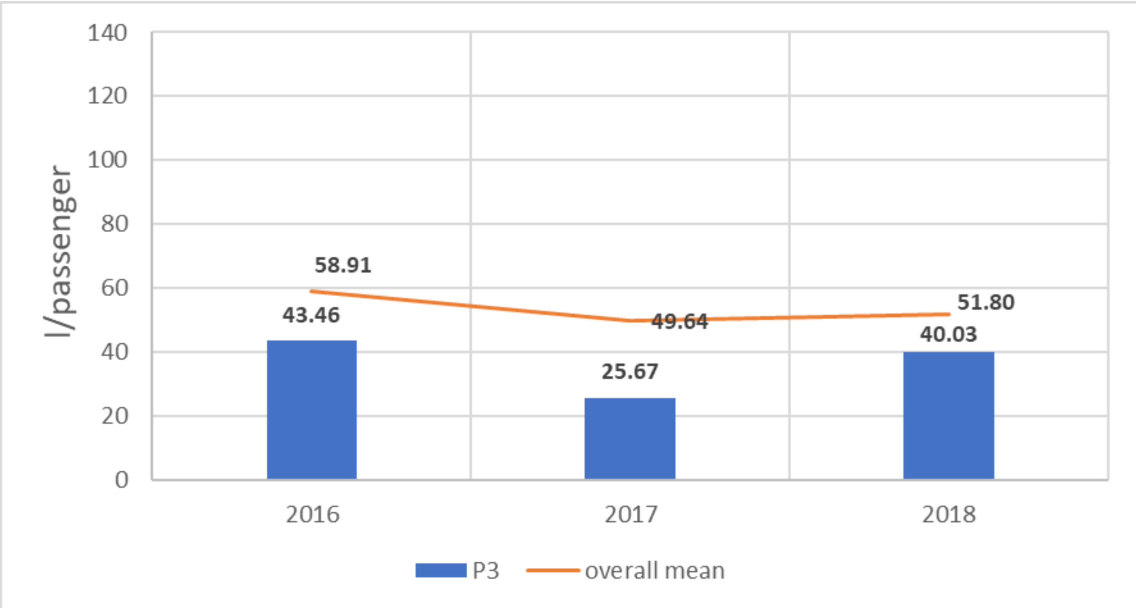

Figure 11 P3 Port's water consumption per passenger not including leakages, incidents, and flushing.

2. Waste production and management at Adrigreen ports

At Adrigreen ports, in 2018, the amount of total waste produced ranked as P1>P2>P3 (Fig.12).

It should be pointed out that the data concerning P1 are rather heterogeneous compared to those regarding P2 and P3, above all because it was not possible to weigh the quantities of waste produced and differentiated at municipal collection level. In fact, the company in charge for collection of such waste does not verify the amounts. Moreover, it would be difficult to discriminate the waste produced by several companies, agencies etc. located nearby. On the other hand, almost no leisure boat directs to P1 commercial port since they usually moor at the nearby specialized port.

P1 port provided waste production data for the years 2016 and 2018. In order to make proper comparisons, in agreement with P1 Port Authority, the 2017 waste production was estimated as the average between the values of waste production in 2016 and 2018.

In 2018, the quantity of waste produced per port area ranked as follows: P1>P2>P3 (Fig.13).

Between 2016 and 2018 the average amount of waste produced per area of the ports ranked as follows: P1>P2>P3 (Fig 14). At P1 port, the mean value of waste produced per area of the port was above the overall mean value by about 0.2kg/m2. On the contrary, the waste produced per area of the port was below the overall mean value by about 0.3kg/m2 at P3. At P2, the waste produced per area of the port was similar the overall mean value of the three ports.

Figures 15–17 show comparisons between the port's value of waste production per port area and the overall mean value of the respective year from 2016 to 2018.

Between 2016 and 2018 the mean waste produced per passenger of the ports ranked as follows: P3>P1>P2 (Fig 18). At P3, the mean value of waste produced per passenger was above the overall mean value by about 1.5kg/passenger. P3 port's waste production per passenger is likely affected by the relatively high amount of waste produced by leisure ships (mainly private yachts) and the low number of registered passengers. On the contrary, the quantities of waste produced per passenger were below the overall mean value by about 0.6 and 0.9kg/passenger at P1 and P2 ports, respectively.

Figures 19–21 show comparisons between waste production at ports per passenger and the overall mean value of the corresponding years from 2016 to 2018.

None of the ports implements economic incentives for recycling solid waste. For example, with the pay-as-you-throw program the companies located at the ports would be charged according to the amount of municipal solid waste produced while P1 charges large ships for the amount of waste to be disposed of.

P2 and P3 ports reported to have no plans for dredging disposal, whereas P1 reported to have a program agreement for dredging disposal. This agreement was signed between the P1 Port Authority and the regional and national authorities, and the nearby local municipalities with a port infrastructure.

None of the ports reported the re-use of decontaminated sediment. For example, decontaminated sediment may be considered as material for the infrastructure and environmental engineering sectors.

At P2 and P3, the dredged material is not subject to analysis (e.g. assessment of physical, chemical, and biological properties). On the contrary, at P1 the physical, chemical, ecotoxicological and microbiological analysis of dredged material are held according to the dredged material legislation that is enforced at the national level.

P1 has appointed two different concessionaires for the recycling and collection of waste. Specifically, a concessionary is in charge for the waste from ships and the other one for the waste from the port area. P2 and P3 have implemented plans regarding preparation for reuse or recycling of waste from the ships. Specifically, the municipality waste company is in charge of the reuse or recycling of waste from the ship at P2.

In all the ports involved, waste management is de-centralized, and it is implemented through concessionaires.

Regarding initiatives planned or in place to address marine litter and pollution, P3 reported to have no such initiatives while P2 Port Authority has signed a contract with a specialized company, which collects solid non-hazardous waste from the sea in the port basin. Moreover, there is a contract with another company for the prevention of marine pollution and collection of waste such as oily waters from ships and other dangerous waste.

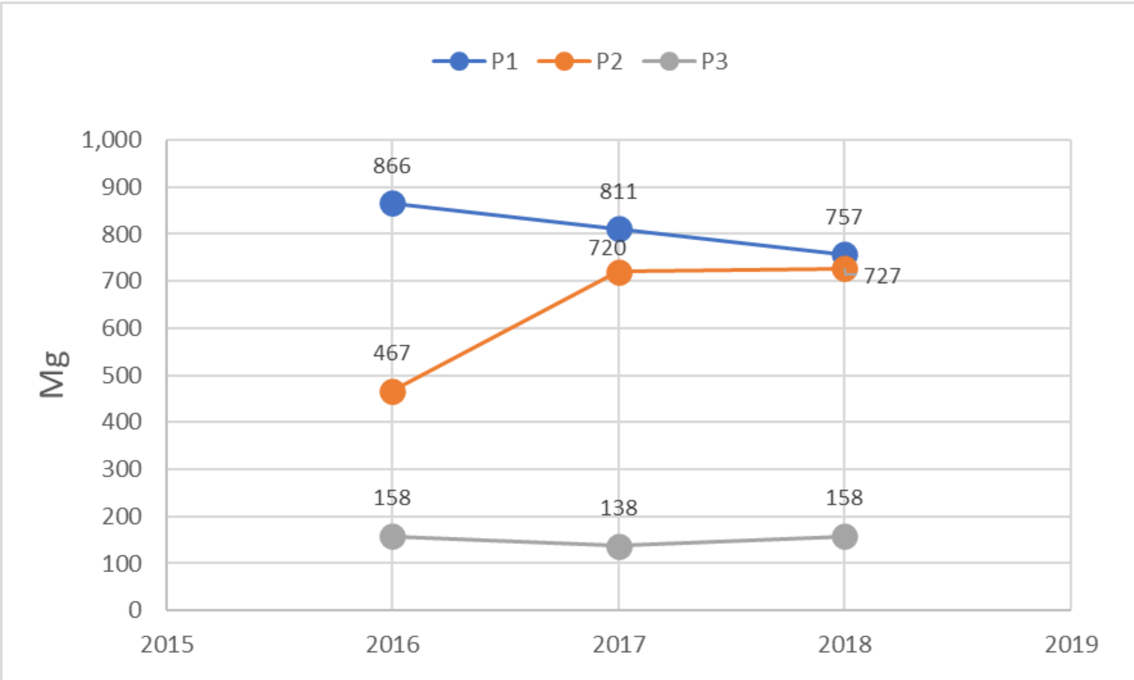

Figure 12 Total waste produced at ports.

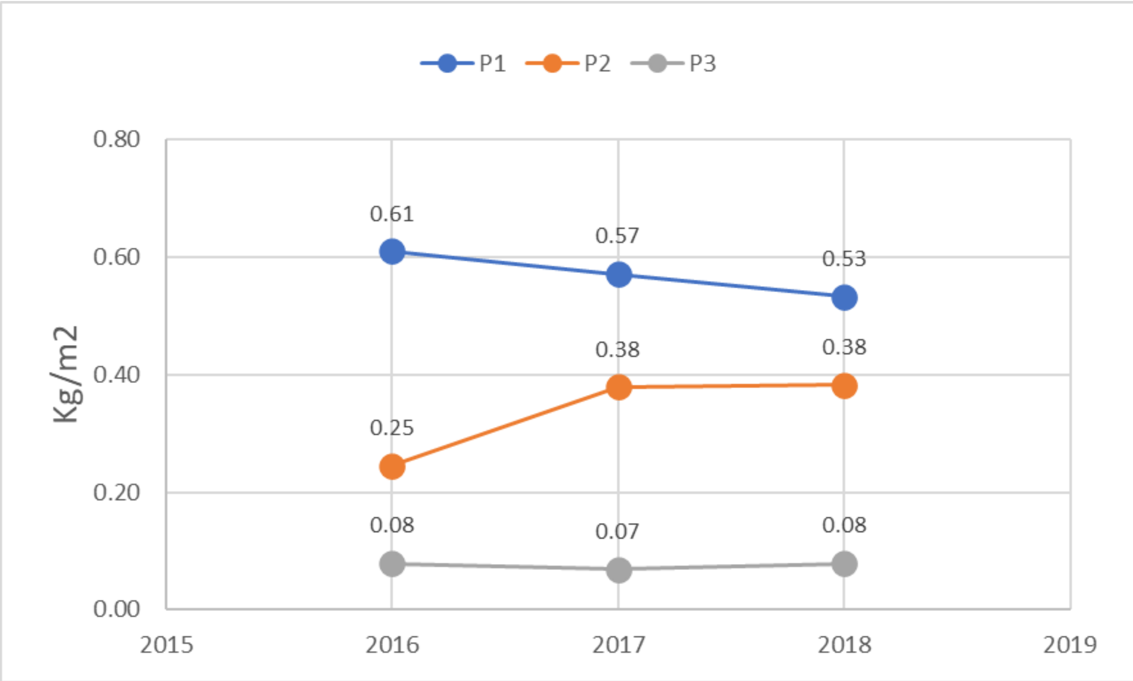

Figure 13 Ports' waste production per port area.

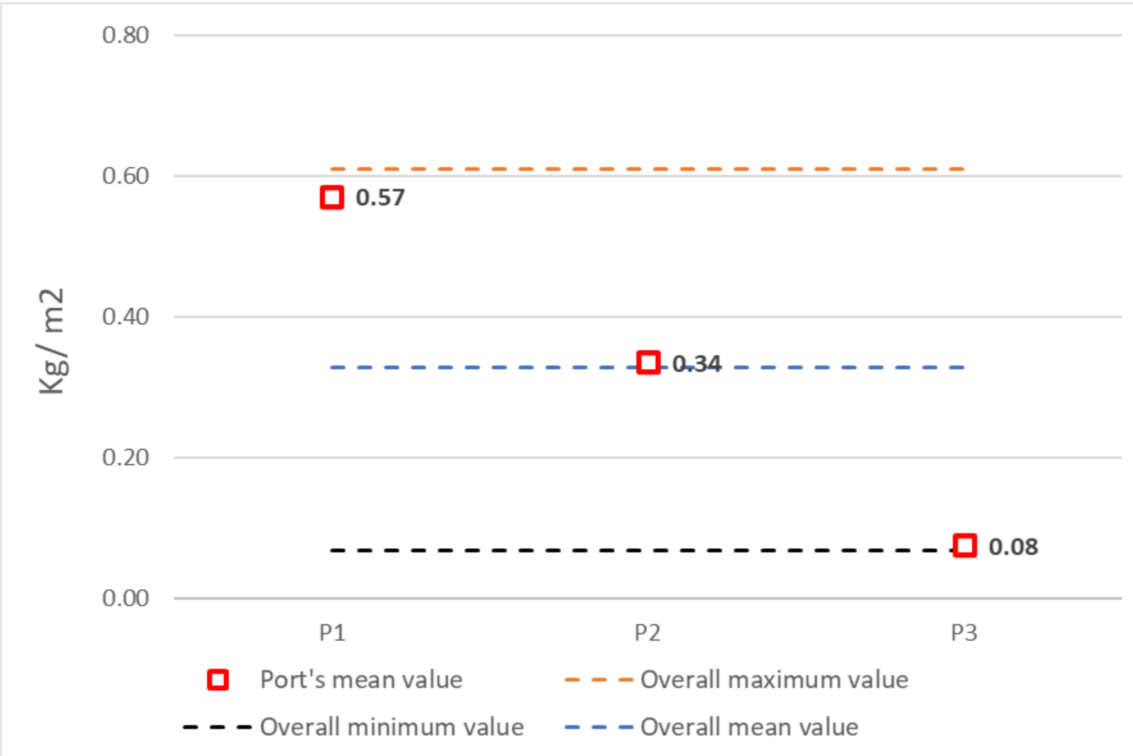

Figure 14 Ports' mean waste production and overall maximum, minimum and mean waste production values per port area in the time period 2016–2018.

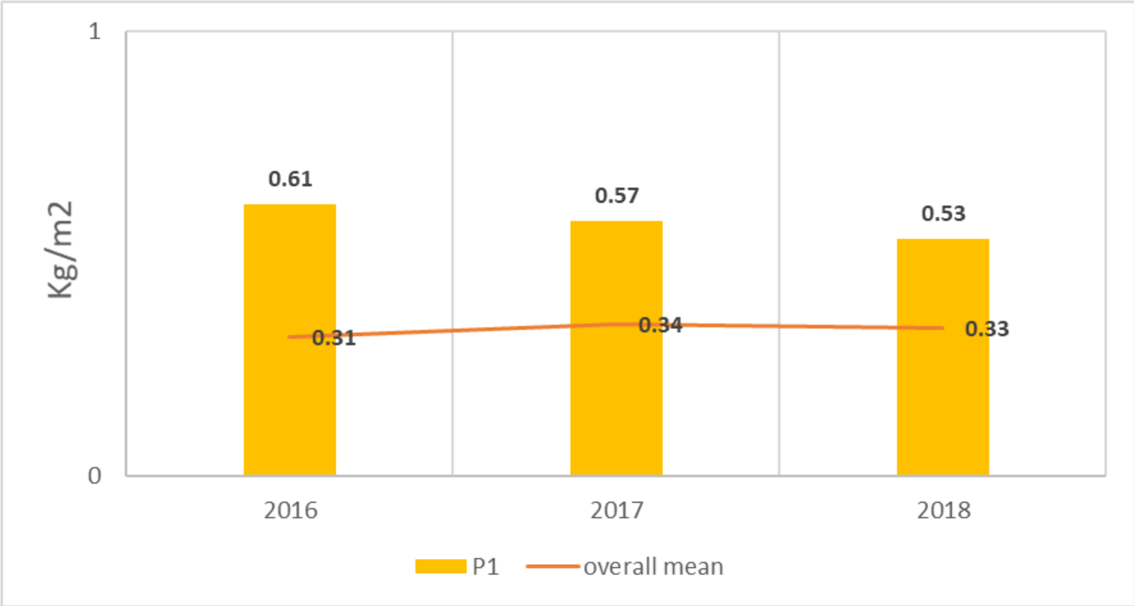

Figure 15 P1 Port's waste consumption per port area.

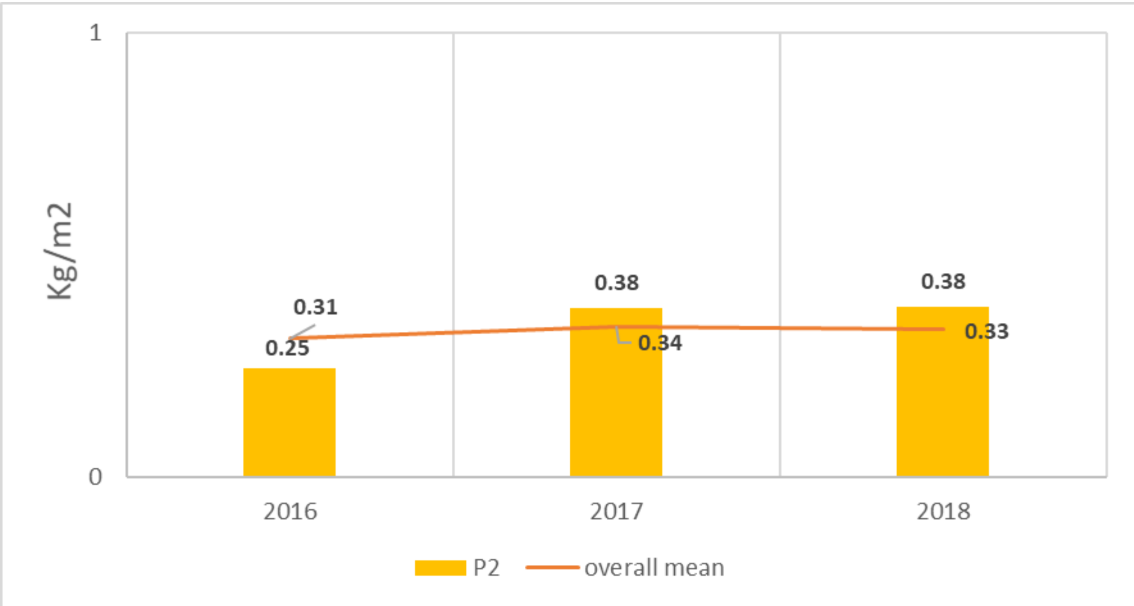

Figure 16 P2 Port's waste consumption per port area.

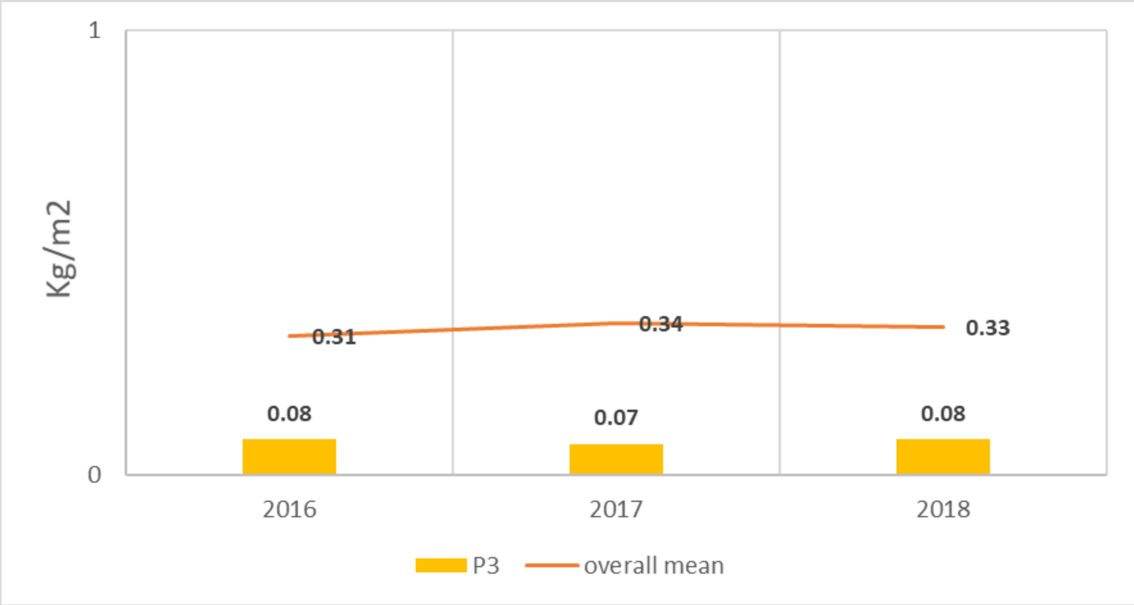

Figure 17 P3 Port's waste consumption per port area.

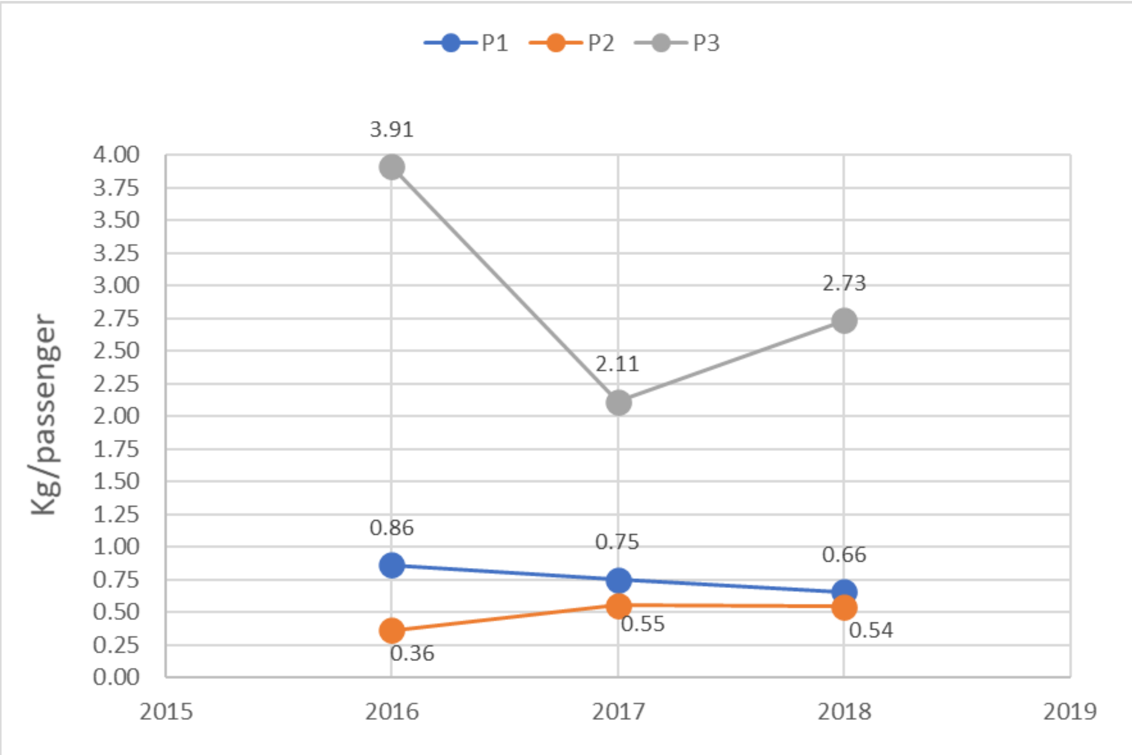

Figure 18 Ports’ waste production per passenger.

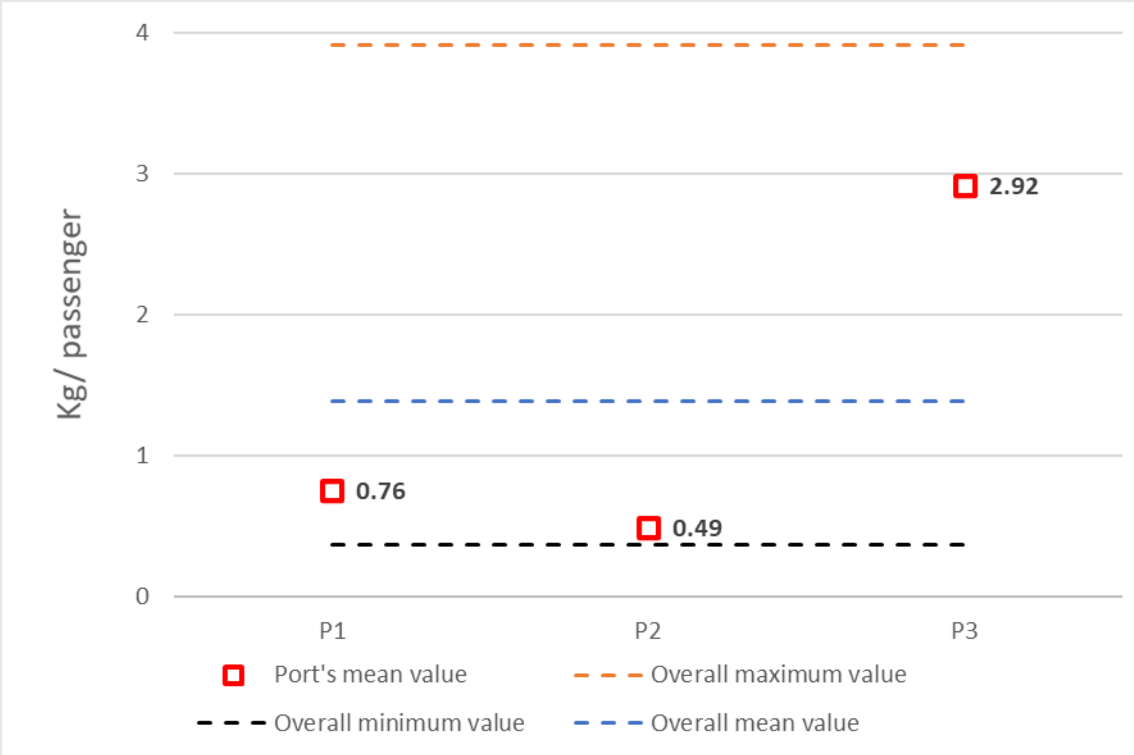

Figure 19 Ports' mean waste production and overall maximum, minimum and mean waste production values per passenger in the time period 2016–2018.

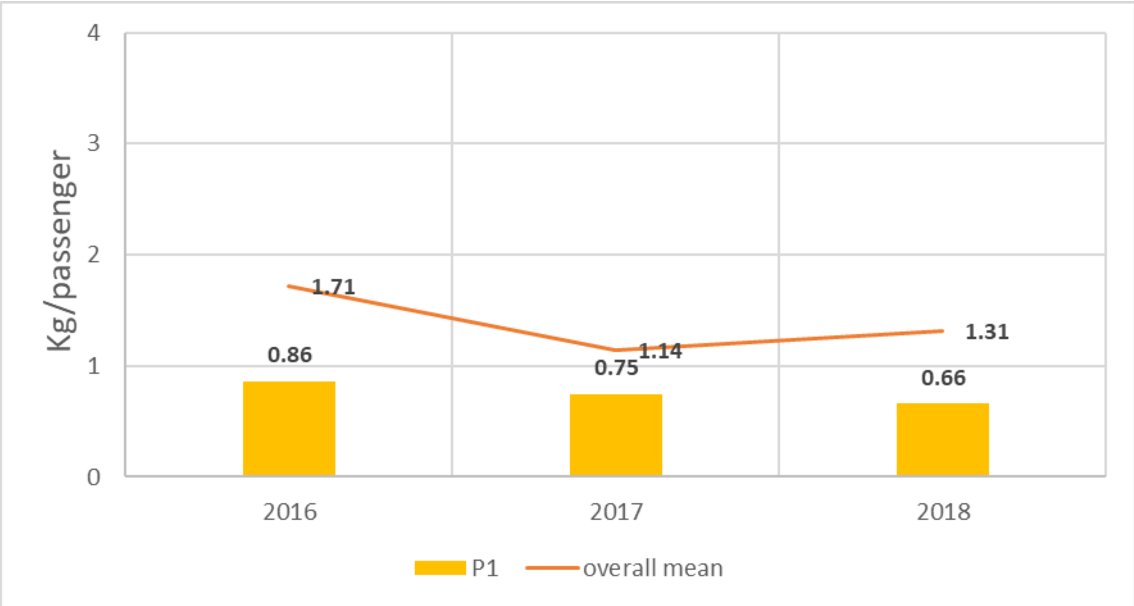

Figure 20 P1 Port's waste production per passenger.

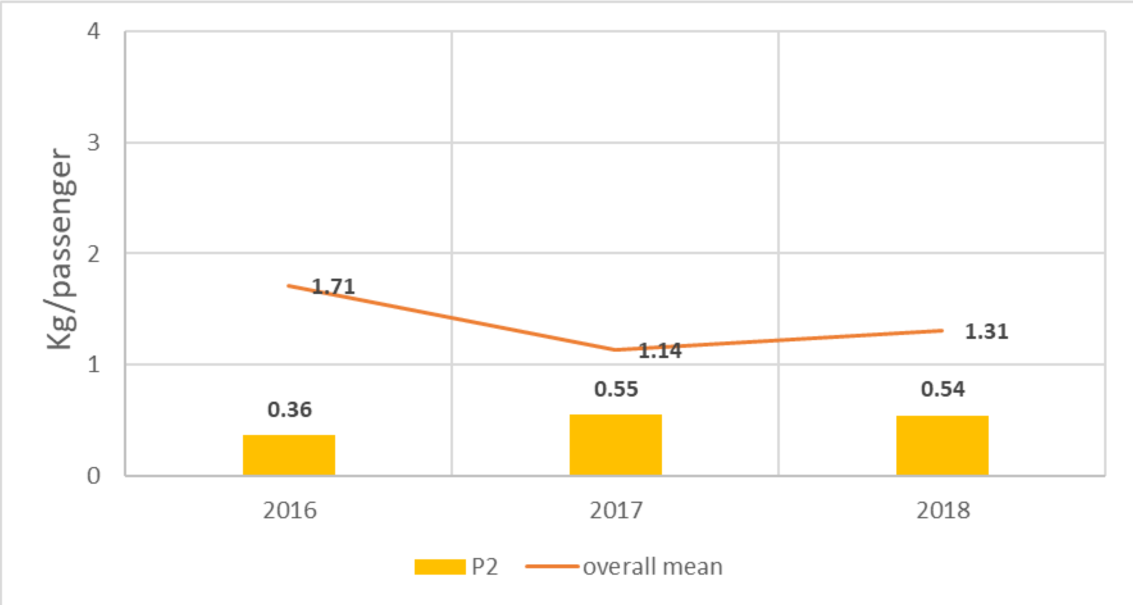

Figure 21 P2 Port's waste production per passenger.

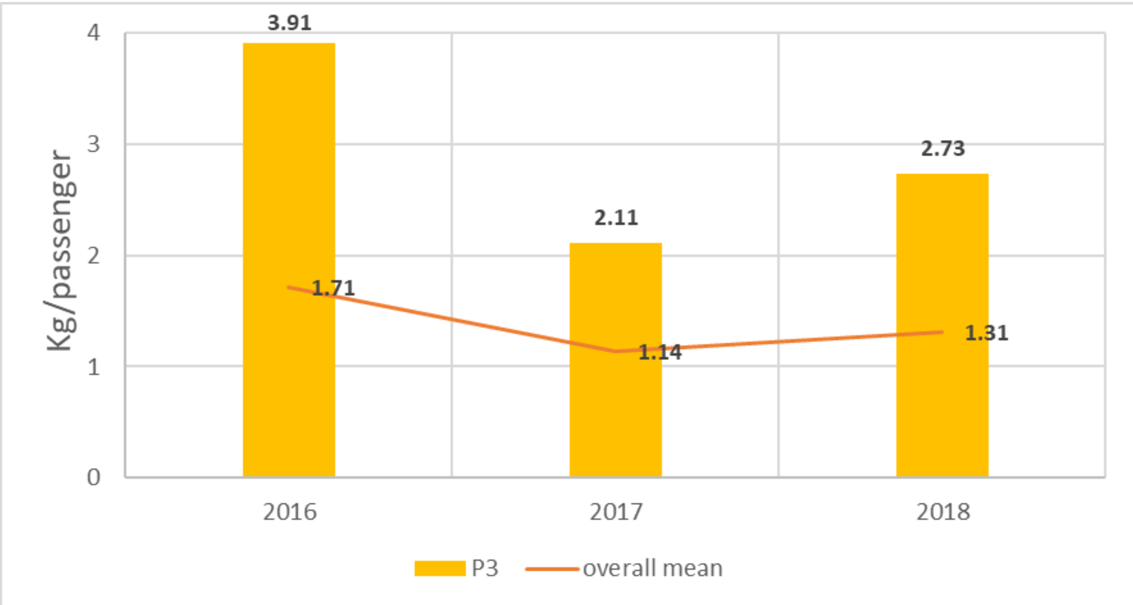

Figure 22 P3 Port's waste production per passenger.

3. Energy Consumption and Management at Adrigreen ports

Unfortunately, none of the ports provided a full account of energy consumption. In fact, they only provided data about electricity consumption which became the only possible dataset for benchmarking. All other possible energy consumptions (for example in terms of fuel for heating, cooling, hot water, etc.) were not supplied by any of the ports.

In 2018, the overall amount of electricity consumption ranked as P1>P2>P3 (Fig.22). P1 provided only 2016 energy consumption data. In order to make proper comparisons, in agreement with P1 Port Authority, the 2017 and 2018 energy consumption data were statistically estimated.

In 2018, the electricity consumption per port area ranked as P1>P2>P3 (Fig.23). Between 2016 and 2018 the mean electricity consumption per port area ranked as P1>P2>P3 (Fig.24).

At P1, the mean values of electricity consumption per area of the port were above the overall mean value by 0.8kWh/m2. On the contrary, at P2 and P3, the mean values of electricity consumption per area of the port were about 0.2 and 0.6kWh/m2 below the overall mean value.

Figures 25-27 show the comparisons between the values of electricity consumption per port area and the overall average values for the relevant years from 2016 to 2018.

In 2018, the electricity consumption per passenger ranked as P3>P1>P2 (Fig.28). In 2018, the electricity consumption per cruise passenger ranked as P2>P3>P1 (Fig.29). In 2018, the electricity consumption per ferry passenger ranked as P3>P1>P2 (Fig.30).

Between 2016 and 2018 the mean electricity consumption per passenger ranked as P3>P1>P2 (Fig.31). At P3, the mean values of electricity consumption per passenger were above the overall mean value by about 7.5kWh/passenger. P3 electricity consumption per passenger is affected by the high amount of electricity used by the leisure boats that are often moored at the port. On the contrary, at P1 and P2 ports, the mean values of electricity consumption per passenger were about 3.2 and 4.3kWh/passenger below the overall mean value.

Figures 31–34 show the comparisons between the values of electricity consumption per passenger and the overall average values for the relevant years from 2016 to 2018.

P2 has improved the energy efficiency of public lighting. P1 carried out an energy audit for its utilities; a plan for energy efficiency measurers was outlined. At P2, a geothermal heating and cooling system is going to serve the terminal building. This will likely reduce electricity consumption. At P2 there is a quay electrification system currently available only for leisure yachts and small boats.

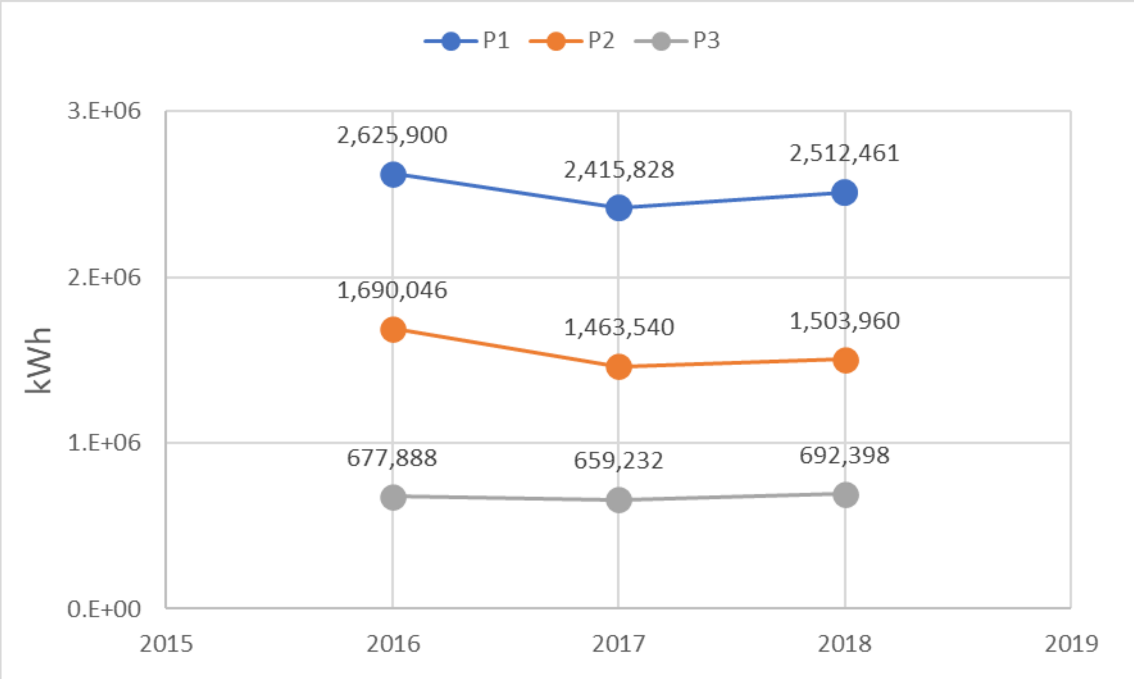

Figure 23 Total electricity consumption at ports.

3.1 Electricity consumption indicators

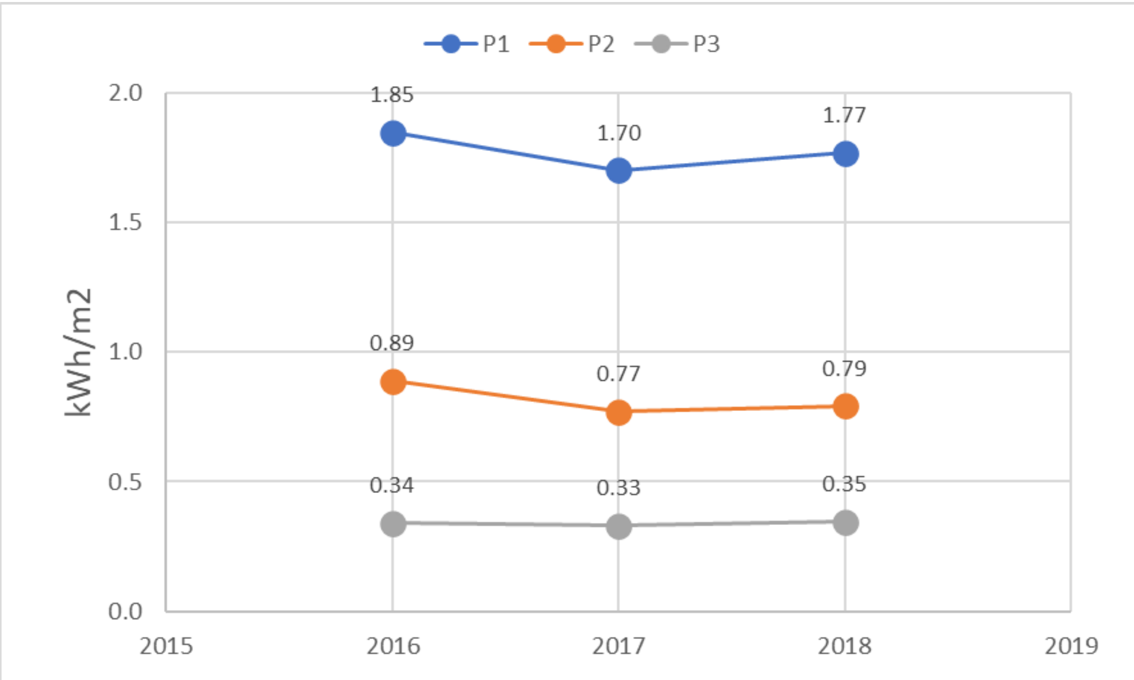

Figure 24 Ports’ electricity consumption per port area.

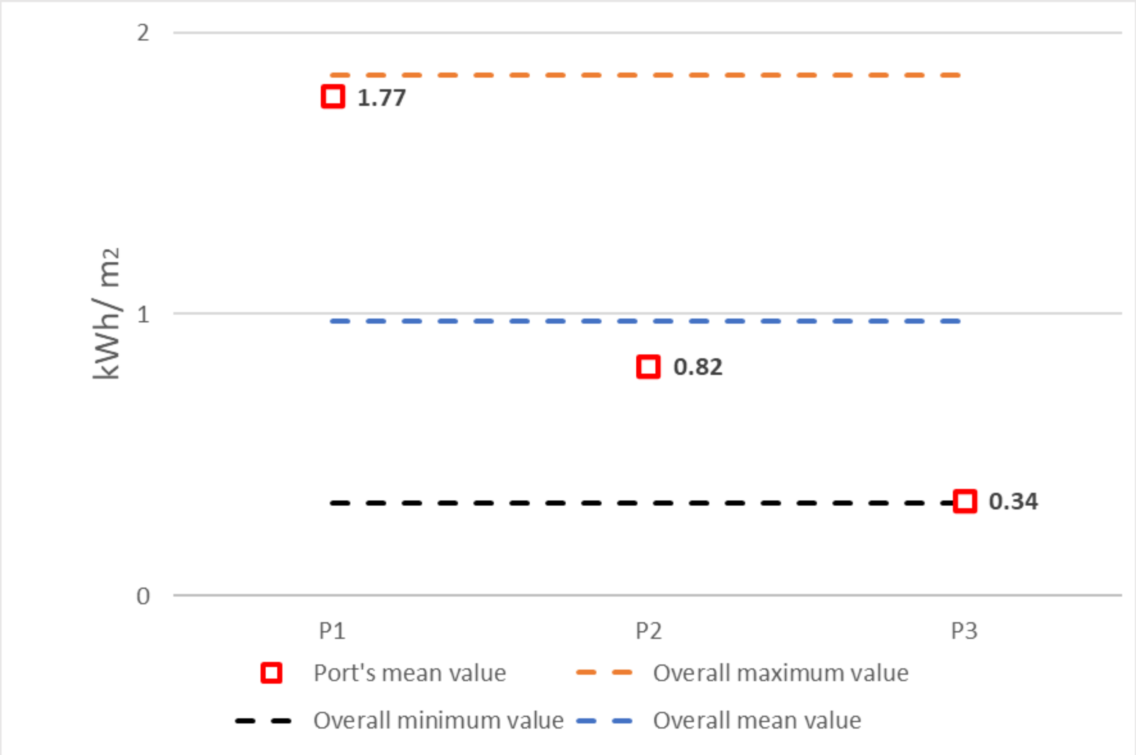

Figure 25 Port’s mean electricity consumption and overall maximum, minimum and mean electricity consumption values per port area in the time period 2016–2018.

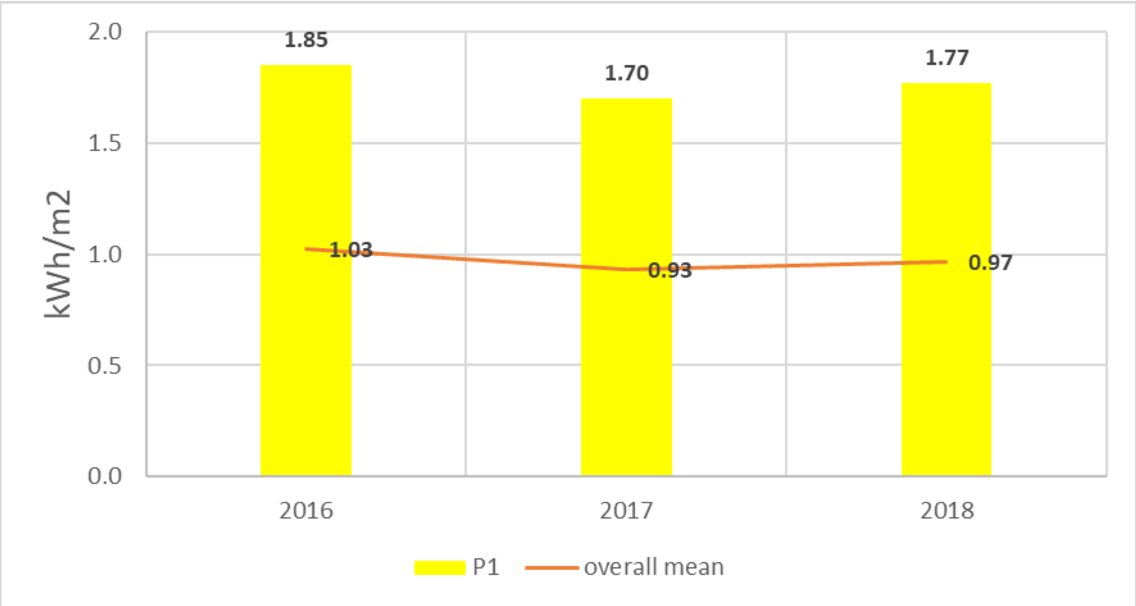

Figure 26 P1 electricity consumption per port area.

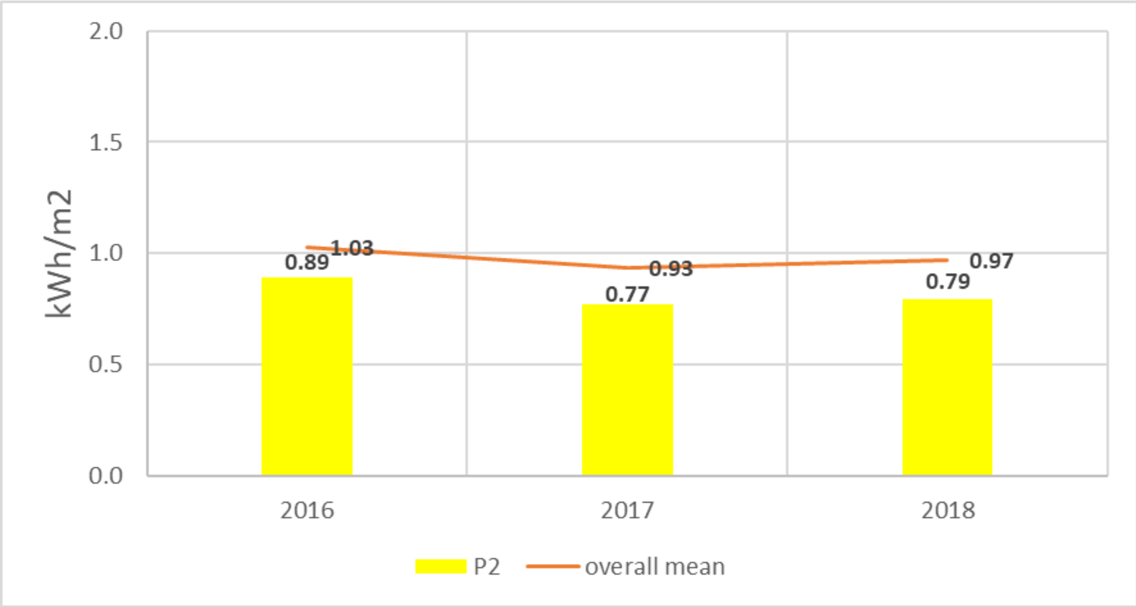

Figure 27 P2 electricity consumption per port area.

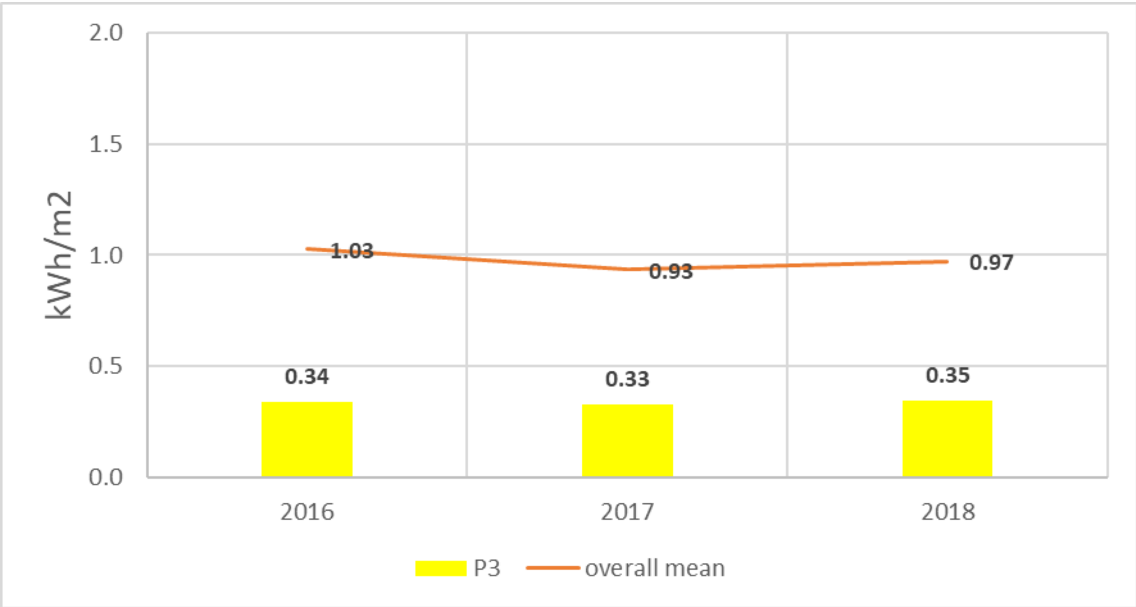

Figure 28 P3 electricity consumption per port area.

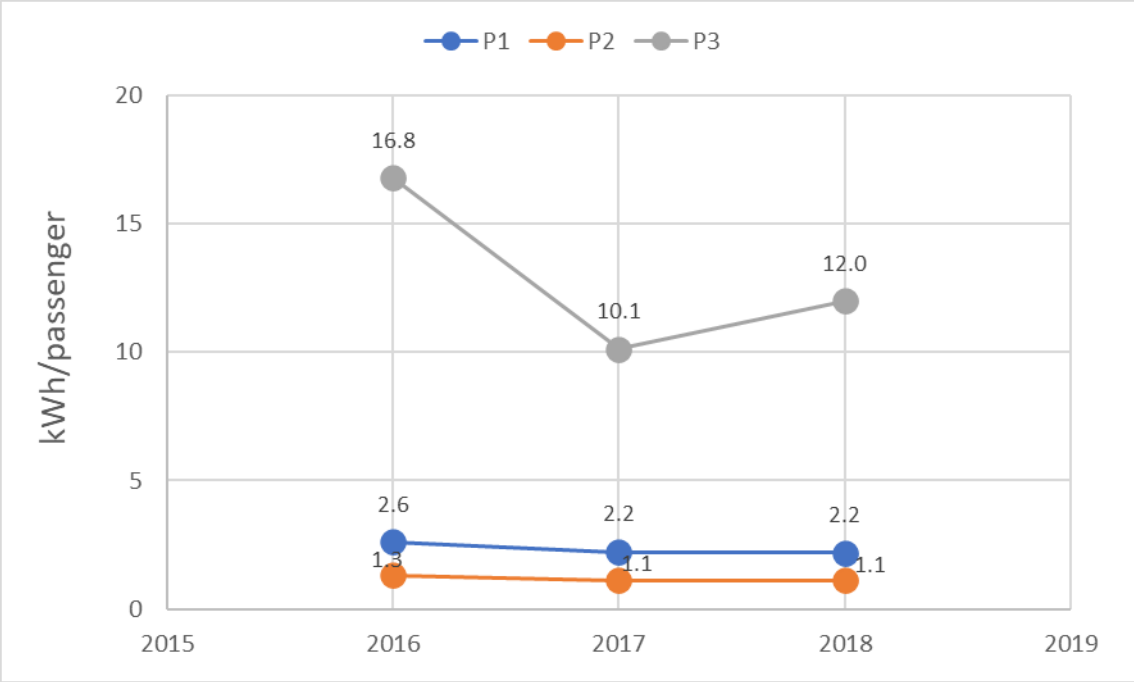

Figure 29 Electricity consumption per passenger (ferry and cruise passengers).

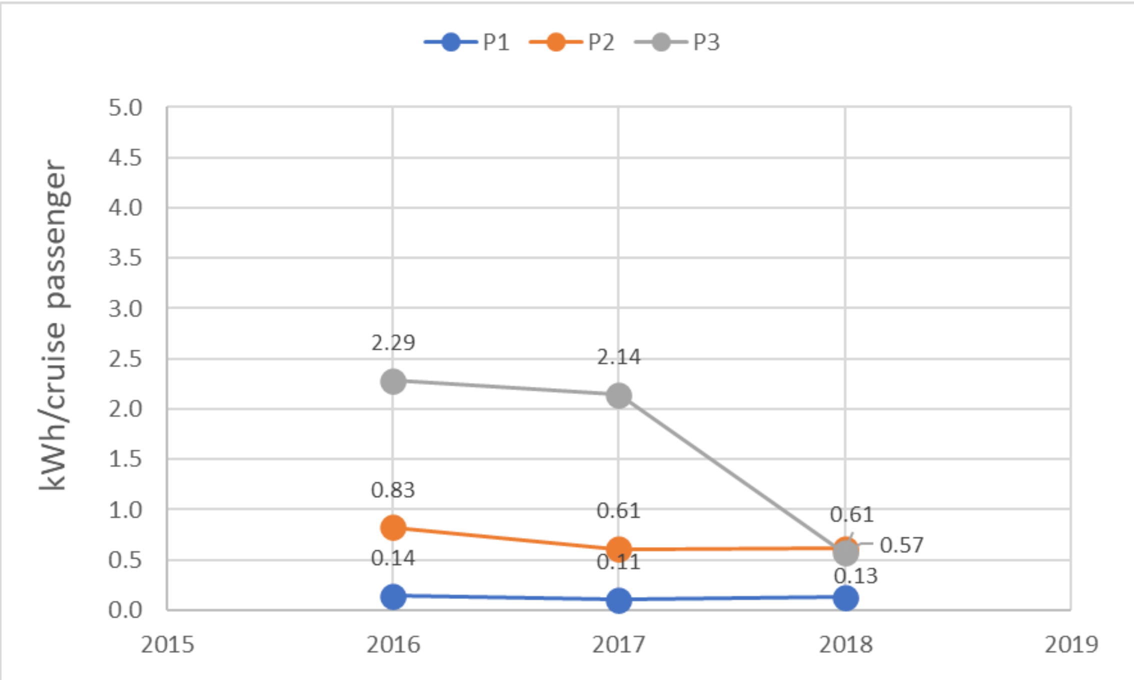

Figure 30 Ports’ electricity consumption per cruise passenger.

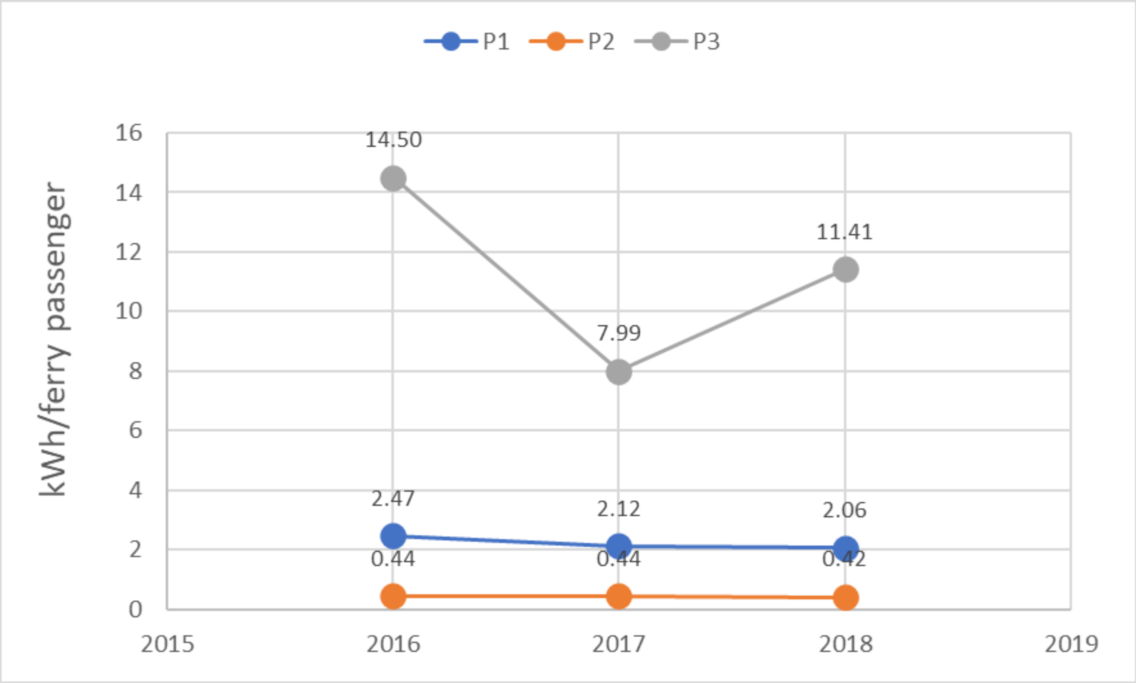

Figure 31 Ports' electricity consumption per ferry passenger.

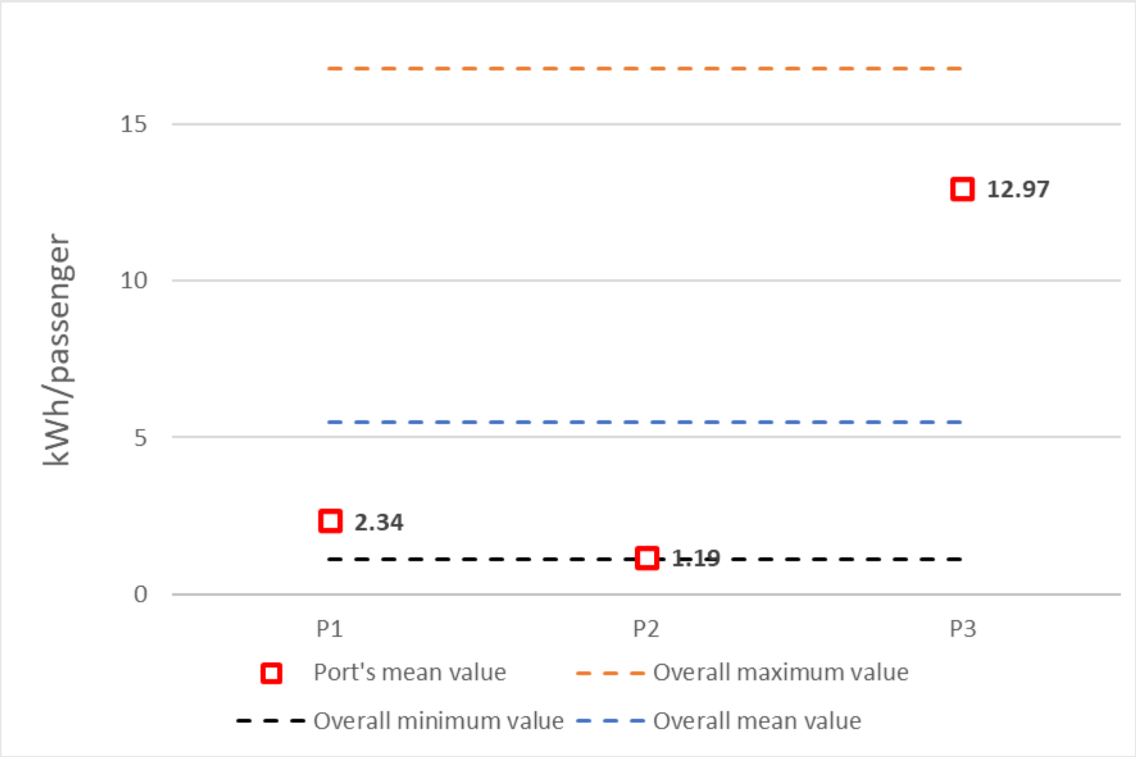

Figure 32 Ports' mean electricity consumption vs. overall maximum, minimum and mean values per passenger 2016–2018.

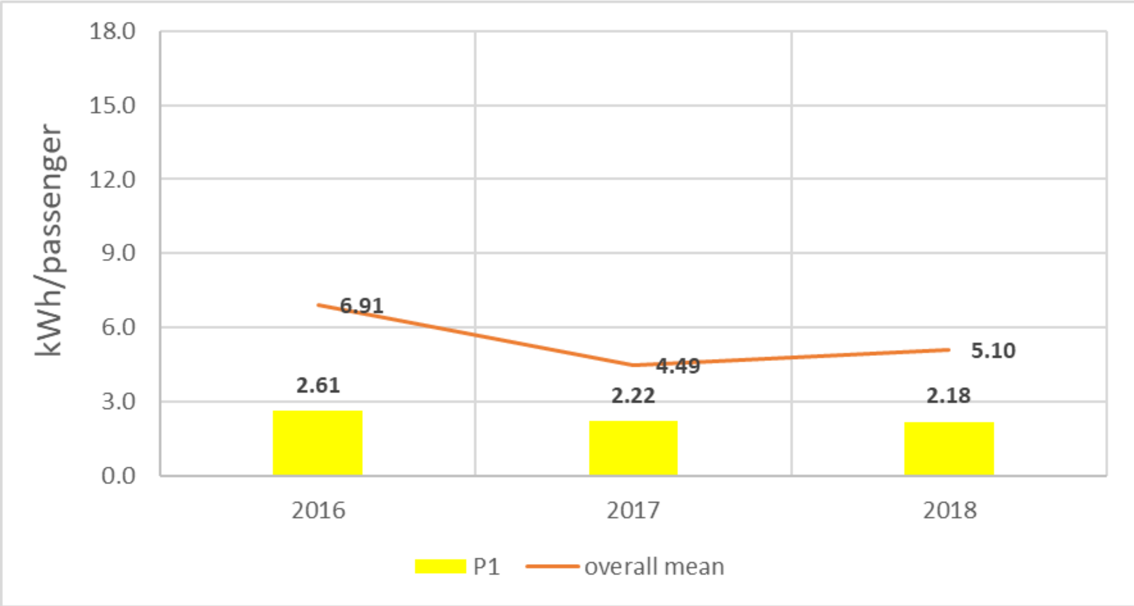

Figure 33 P1 electricity consumption per passenger.

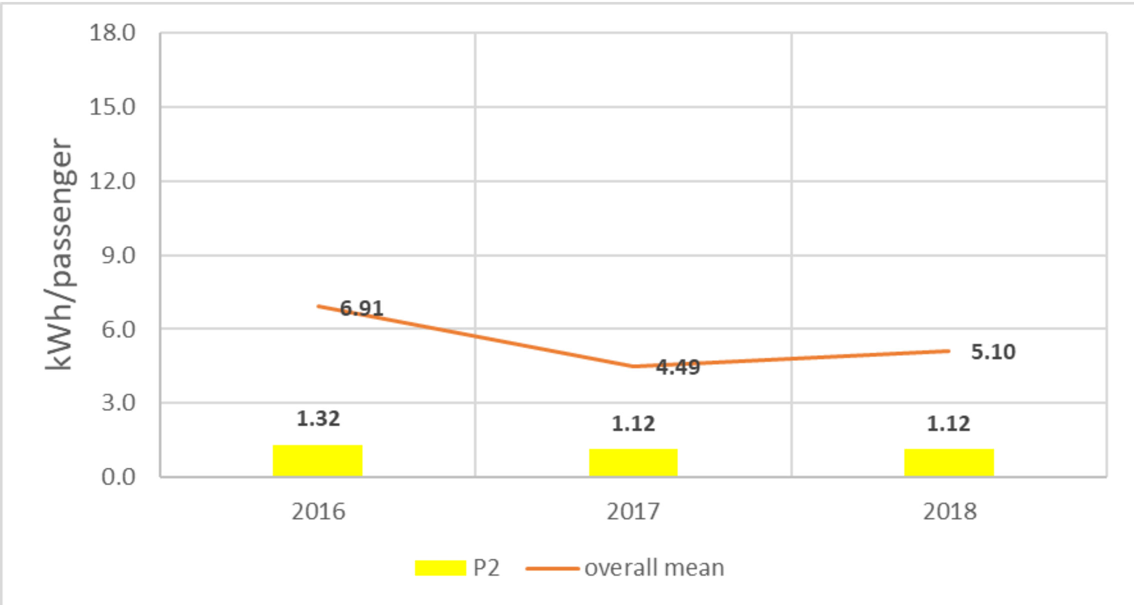

Figure 34 P2 electricity consumption per passenger.

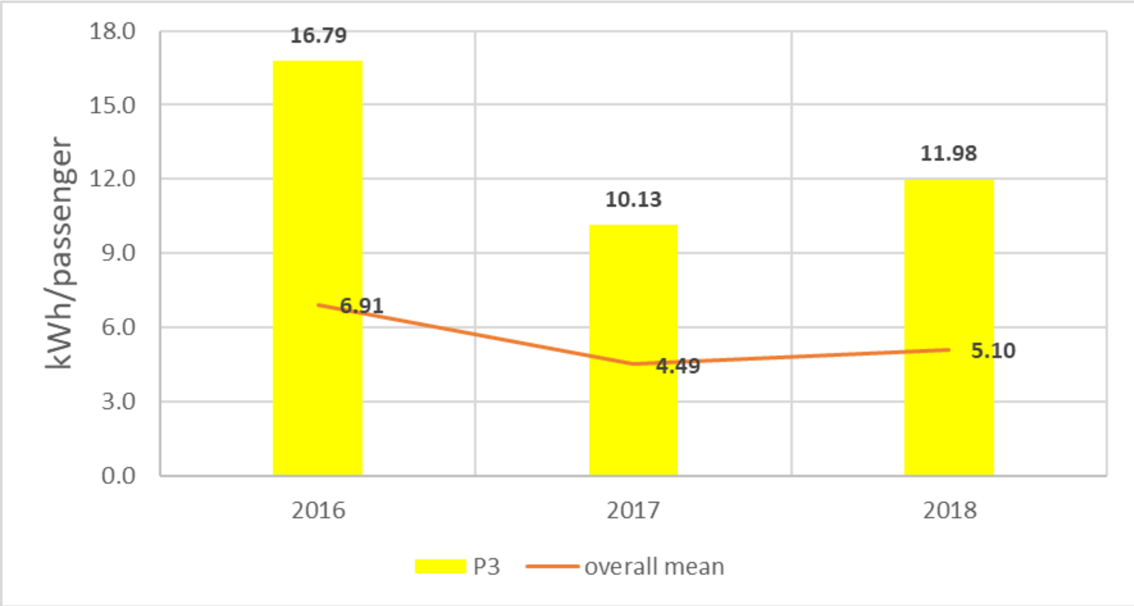

Figure 35 P3 electricity consumption per passenger.

4. Greenhouse gases emissions deriving from water consumption at Adrigreen ports

In 2018, GHG emissions deriving from water consumption ranked as P1>P2>P3 (Fig.36).

In 2018, GHG emissions deriving from water consumption per area of the port ranked as P1>P2>P3 (Fig 37).

Between 2016 and 2018 the mean GHG emissions deriving from water consumption per area of the port ranked as P1>P2>P3 (Fig.38).

At A1, the mean value of GHG emissions deriving from water consumption per area of the port was above the overall mean value by about 0.03 kg CO2eq/m2 while at P2 and P3 the mean values of GHG emissions deriving from water consumption per area of the port were about 0.02 kg CO2eq/m2 below the overall mean value.

Figures 39–41 show comparisons between the port's value of GHG emissions deriving from water consumption per area of the port and the overall mean value of the respective year from 2016 to 2018.

In 2018, GHG emissions deriving from water consumption per passenger ranked as P1>P3>P2 (Fig.42).

Between 2016 and 2018 the mean GHG emissions deriving from water consumption per passenger ranked as P1>P3>P2 (Fig.43).

At P1, the mean value of GHG emissions deriving from water consumption per a passenger was above the overall mean value by about 0.04 kg CO2eq/ passenger.

On the contrary, at P2 and P3 the mean values of GHG emissions deriving from water consumption per passenger were about 0.03 and 0.01 kg CO2eq/ passenger below the overall mean value.

Figures 44–46 show comparisons between the port's value of GHG emissions deriving from water consumption per passenger and the overall mean value of the respective year from 2016 to 2018.

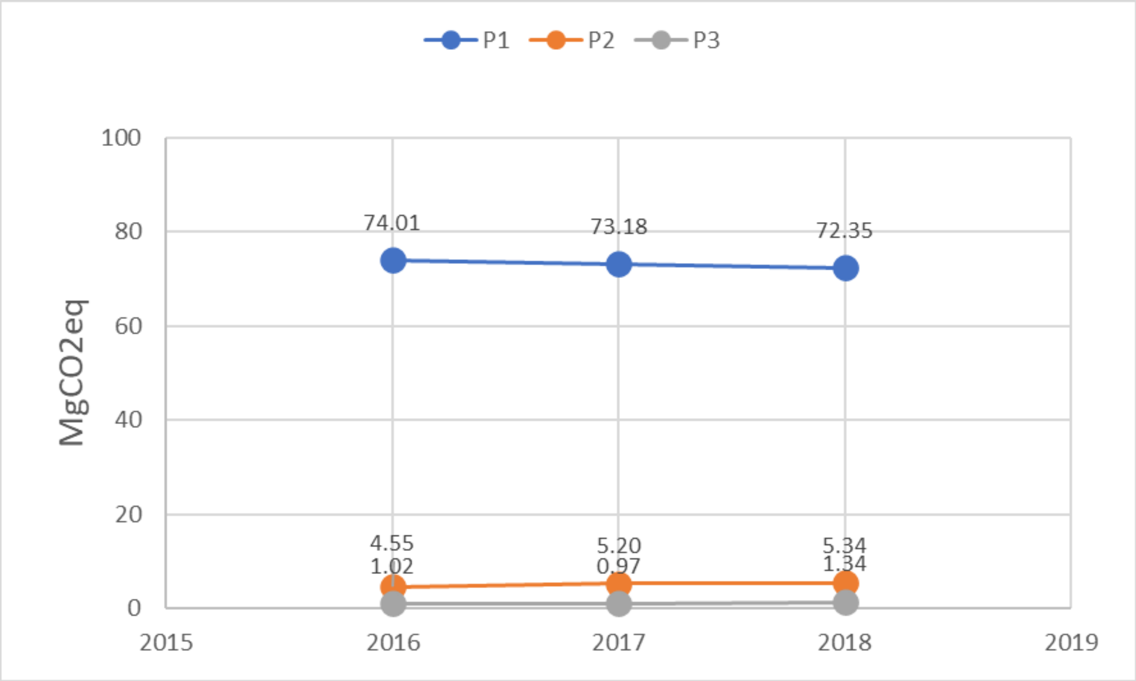

Figure 36 Ports' GHG emissions deriving from water consumption.

4.1 Indicators for greenhouse gases emissions deriving from ports' water consumption

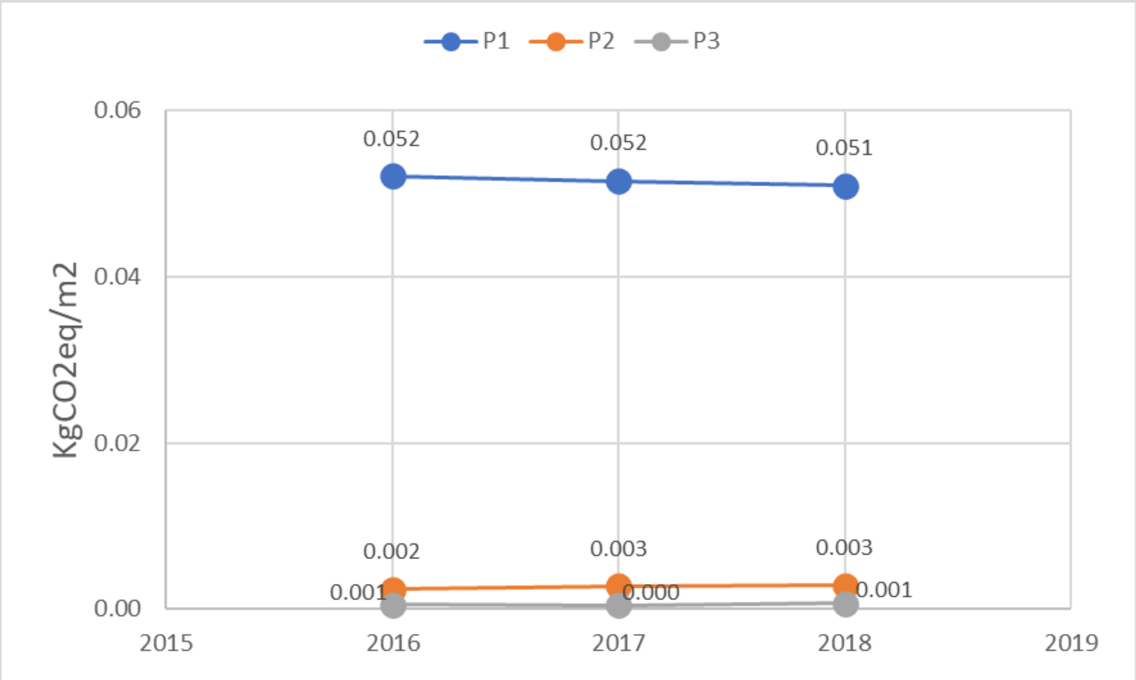

Figure 37 Ports' GHG emissions deriving from water consumption per port area.

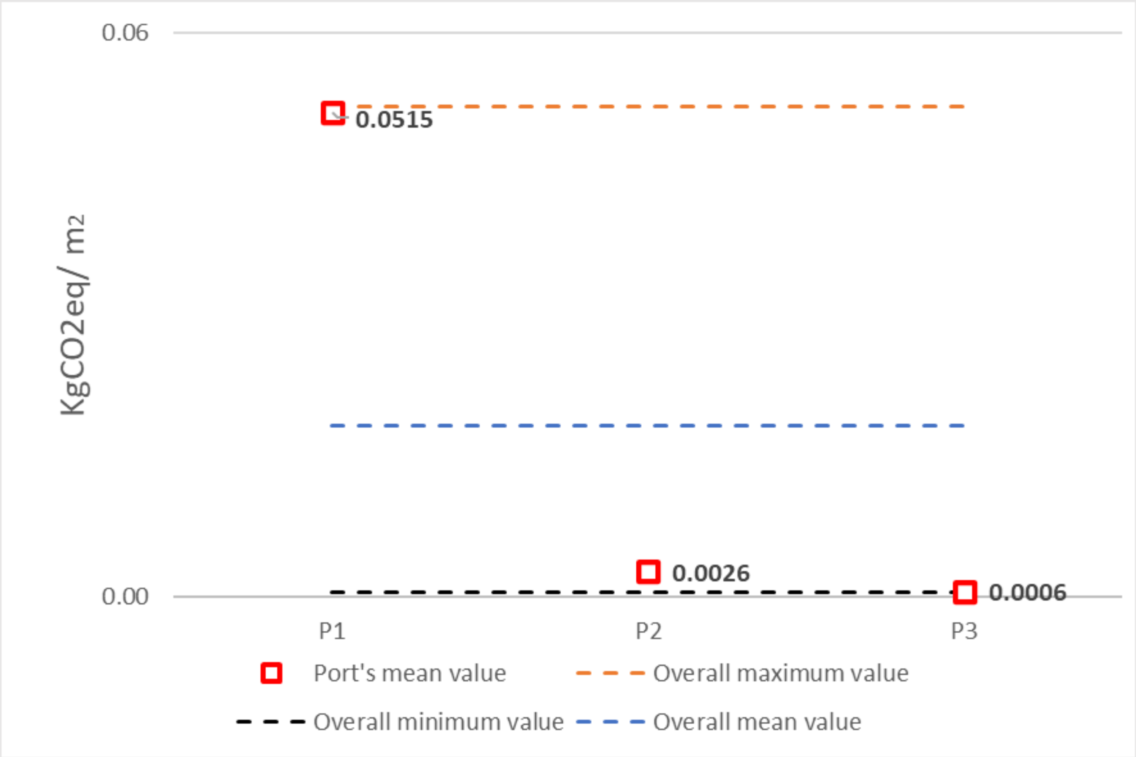

Figure 38 Ports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from water consumption per port area in the time period 2016–2018.

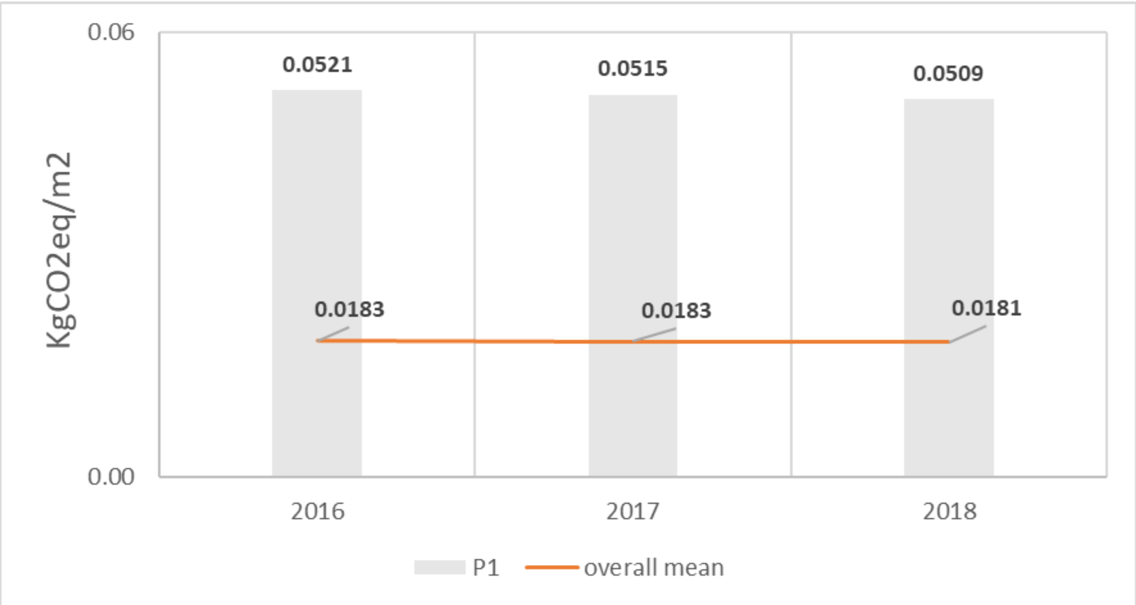

Figure 39 P1 GHG emissions deriving from water consumption per port area.

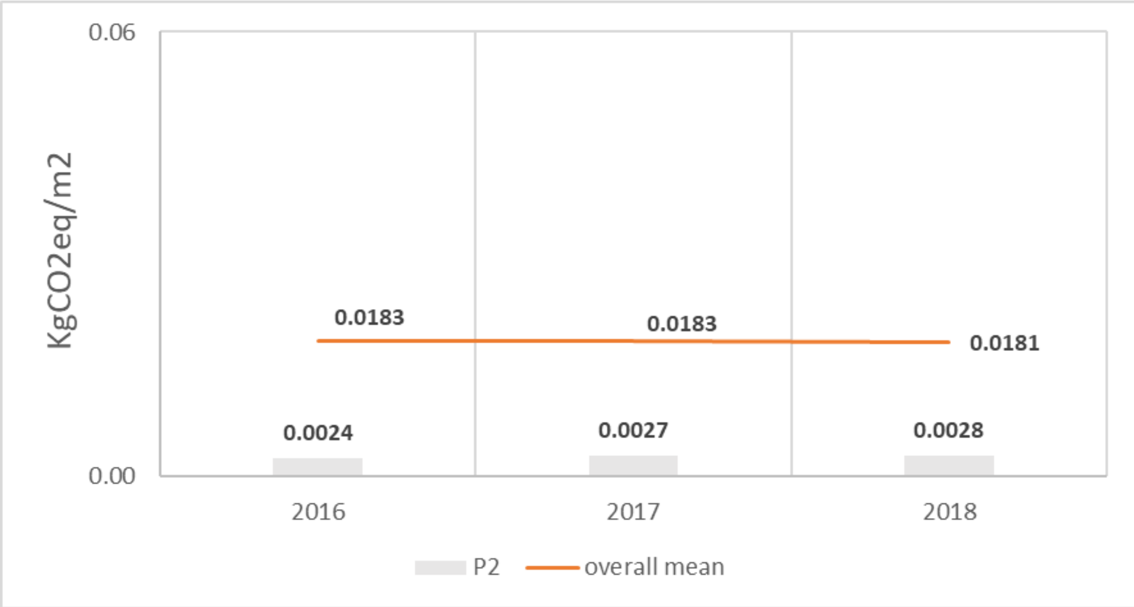

Figure 40 P2 GHG emissions deriving from water consumption per port area.

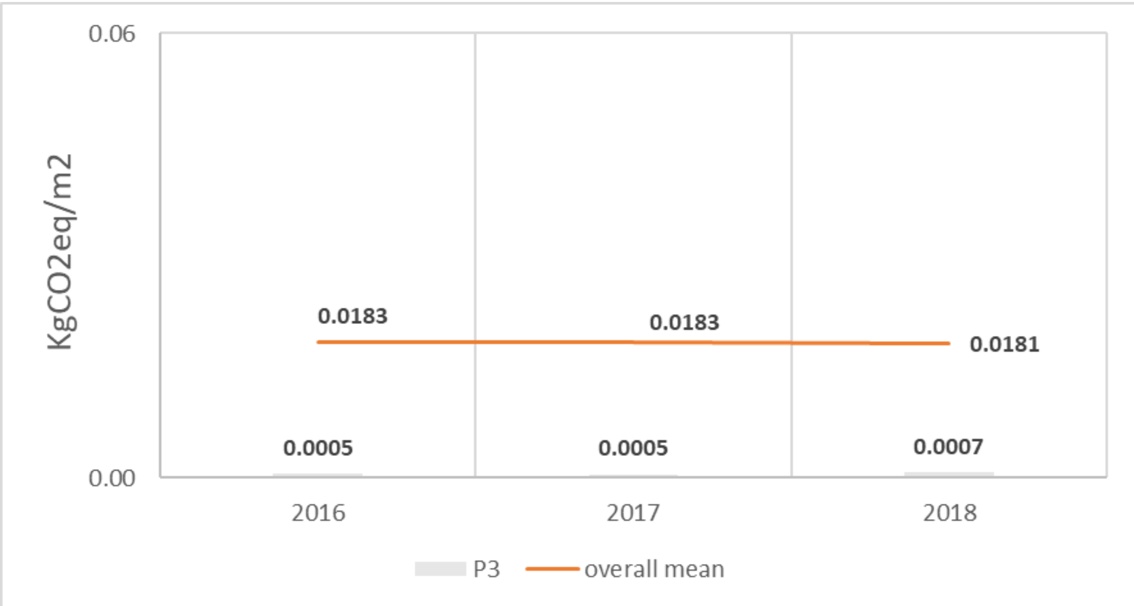

Figure 41 P3 GHG emissions deriving from water consumption per port area.

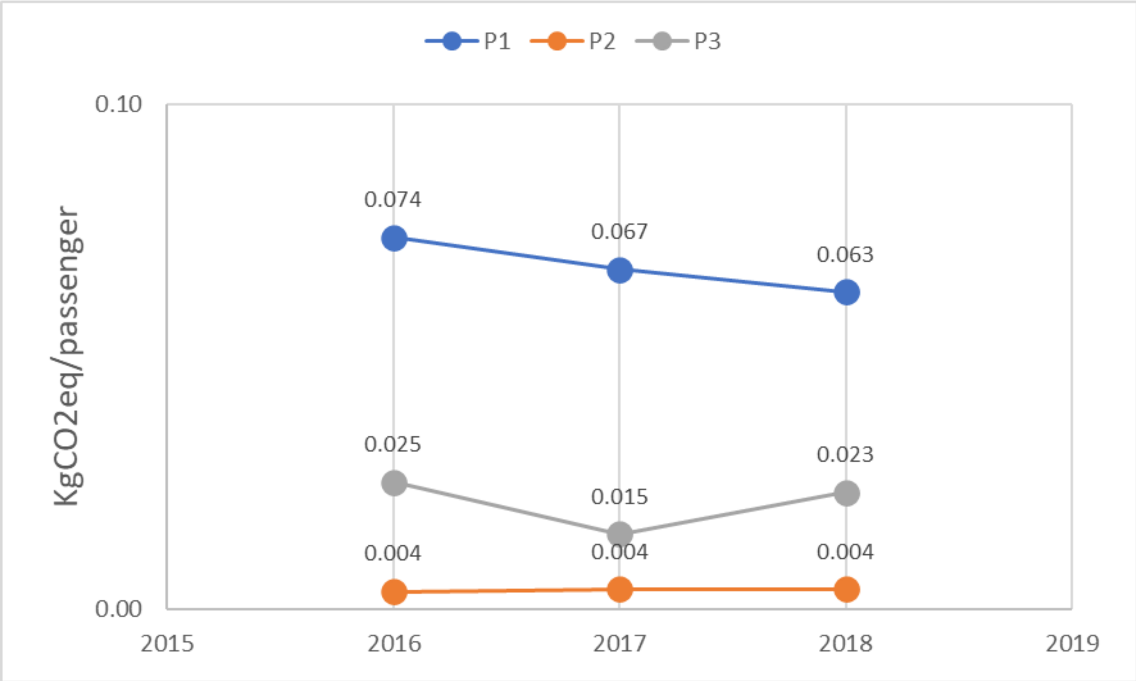

Figure 42 Ports' GHG emissions deriving from water consumption per passenger.

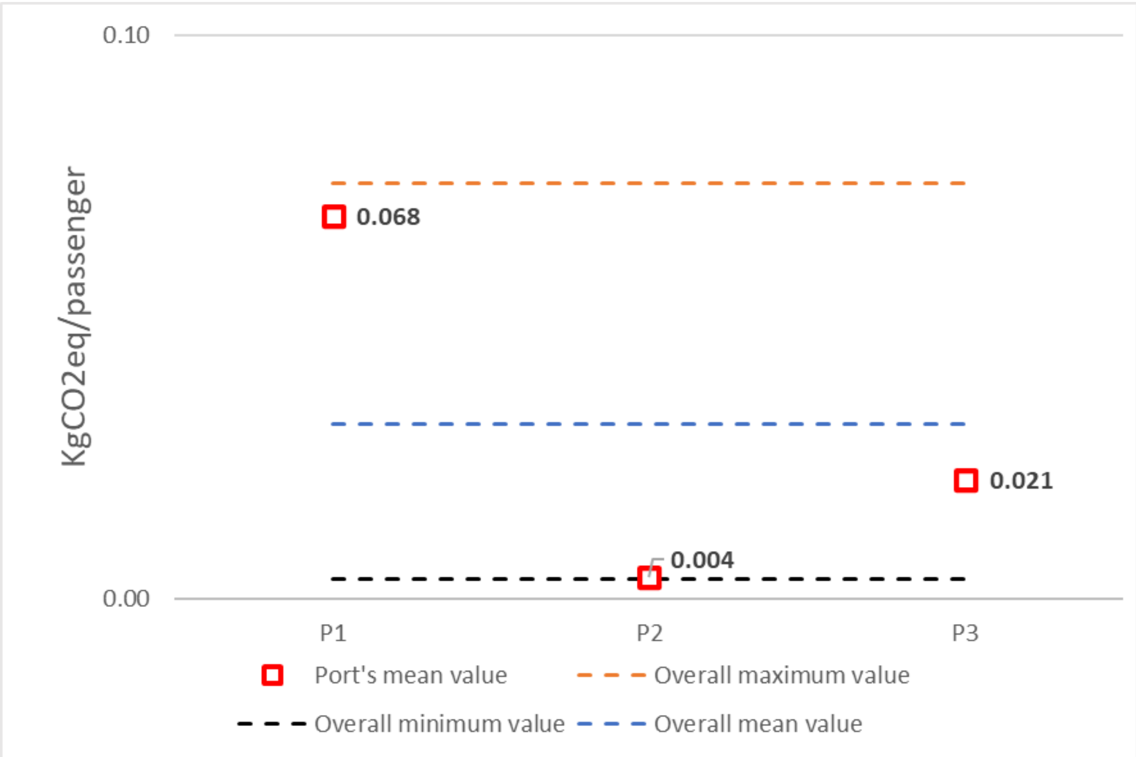

Figure 43 Ports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from water consumption per passenger in the time period 2016–2018.

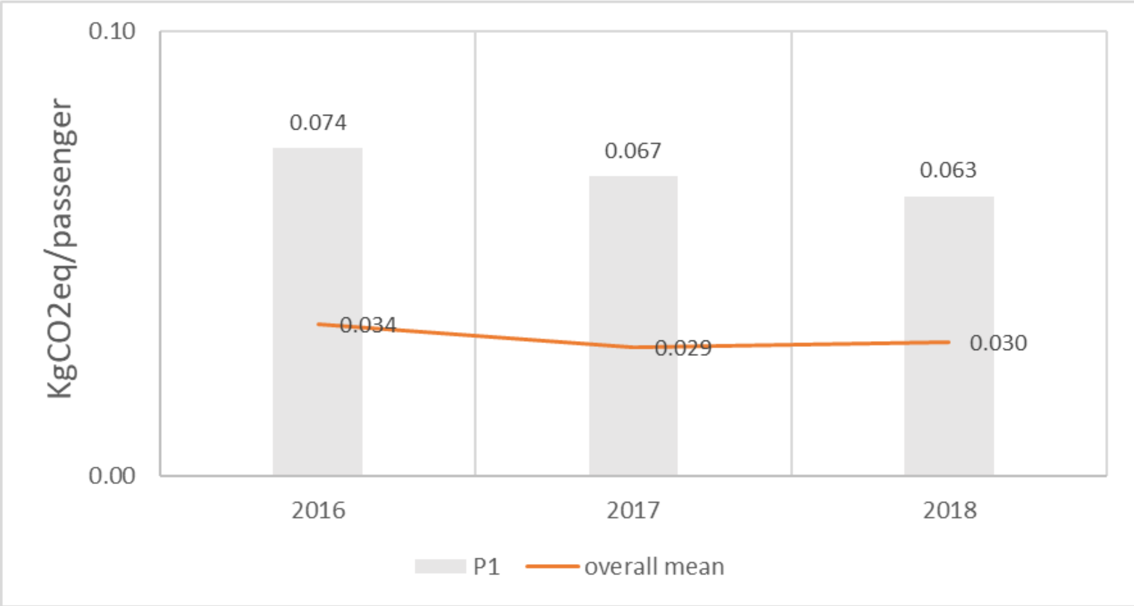

Figure 44 P1 Port's GHG emissions deriving from water consumption per passenger.

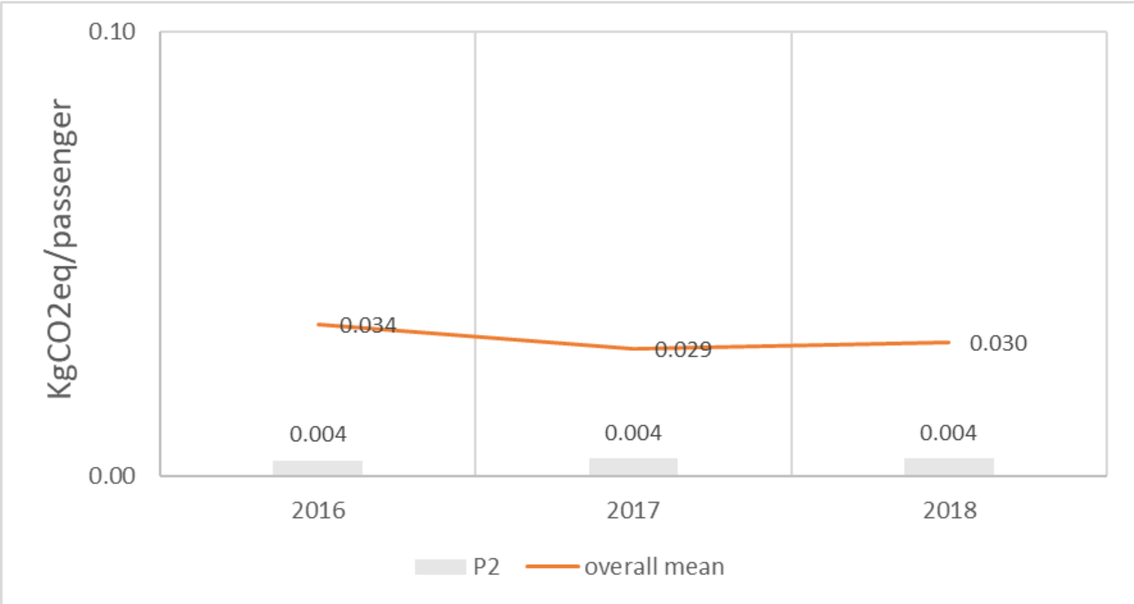

Figure 45 P2 Port's GHG emissions deriving from water consumption per passenger.

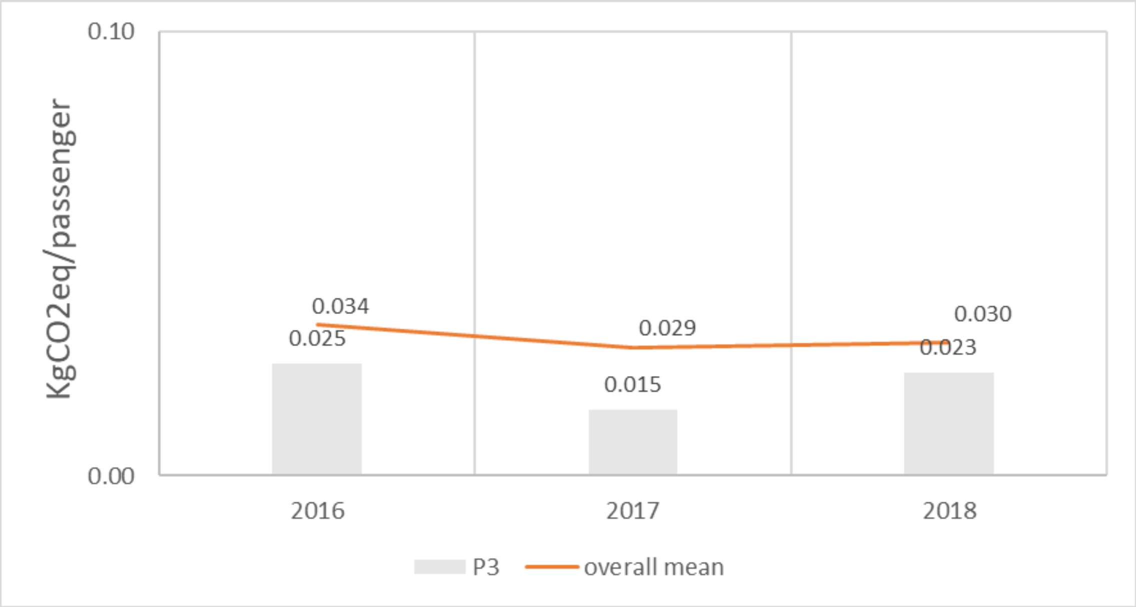

Figure 46 P3 Port's GHG emissions deriving from water consumption per passenger.

5. Greenhouse gases emissions due to the fractions of waste produced at Adrigreen ports

In 2018, GHG emissions deriving from waste production ranked as P1>P2>P3 (Fig.47).

In 2018, GHG emissions deriving from waste production per area of the port ranked as P1>P2>P3 (Fig.48).

Between 2016 and 2018 the mean GHG emissions deriving from waste production per area of the port ranked as P1>P2>P3 (Fig.49).

At P1, the mean value of GHG emissions deriving from waste production per area of the port was above the overall mean value by about 0.13 kg CO2eq/m2.

On the contrary, at P2 and P3 the mean values of GHG emissions deriving from waste production per area of the port were about 0.6 and 0.8 kg CO2eq/m2 below the overall mean value, respectively.

Figures 50–52 show comparisons between the port's value of GHG emissions deriving from waste production per area of the port and the overall mean value of the respective year from 2016 to 2018.

In 2018, GHG emissions deriving from waste production per passenger ranked as P3>P1>P2 (Fig.53).

Between 2016 and 2018 the mean GHG emissions deriving from waste production per passenger ranked as P3>P1>P2 (Fig.54).

At A3, the mean value of GHG emissions deriving from waste production per passenger was above the overall mean value by about 0.35 kg CO2eq/passenger.

On the contrary, at P1 and P2 the mean values of GHG emissions deriving from waste production per passenger were about 0.1 and 0.3 kg CO2eq/passenger below the overall mean value, respectively.

Figures 55–57 show comparisons between the ports' value of GHG emissions deriving from waste production per passenger and the overall mean value of the respective year from 2016 to 2018.

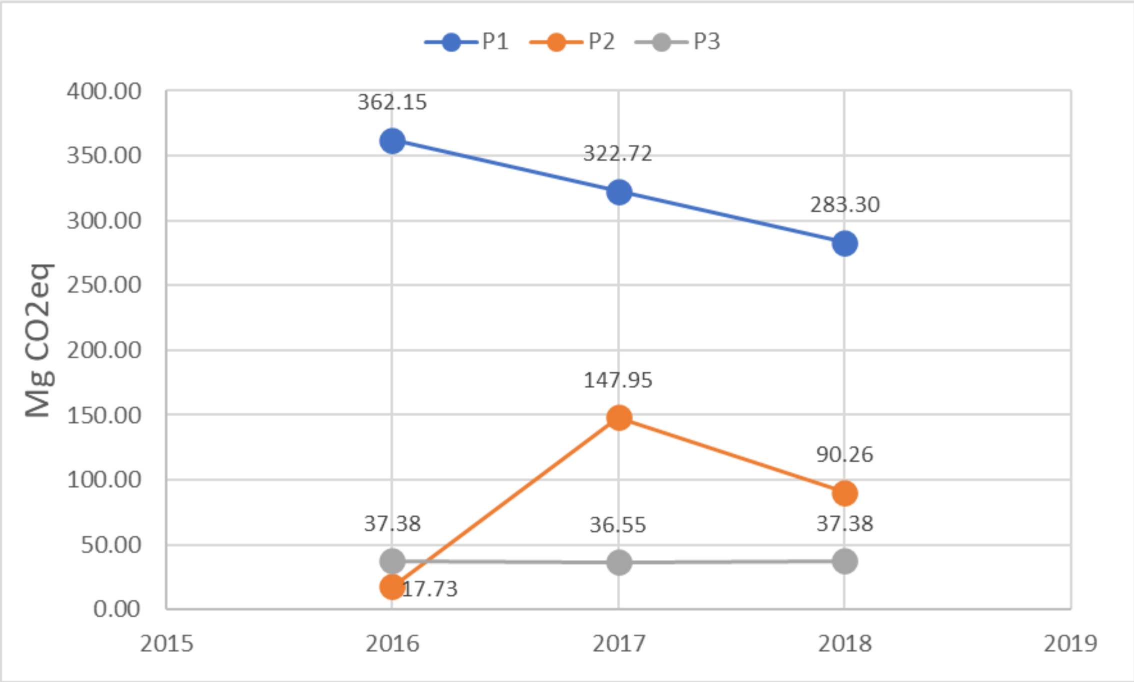

Figure 47 Ports' GHG emissions deriving from waste production.

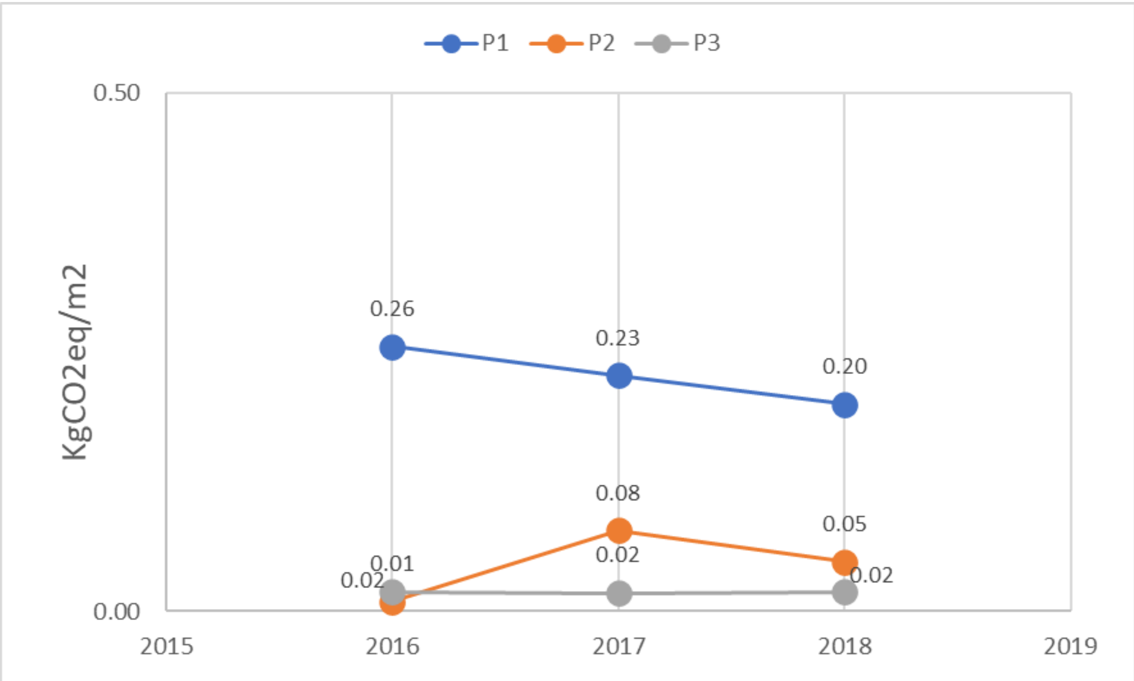

Figure 48 Ports' GHG emissions deriving from waste production per port area.

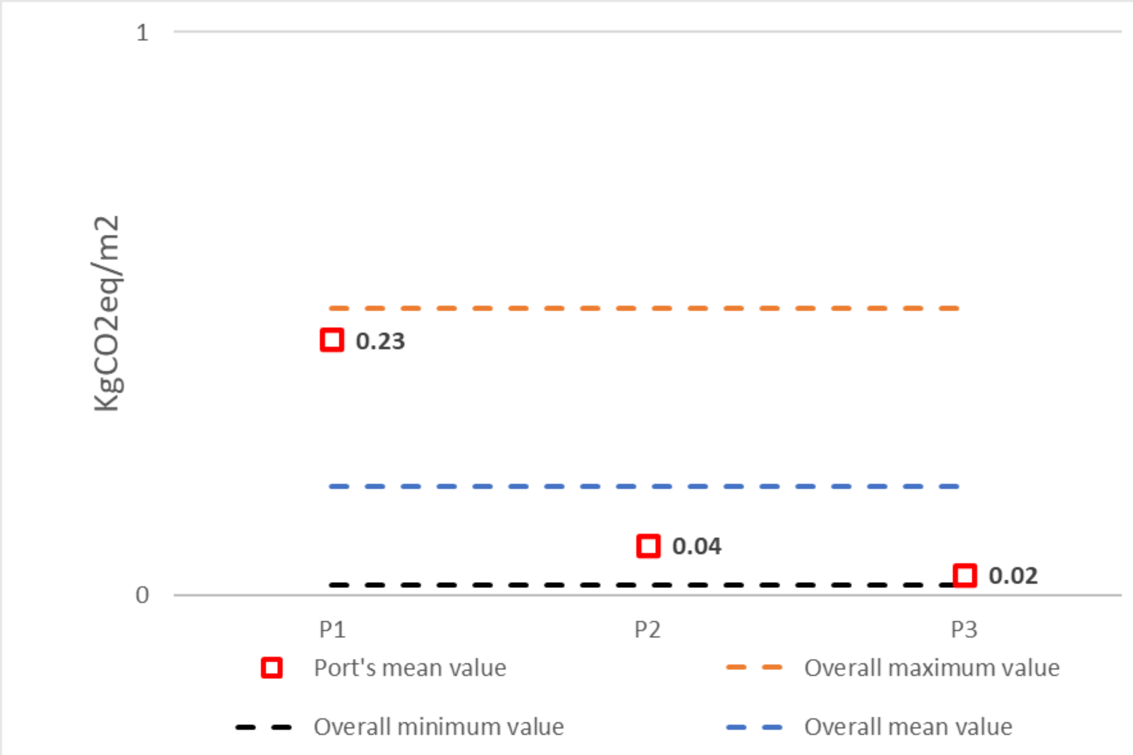

Figure 49 Ports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from waste production per port area in the time period 2016–2018.

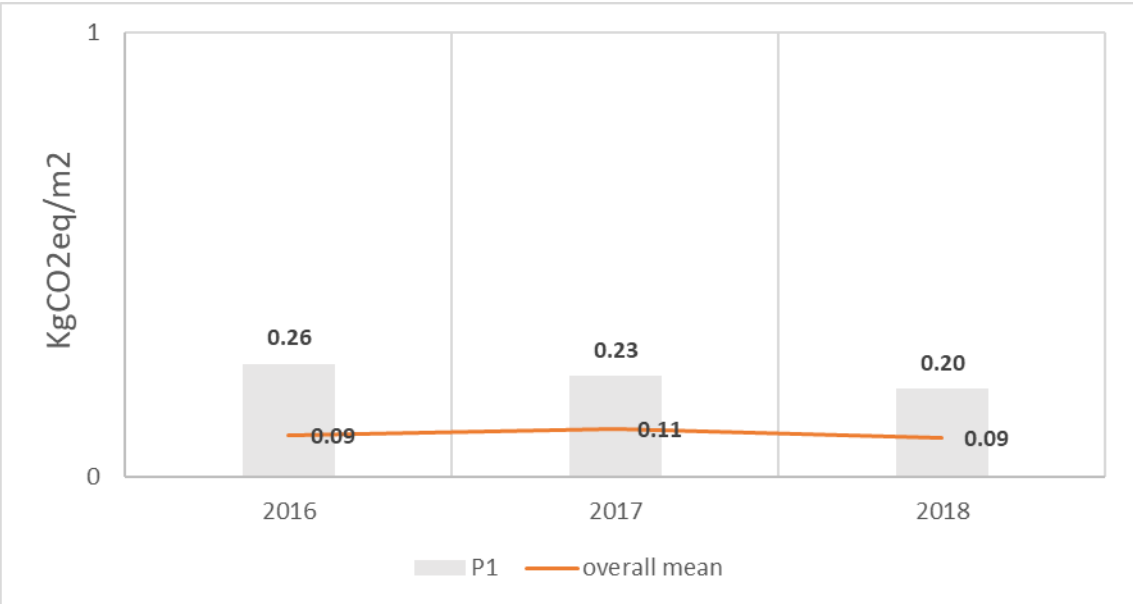

Figure 50 P1 GHG emissions deriving from waste production per port area.

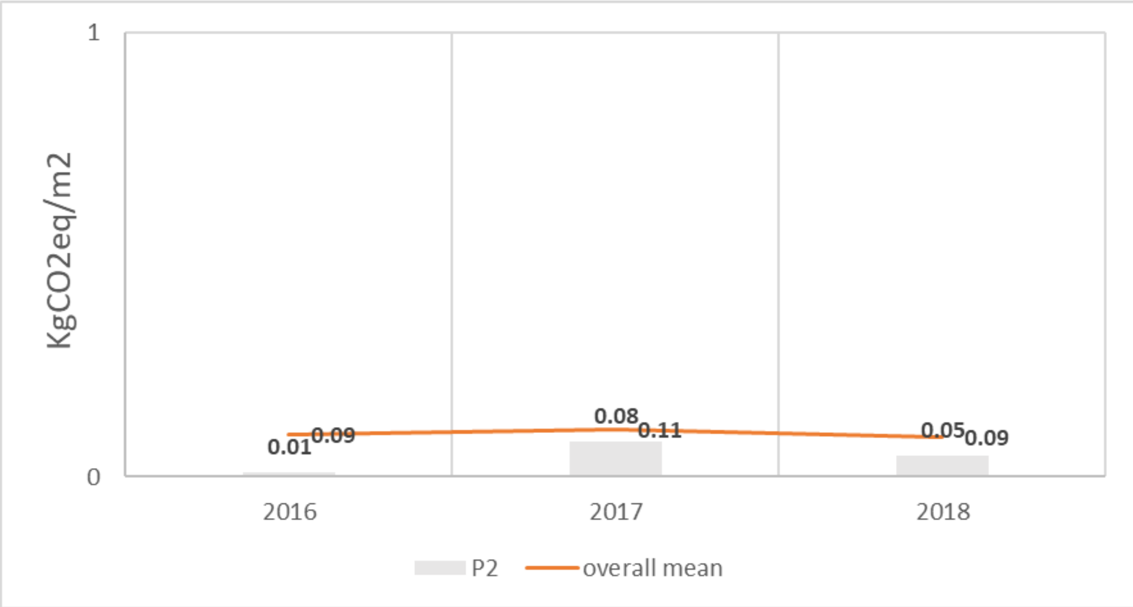

Figure 51 P2 GHG emissions deriving from waste production per port area.

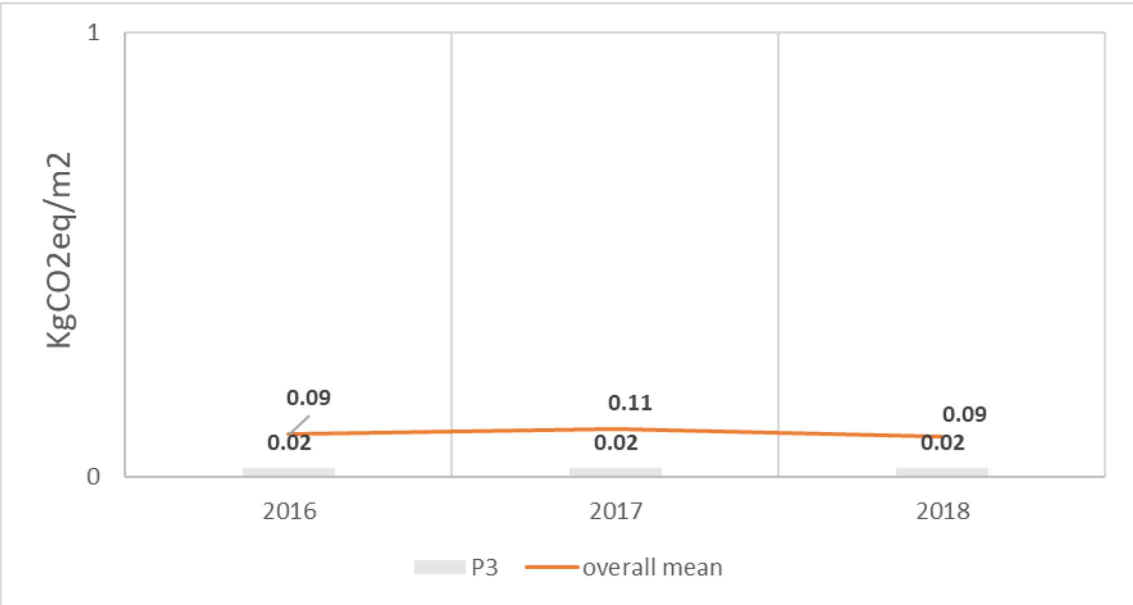

Figure 52 P3 GHG emissions deriving from waste production per port area.

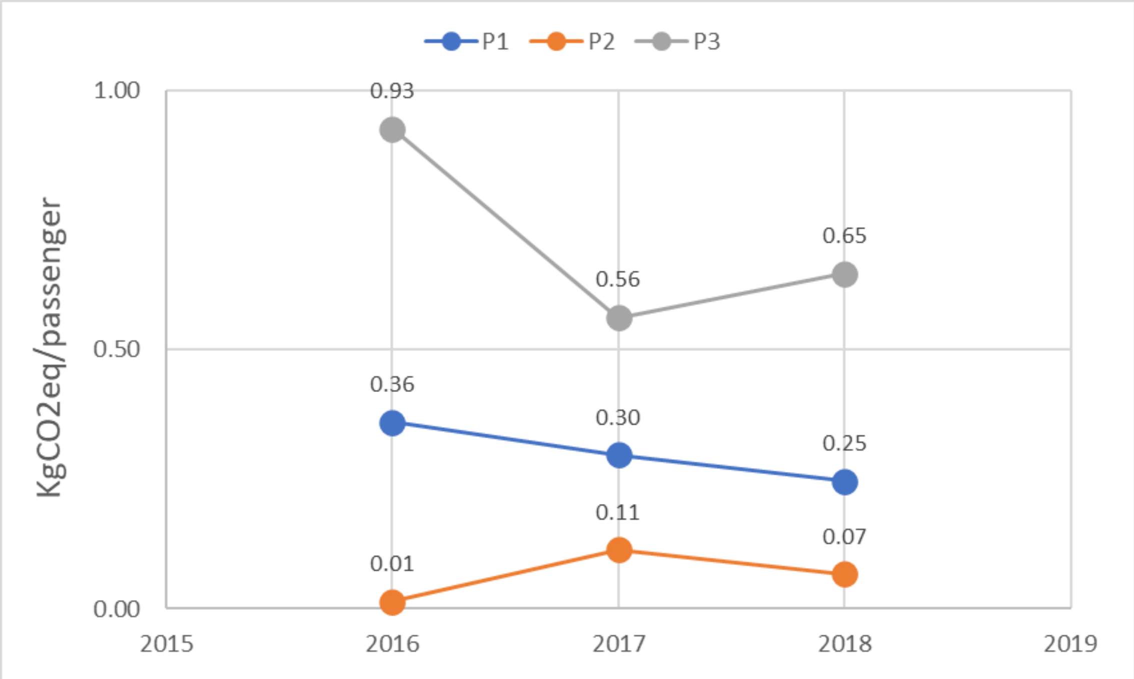

Figure 53 Ports' GHG emissions deriving from waste production per passenger.

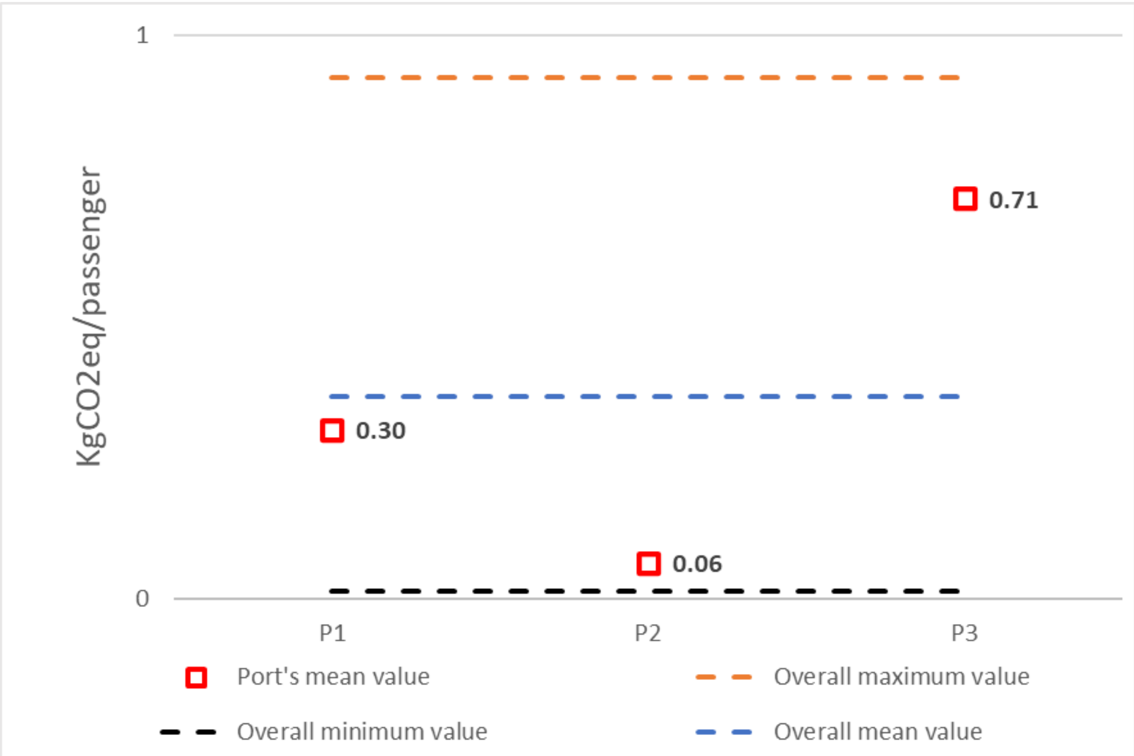

Figure 54 Ports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from waste production per passenger in the time period 2016–2018.

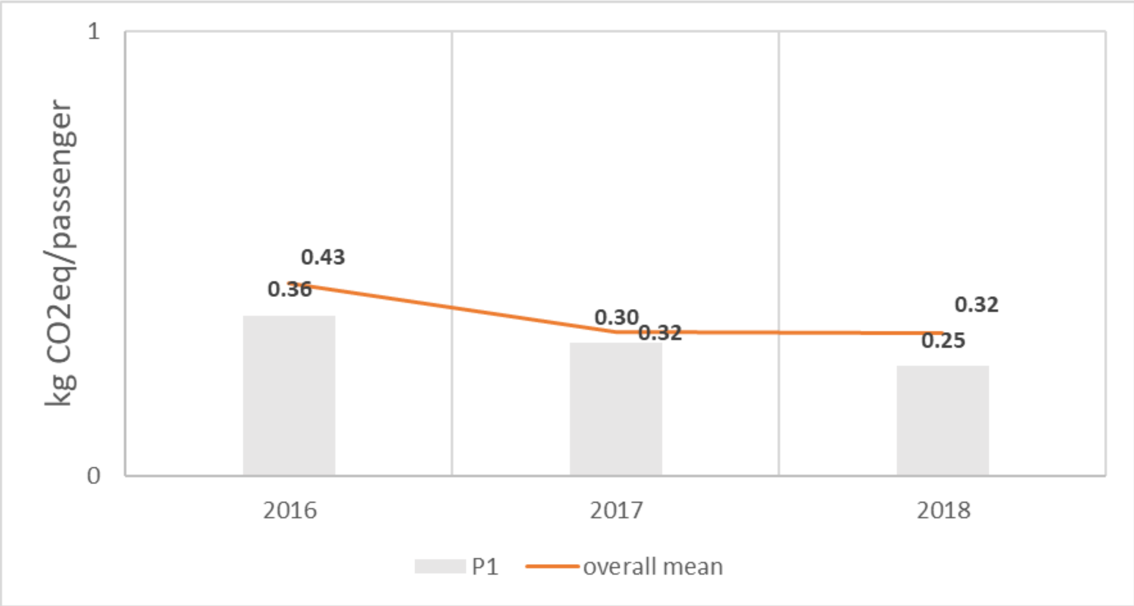

Figure 55 P1 GHG emissions deriving from waste production per passenger.

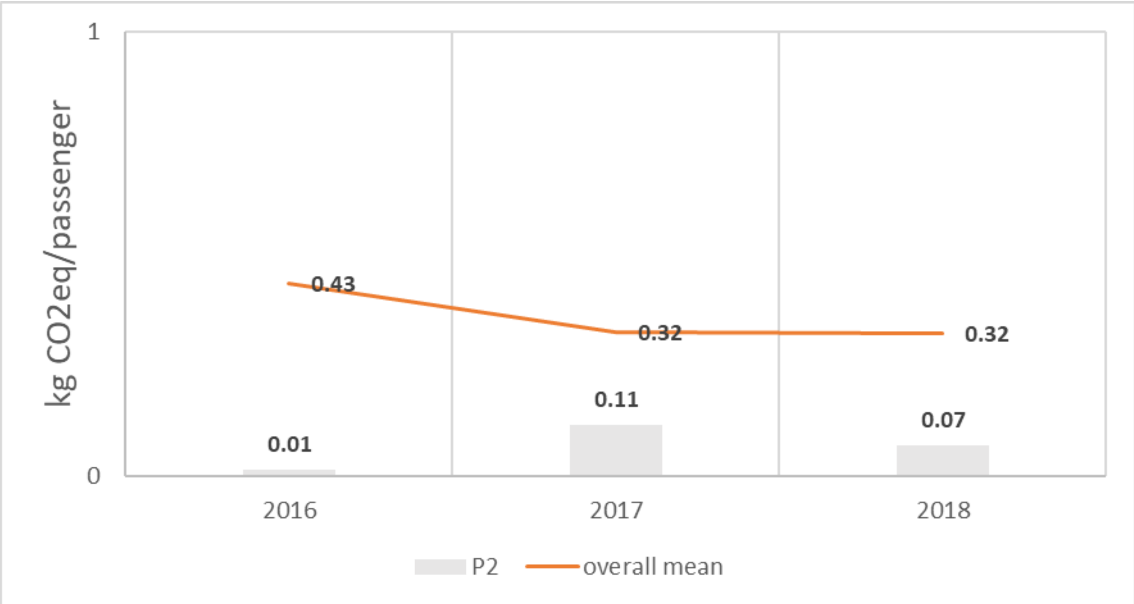

Figure 56 P2 GHG emissions deriving from waste production per passenger.

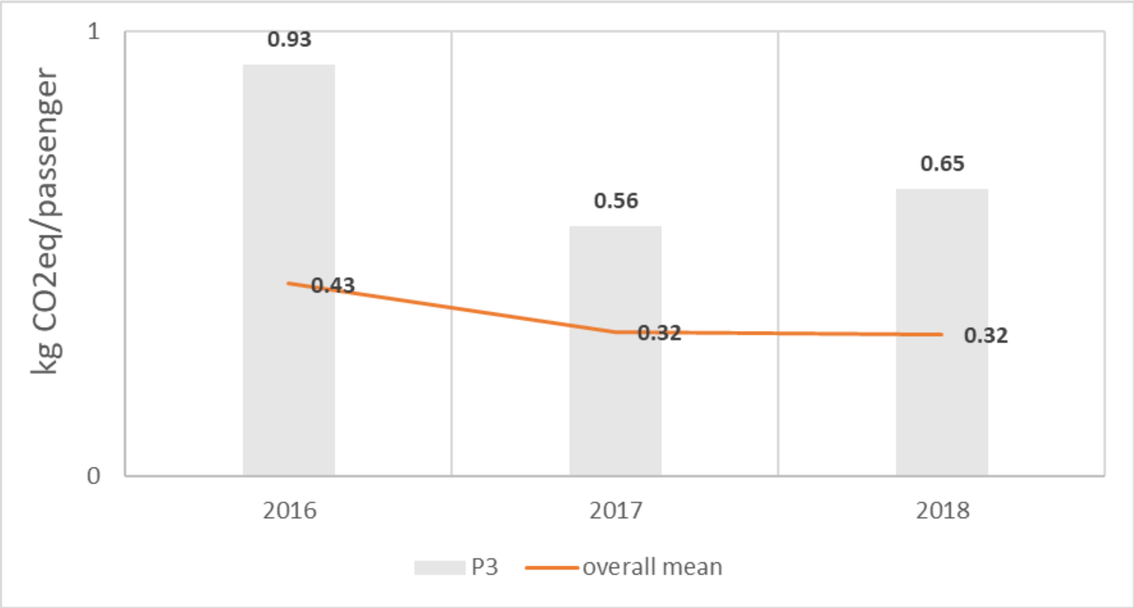

Figure 57 P3 GHG emissions deriving from waste production per passenger.

6. Greenhouse gases emissions deriving from electricity consumption at Adrigreen ports

In 2018, GHG emissions deriving from electricity consumption ranked as P1>P2>P3 (Fig.58).

In 2018, GHG emissions deriving from electricity consumption per area of the port ranked as P1>P2>P3 (Fig.59).

Between 2016 and 2018 the mean GHG emissions deriving from electricity consumption per area of the port ranked as P1>P2>P3 (Fig.60).

At P1, the mean value of GHG emissions deriving from electricity consumption per area of the port was above the overall mean value by about 0.3 kg CO2eq/m2. On the contrary, at P2 and P3 the mean values of GHG emissions deriving from electricity consumption per area of the port were 0.11 and 0.21 kg CO2eq/m2, respectively, below the overall mean value.

Figures 61–63 show comparisons between the port’s GHG emissions deriving from electricity consumption per area of the port and the overall mean value of the respective year from 2016 to 2018.

In 2018, GHG emissions deriving from electricity consumption per passenger ranked as P3>P1>P2 (Fig.64).

Between 2016 and 2018 the mean GHG emissions deriving from electricity consumption per passenger ranked as P3>P1>P2 (Fig.65).

At P3, the mean value of GHG emissions deriving from electricity consumption per passenger was above the overall mean value by about 1.4 kg CO2eq/passenger. On the contrary, at P1 and P2 the mean values of GHG emissions deriving from electricity consumption per passenger were 0.4 and 1 kg CO2eq/passenger, respectively, below the overall mean value.

Figures 66–68 show comparisons between the port’s GHG emissions deriving from electricity consumption per passenger and the overall mean value of the respective year from 2016 to 2018.

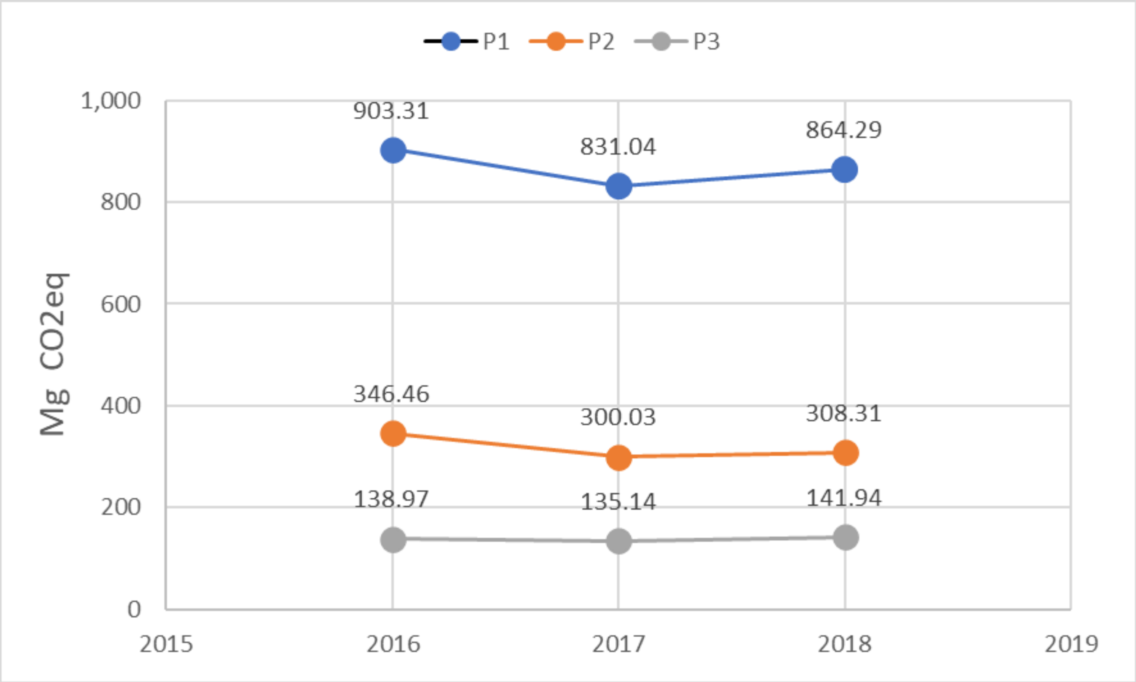

Figure 58 Ports' GHG emissions deriving from electricity consumption.

6.1 Indicators for greenhouse gases emissions deriving from port's energy consumption

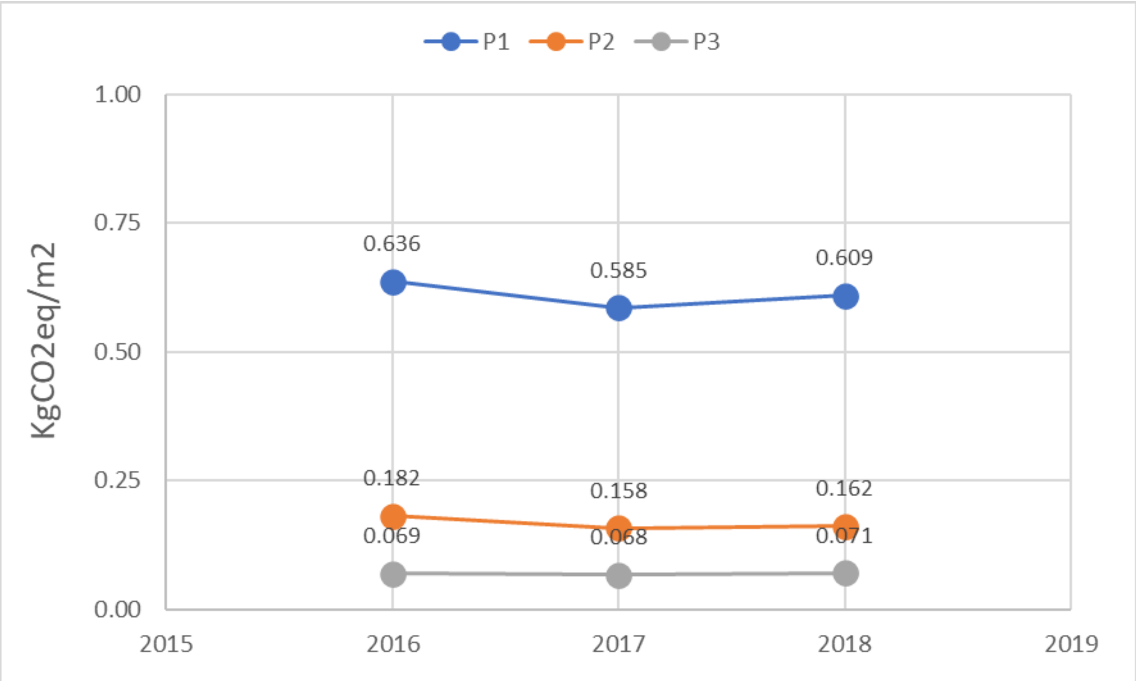

Figure 59 Ports' GHG emissions deriving from electricity consumption per port area.

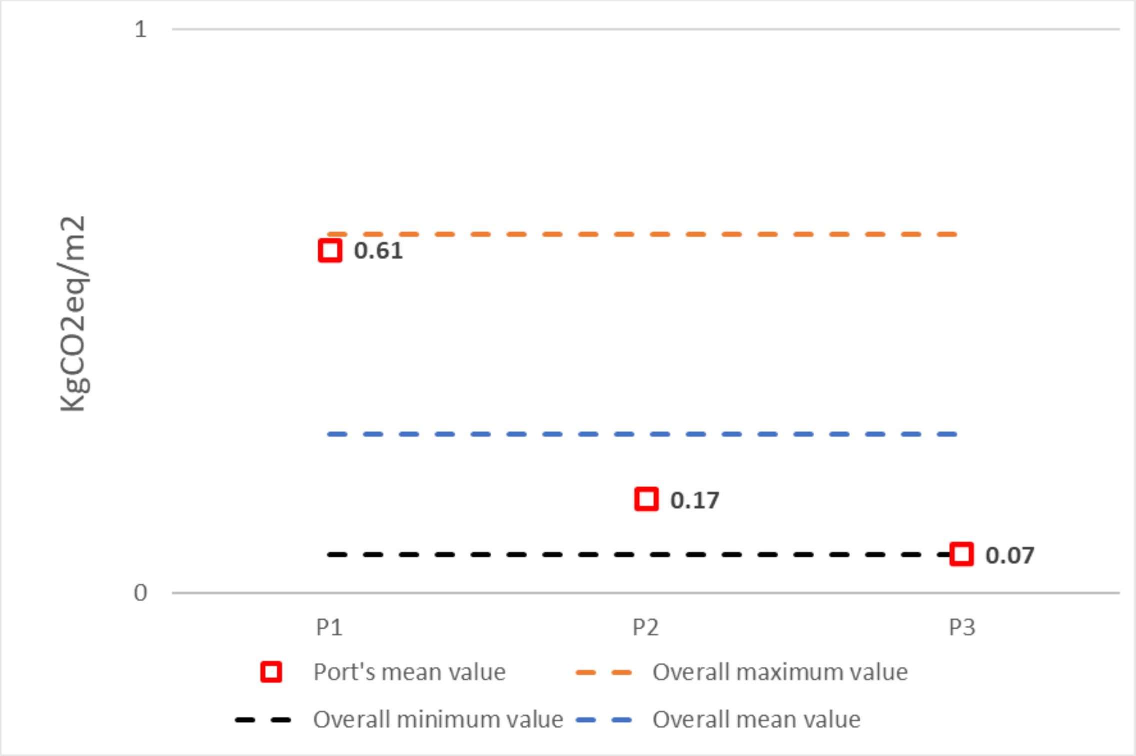

Figure 60 Ports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from electricity consumption per port area in the time period 2016–2018.

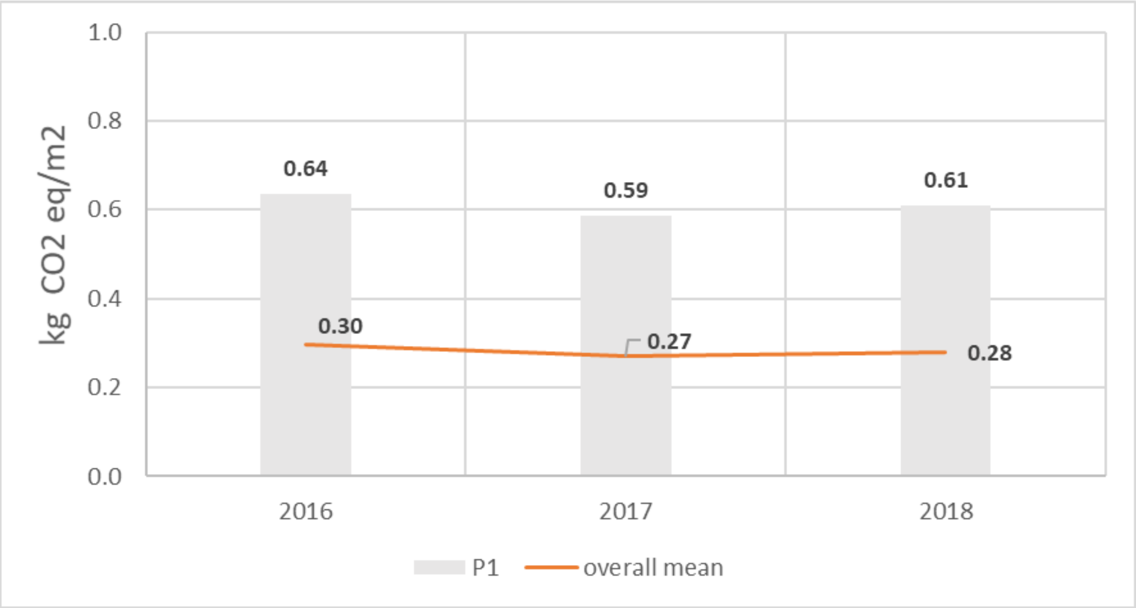

Figure 61 P1 GHG emissions deriving from electricity consumption per port area.

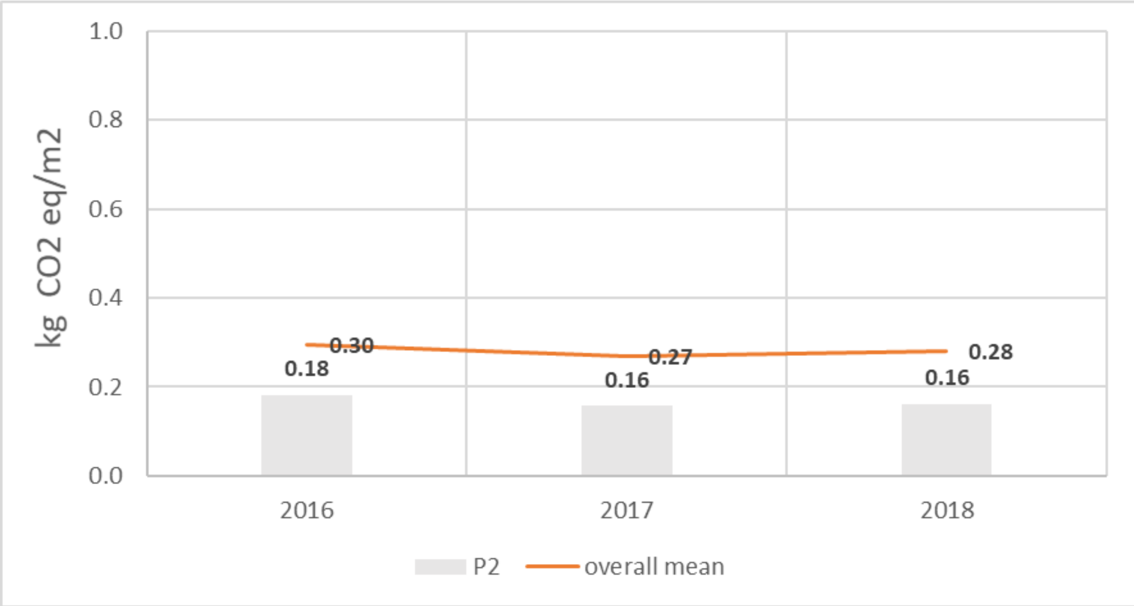

Figure 62 P2 GHG emissions deriving from electricity consumption per port area.

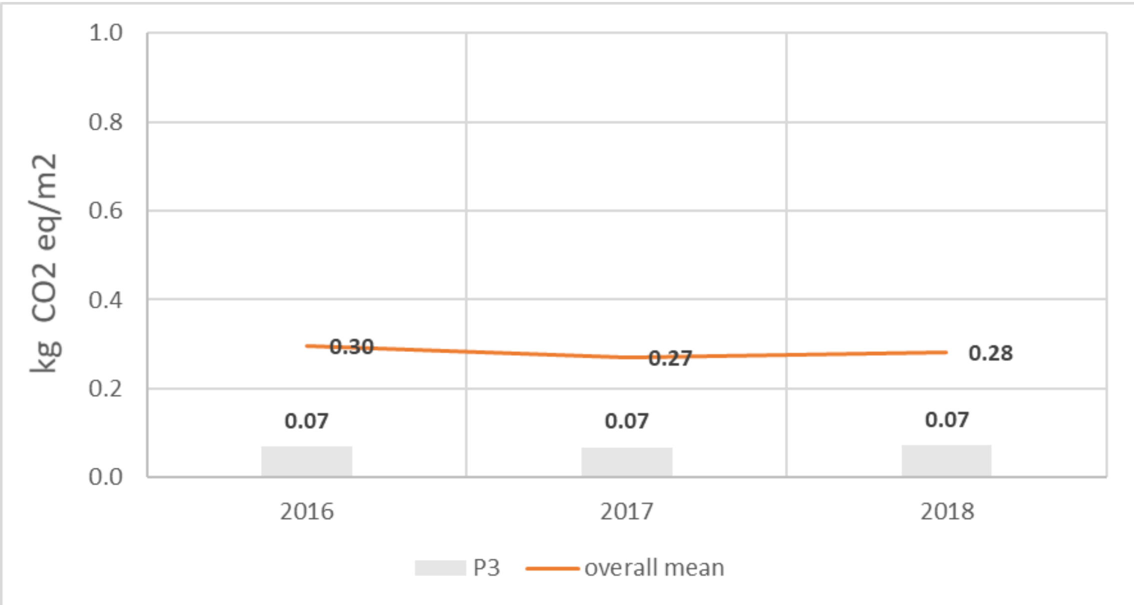

Figure 63 P3 GHG emissions deriving from electricity consumption per port area.

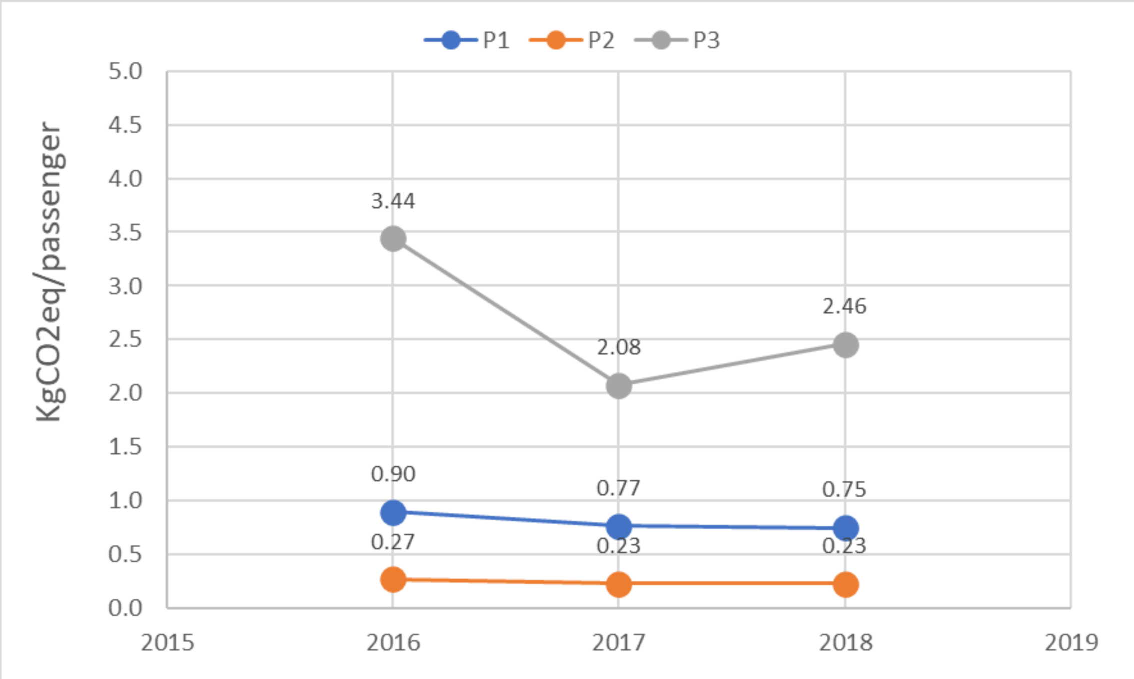

Figure 64 Ports' GHG emissions deriving from electricity consumption per passenger.

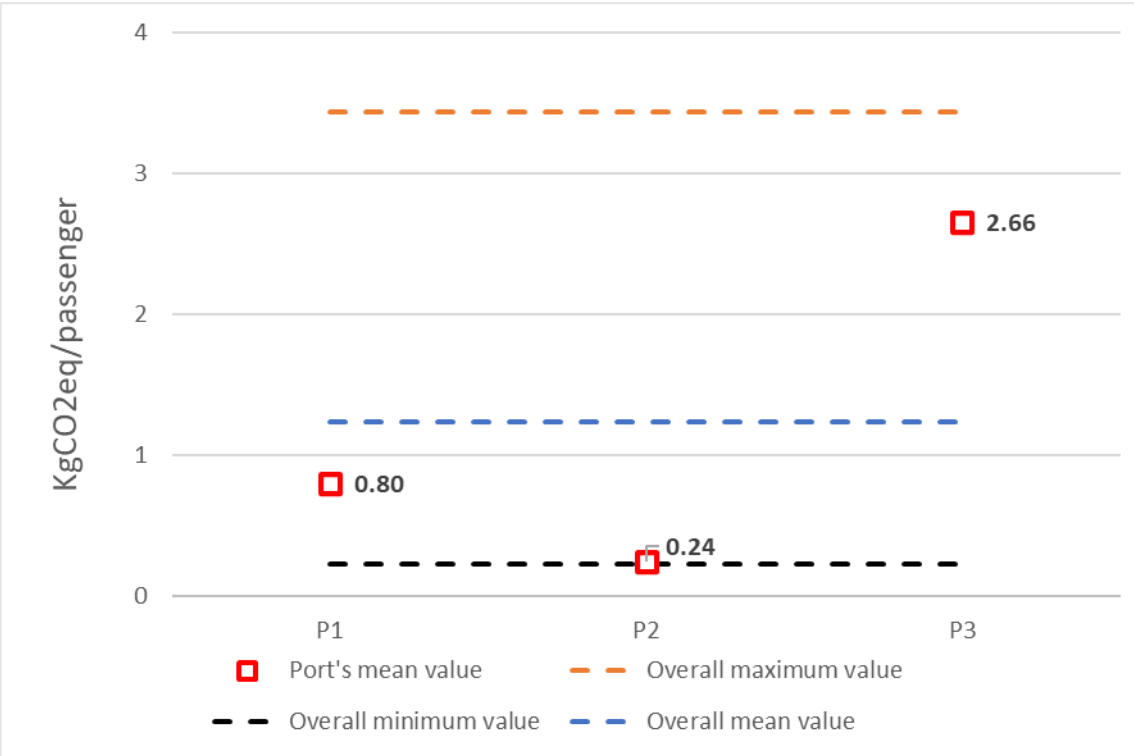

Figure 65 Ports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from electricity consumption per passenger in the time period 2016–2018.

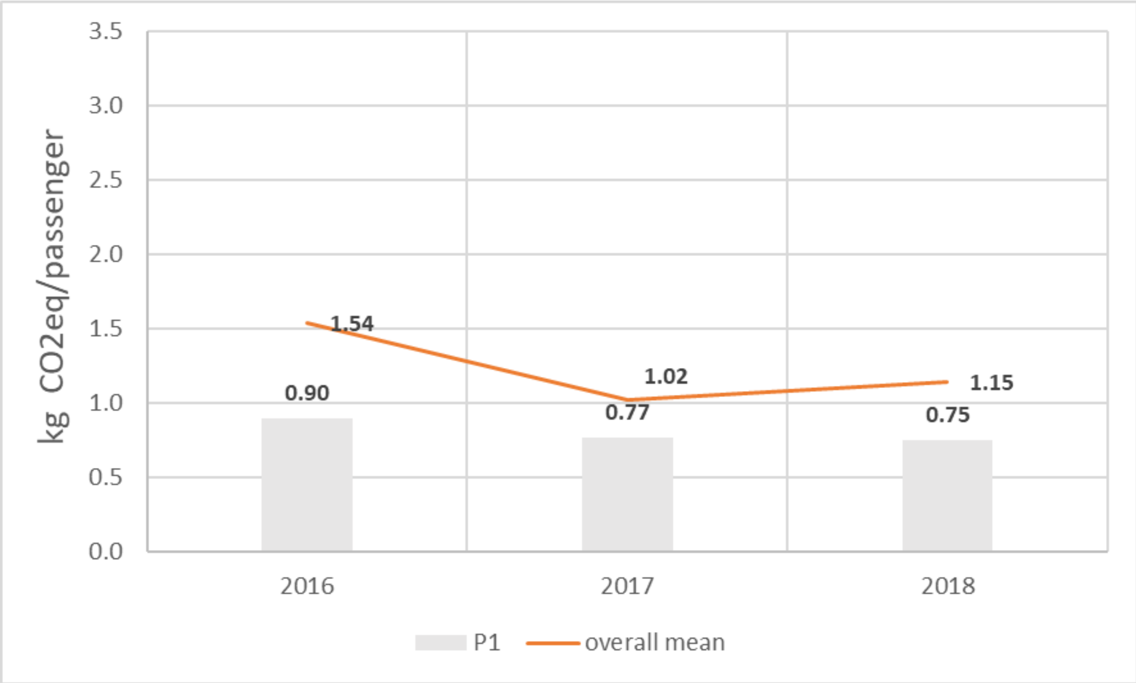

Figure 66 P1 GHG emissions deriving from electricity consumption per passenger.

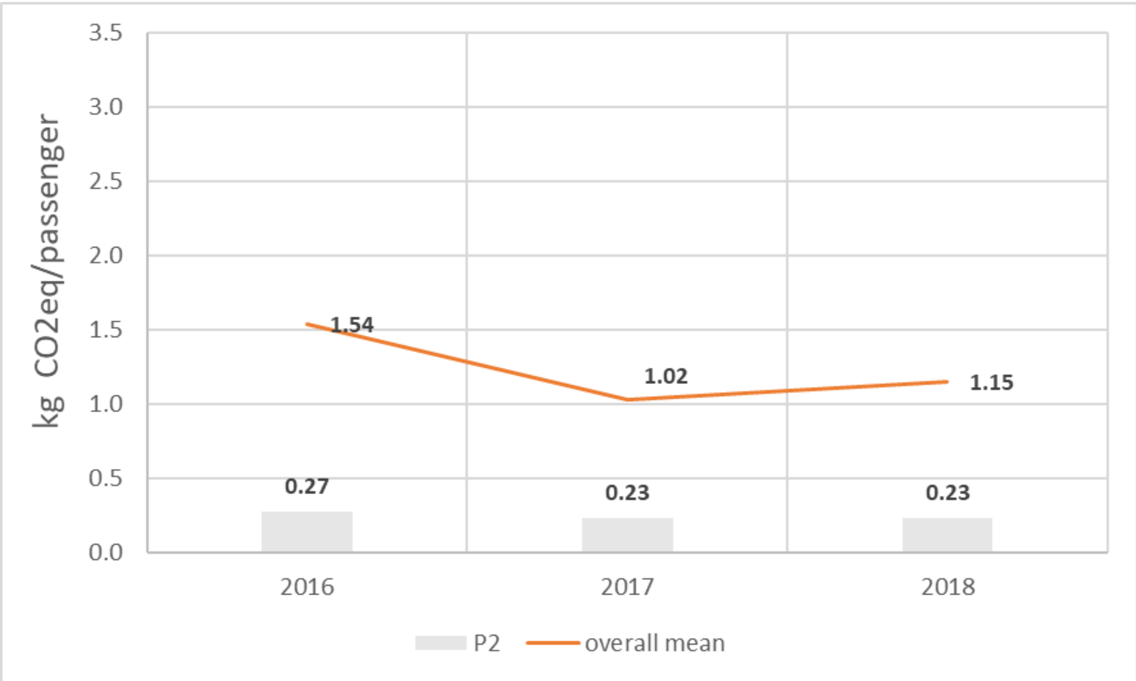

Figure 67 P2 GHG emissions deriving from electricity consumption per passenger.

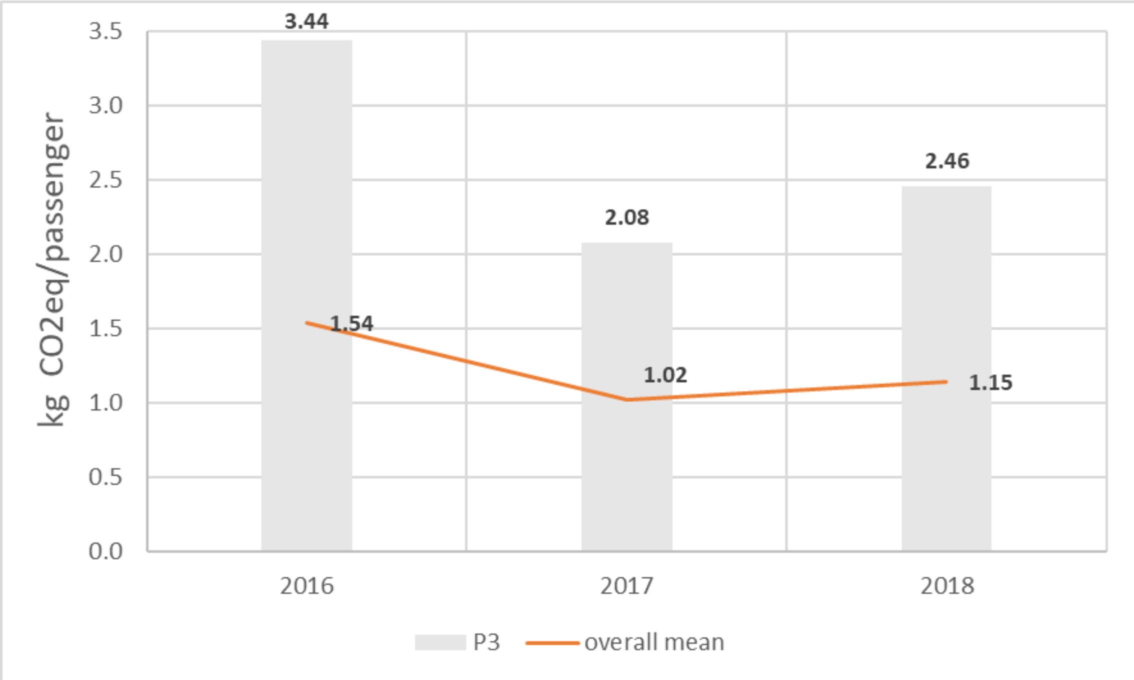

Figure 68 P3 GHG emissions deriving from electricity consumption per passenger.

7. Multimodality

As an index of the connections provided by local public transport service, the total number of bus runs per year was biased by the number of passengers at each port.

In 2018, the number of bus runs per passenger ranked as P2>P3>P1.

From P1, it is possible to reach the railway station, the nearby airport and the long-distance buses thanks to local public transport service.

Different Adrigreen partners are taking part to the Interreg project INTER-PASS. The aim of INTER-PASS is to foster and develop the intermodal connections between ports and airports in the Adriatic–Ionian Region. For example, a direct connection between a Croatian port and the nearby airport was established in 2019. This allowed the passengers to reach the port and airports through a direct bus line. The connection between the port and the nearby airport is every 30 minutes by direct shuttle bus. Moreover, at the port it was built a temporary bus station which is 4 minutes walking distance from railway station and 7 minutes walking distance from central bus station.

Within the framework of a project signed by the regional authority, the Regional Chamber of Commerce, the Municipality and the P1 Authority, there is the possibility to download an app, providing useful information for ports' passengers. In the section "mobility", indications of the main intermodal hotspots are provided.

Regarding the infrastructures serving the P3 area, the main road by which the port is supplied (delivery, waste removal, parking) has 2 traffic lanes with two-way traffic. On one side there is a sidewalk with numerous service facilities, while on the other side there is a railway which obstructs one of the shipyards, and parking spaces. The ferry is reachable from the port by foot (750 m distance). Within the marina there is a gas station for boats.

Regarding the transport infrastructures reachable from the P3 area, the main street connects the marina with cars, taxi (500 m distance) and a city bus (300 m distance). Nearby, there are 253 parking spaces within two parking lots. In a parking lot there is one electric vehicle charging station with two dedicated parking spaces.

P2 is about 22km away from the nearby airport; the airport can be reached by bus or car for an average travel time of 50 minutes. For tourists, there are frequent shuttle buses that connect the port to the old city center which is only 2.5 km or 10 minutes away.

P2 has a good performance because the number of bus rides grows significantly during the high season with the increase in cruise traffic. On the contrary, P1 and P3 do not show major differences between bus rides in high season and low season.

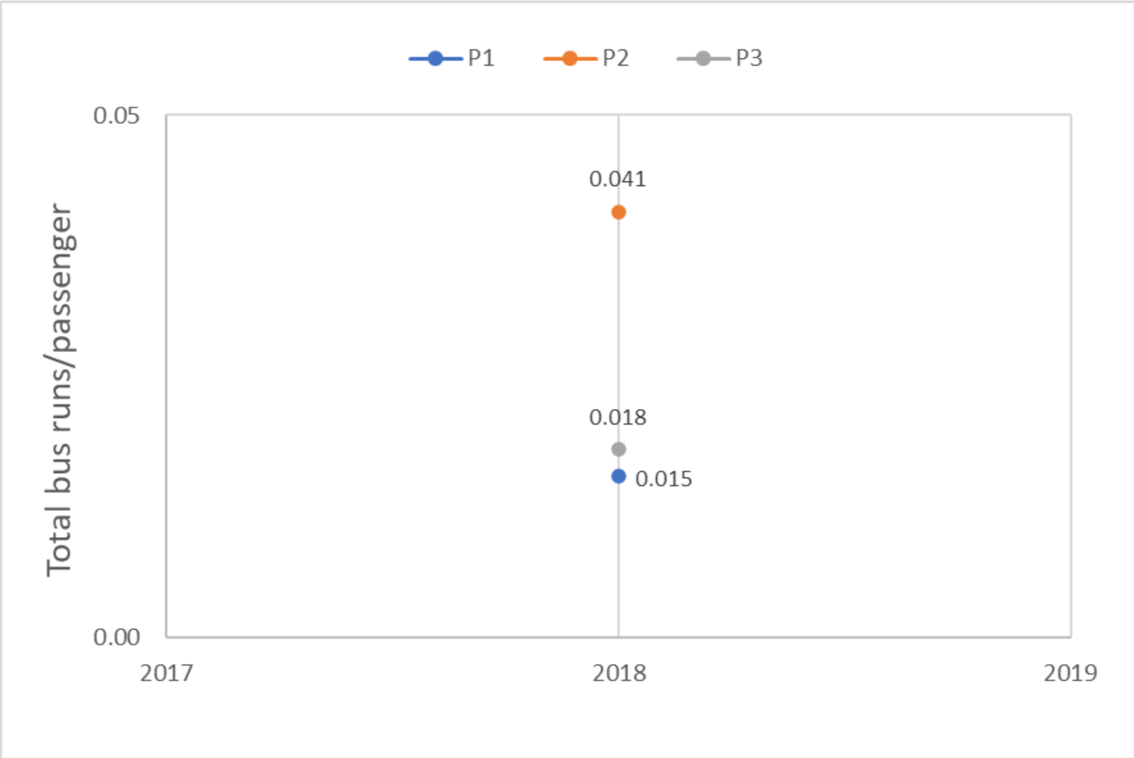

Figure 68 Number of total bus runs per passenger at the ports.

8. Noise pollution

P1 reported that the noise policy and requirements in the port area are harmonized with the EU rules. P1 did not provide any other information about noise pollution.

At P2 and P3, the noise policy and requirements in the port area are not harmonized with the EU rules.

At P2 and P3, there are no noise abatement requirements set by the authorities. Moreover, noise is not a potential risk factor for the development of P2 and P3. P2 and P3 are not subject to port operation restrictions because of noise nuisance.

P3 reported that noise from ships and docks has no significant impact on the environment since the infrastructure is located nearby the major city road.

Regarding the technical and operational solutions aimed to control noise pollution, both P2 and P3 have lower speed limits within the port area. There is a 20 km max speed zone at P2.

At P3, onshore power supply may be used instead of auxiliary engines depending on the vessel size.

Both P2 and P3 do not set higher port fees against vessel noise or discount to low-noise vessels.

At P3, no traffic arrangements were made to reduce the noise impact of the port coming from in/out shore side traffic. On the contrary, P2 installed physical obstacles forcing to slow, and arranged the queuing and parking areas for trucks and cars going to ships in a less disturbing way.

Regarding the technical and operational solutions against noise pollution, both P2 and P3 reported to not use the following:

- low noise machinery and vehicle fleet;
- Ramp design (e.g. rubber linings and insulations onto the ramps, etc.;
- Engagement and involvement of the personnel in applying more silent cargo handling methods.

9. Conclusions

WATER

Between 2016 and 2018, mean water consumption ranged from 6.64 to 117.33 l/passenger and from 0.96 to 88.98 l/m2 at Adrigreen ports. According to Adrigreen partners, water consumption per passenger may be affected by the amount of water consumed:

- due to basic activities and the personnel working at the ports with a relatively smaller number of passengers per year;
- due the high number of ships in port that refill tanks or by pleasure and fishing vessels.

WASTE

Between 2016 and 2018, mean waste production ranged from 0.49 to 2.92 kg/passenger and from 0.08 to 0.57 kg/m2 at Adrigreen ports.

All the ports have a de-centralized waste management system with one or more concessionaires engaged for collection and recycling.

According to Adrigreen partners, in some cases it is not immediate to obtain data about the fractions of waste produced because these are collected by the concessionaires. Waste produced per passenger may be affected by the amount of waste produced by cruise ship, pleasure ships and fishing vessels.

ELECTRICITY

Between 2016 and 2018, mean electricity consumption ranged from 1.19 to 12.97 kWh/passenger and 0.34 to 1.77 kWh/m2 at Adrigreen ports.

Electricity consumption is the major contributor to greenhouse gases emissions at the ports.

For the three ports, implementing a policy to reduce electricity consumption would be advantageous both in economic and environmental terms.

NOISE

Based on the data provided, noise pollution does not affect the development of Adrigreen ports and their activities. However, the three ports implemented measures to reduce or monitoring noise pollution or are going to do so in the future.

MULTIMODALITY

From Airport to Port:

- The three ports involved can be reached by bus and car. The frequency of the bus service is between 8 minutes and 30 minutes. Travel time by bus is between about 20 minutes (P1, P3) and 50 minutes (P2).

From Railways station to Port:

- In all the ports, the railway does not reach the port. However, from P1 and P3 ports it is possible to reach the nearby railway station either on foot or by bus in about 10 minutes. There are no railway stations near P3 port.

Several Adrigreen partners are taking part to the Interreg project INTER-PASS. The aim of INTER-PASS is to foster and develop the intermodal connections between ports and airports in the Adriatic–Ionian Region.

The situation at Adrigreen Ports is very diverse and will require ad-hoc interventions for such assorted conditions.

10. Summary table of the performance indicators

Scope	Unit	Ranking	Time period
Absolute water consumption	m3	P1>P2>P3	2018
Water consumption per port area	l/m2	P1>P2>P3	2018
Mean water consumption per port area	l/m2	P1>P2>P3	2016–2018
Water consumption per passenger	l/pass	P1>P3>P2	2018
Mean water consumption per passenger	l/pass	P1>P3>P2	2016–2018
Absolute waste production	Mg	P1>P2>P3	2018
Waste production per port area	kg/m2	P1>P2>P3	2018
Mean waste production per port area	kg/m2	P1>P2>P3	2016–2018
Waste produced per passenger	kg/pass	P3>P1>P2	2018
Mean waste production per passenger	kg/pass	P3>P1>P2	2016– 2018
Total amount of electricity consumption	kWh	P1>P2>P3	2018
Electricity consumption per port area	kWh/m2	P1>P2>P3	2018
Mean electricity consumption per port area	kWh/m2	P1>P2>P3	2016–2018
Electricity consumption per passenger	kWh/pass	P3>P1>P2	2018
Mean electricity consumption per passenger	kWh/pass	P3>P1>P2	2016–2018
GHG emissions from water consumption	Mg CO2eq	P1>P2>P3	2018
GHG emissions from water consumption per port area	Kg CO2eq/m2	P1>P2>P3	2018
Mean GHG emissions from water consumption per port area	Kg CO2eq/m2	P1>P2>P3	2016–2018
GHG emissions from water consumption per passenger	Kg CO2eq/pass	P1>P3>P2	2018
Mean GHG emissions from water consumption per passenger	Kg CO2eq/pass	P1>P3>P2	2016–2018
GHG emissions from waste produced	Mg CO2eq	P1>P2>P3	2018
GHG emissions from waste produced per port area	Kg CO2eq/m2	P1>P2>P3	2018
Mean GHG emissions from waste produced per port area	Kg CO2eq/m2	P1>P2>P3	2016–2018
GHG emissions from waste produced per passenger	Kg CO2eq/pass	P3>P1>P2	2018
Mean GHG emissions from waste produced per passenger	Kg CO2eq/pass	P3>P1>P2	2016–2018
GHG emissions from electricity consumption	Mg CO2eq	P1>P2>P3	2018
GHG emissions from electricity consumption per port area	Kg CO2eq /m2	P1>P2>P3	2018
Mean GHG emissions from electricity consumption per port area	Kg CO2eq/m2	P1>P2>P3	2016–2018
GHG emissions from electricity consumption per passenger	Kg CO2eq/pass	P3>P1>P2	2018
Mean GHG emissions from electricity consumption per passenger	Kg CO2eq/pass	P3>P1>P2	2016–2018

References

Dominici Loprieno, A.; Scalbi, S.; Tonon, D.; Zamagni, A. 2017. Update- Italian database emission factors. Available at https://climfoot-project.eu/download/689

Forster, P., V. Ramaswamy, P. Artaxo, T. Berntsen, R. Betts, D.W. Fahey, J. Haywood, J. Lean, D.C. Lowe, G. Myhre, J. Nganga, R. Prinn, G. Raga, M. Schulz and R. Van Dorland, 2007: Changes in Atmospheric Constituents and in Radiative Forcing. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-chapter2-1.pdf

Koffi, B.; Cerutti, A.; Duerr, M.; Iancu, A.; Kona, A.; Janssens-Maenhout, G. 2017. CoM Default Emission Factors for the Member States of the European Union - Version 2017, European Commission, Joint Research Centre (JRC) [Dataset]. Available at http://data.europa.eu/89h/jrc-com-ef-comw-ef-2017

Oficina Catalana del Canvi Climàtic. 2019. Practical guide for calculating greenhouse gas (GHG) emissions. Available at https://canviclimatic.gencat.cat/web/.content/04_ACTUA/Com_calcular_emissions_GEH/guia_de_calcul_demissions_de_co2/190301_Practical-guide-calculating-GHG-emissions_OCCC.pdf

WPCI (World Ports Climate Initiative). (2010). *Carbon Footprinting for Ports, Guidance document*. Retrieved from http://wpci.iaphworldports.org/data/docs/carbonfootprinting/PV_DRAFT_WPCI_Carbon_Footprinting_Guidance_Doc-June-30-2010_scg.pdf (Accessed 15/11/2018)

Annex1 – Newly developed datasheets

1. Port general info.

This datasheet contains a brief description of the port area such as port characteristics, activities, quality and environmental general information.

We recommend collecting such info at the port managing authority (e.g. people/organization department and infrastructure department) or at other authorities (e.g. traffic and transportation authorities).

Data will be used in order to formulate an initial screening about technical data, environmental standards and policies.

- Table 1.1. Reference data of the port.
  - Managing Authority
  - Site
  - Country/EU Member State
  - Region/City
  - Geographical coordinates (Lat, Lon)
- Table 1.2. Port characteristics.
  - Size of the port area
  - Size of the area under the competence of the port authority
  - Navigable waters in the port area
  - Heated spaces
  - Air conditioned spaces
- Table 1.3. Employees.
  - Full-time employees
  - Seasonal employees
  - Other - Please specify - Add further lines
- Table 1.4. Other departments.
  - Managing authority/function
  - Military
  - Shipping agencies
  - Governmental Authority
  - Companies and port services
  - Associations
  - Shipyards
  - Other - Please specify - Add further lines
- Table 1.5. Activities.
  - Activities relating to storage, loading, and unloading of containers
  - Activities related to the storage, loading and unloading of general cargo and bulk (liquid and solid)
  - Cruise and ferry traffic
  - Fishing activity
  - Nautical / recreational activity
  - Other - Please specify - Add further lines

- Table 1.6. Open air spaces.
  - Number of berths
  - Number of passenger terminals
  - Number of cargo terminals
  - Total length of quayside (m)
  - Tidal range (m)
  - Maximum authorized length of a ship (m)
  - Maximum authorized breadth of a ship(m)
  - Maximum authorized draft of a ship (m)
  - Location of the port (i.e. inland port on a river/canal, port on an estuary, etc..)
  - Other - Please specify - Add further lines

- Table 1.7a. Maritime traffic (Latest statistics about port traffic - 2016 and/or 2017 and/or 2018)
  - Total tonnage (in tons)
  - Other ships
  - Cruise passengers
  - Ferry passengers
  - Number of passengers
  - Bicycles
  - Motorbikes
  - Cars/Light Duty Vehicles
  - Heavy duty vehicles
  - Buses
  - Tractors
  - Containers (TEU)
  - Other - Please specify - Add further lines

- Table 1.7b. Incoming road Traffic (2016 or 2017 or 2018)
  - Bicycles
  - Motorbikes
  - Cars
  - Light duty vehicles
  - Heavy duty vehicles
  - Urban buses
  - Extra-urban buses
  - School buses
  - Tourist buses
  - Other - Please specify - Add further lines

- Table 1.7c. Outcoming road Traffic (Same year of Table 1.7b)
  - Bicycles
  - Motorbikes
  - Cars
  - Light duty vehicles
  - Heavy duty vehicles
  - Urban buses

  - Extra-urban buses
  - School buses
  - Tourist buses
  - Other - Please specify - Add further lines

- Table 1.8. Quality and environmental general information.
  - Quality Management System (QMS) or Environmental Management System (EMS) implemented or under development
  - Certifications (e.g. EcoPorts' label according to Ports Environmental Review System (PERS); ISO 14001; EMAS)
  - Assessment and monitoring of the port impacts on marine ecosystem (e.g. fish and shellfish, birds, etc.)
  - Assessment and monitoring of the port impacts on coastal dynamics.
  - Presence of environmental policies at the local level fostering environmental remediation measures of port and port related activities
  - Presence of environmental policies at the regional or national level fostering remediation measures of port and port related activities
  - Presence of an inventory of relevant environmental legislation
  - Presence of an inventory of significant environmental aspects for the port area
  - Presence of environmental training programs for port employees
  - Does the port have an environmental policy?
  - Does the policy aims at improving environmental standards
  - Was the local community involved in developing the environmental policy of the port?
  - Is the environmental policy available to the public?
  - Presence of an environmental monitoring programme
  - Does the port have designated personnel for environmental management?
  - Publication of a publicly available environmental report

- Table 1.9. Infrastructure maintenance.
  - Does the port authority apply green criteria (green/sustainable procurement) for infrastructure maintenance and/or construction?
  - Are sustainable technologies fostered for infrastructure maintenance and/or construction?
  - Recycled materials such as reclaimed asphalt pavement;
  - Cold in-place recycling;
  - Hot in-place recycling;
  - Presence of high albedo materials (e.g. light-coloured aggregate and colour pigments) in asphalt pavements (for low-traffic areas such as sidewalks, and parking lots).
  - Adoption of other technics that may reduce the urban heat island effect by increasing the solar reflectance of the asphalt pavement (cool pavement technologies)
  - Other - Please specify - Add further lines

- Information box. Site conditions and restrictions.
  - Further info and description of port area and neighbours
  - Site conditions and restrictions:
    - 1-Cities nearby: (population, population density, distance in km of the city centre from the infrastructure)

        - 2-Natural reserves nearby: (type of nature reserve: national/regional nature reserve, marine reserve, etc.)
        - 3-Rivers nearby
        - 4- Cultural heritage sites nearby
        - 5-Contaminated site of national or regional interest?
    - Other Remarks

2. Port schedule.

This datasheet contains the technical and schedule information of the ships calling at the port.

We recommend collecting such info at the shipping management branch, service and operational services department, or at shipping companies and ship-owner offices.

Data will be used in order to evaluate the environmental externalities (e.g. airborne pollution) deriving from ships in the reference year.

The datasheet is divided in two sections:

- high season: (please specify e.g. May to September);
- low season (please specify e.g. October to April).

The suggested year of reference is 2018. If comprehensive data are missing for this time period, it is possible to enter relevant data about 2016 or 2017.

- Table 2.1. Port schedule in high season. For each boat or each boat category (Passenger ships, Container Ships, Bulk Carrier, Tanker Ships, Fishing Vessels, Speciality Vessels, Etc:
    - Ship Type
    - NAME or ID code
    - Deadweight [Mg]
    - Gross tonnage [Mg]
    - Length [m]
    - Breadth [m]
    - Ship calls [number]
    - Average hotelling time per call [h]
    - Average manoeuvring time per call [h]
    - Main engine power [kW]
    - Auxiliary engine power [kW]
    - Fuel consumption main engine power [g fuel/kWh]
    - Fuel consumption auxiliary engine power [g fuel/kWh]
    - Auxiliary engine use during hotelling [%]
    - Main engine use during hotelling [%]
    - Auxiliary engine use during manoeuvring [%]
    - Main engine use during manoeuvring [%]
    - Fuel type [fuel category]
    - Sulphur content during manoeuvring phase [%]
    - Sulphur content during hotelling phase [%]"

- Table 2.2. Port schedule in low season. For each boat or each boat category (Passenger ships, Container Ships, Bulk Carrier, Tanker Ships, Fishing Vessels, Speciality Vessels, Etc:
    - Ship Type
    - NAME or ID code
    - Deadweight [Mg]
    - Gross tonnage [Mg]
    - Length [m]
    - Breadth [m]
    - Ship calls [number]
    - Average hotelling time per call [h]
    - Average manoeuvring time per call [h]
    - Main engine power [kW]
    - Auxiliary engine power [kW]
    - Fuel consumption main engine power [g fuel/kWh]
    - Fuel consumption auxiliary engine power [g fuel/kWh]
    - Auxiliary engine use during hotelling [%]
    - Main engine use during hotelling [%]
    - Auxiliary engine use during manoeuvring [%]
    - Main engine use during manoeuvring [%]
    - Fuel type [fuel category]
    - Sulphur content during manoeuvring phase [%]
    - Sulphur content during hotelling phase [%]"

3. Other vehicles

This datasheet contains all the technical information about port surface transportation vehicles (e.g. lifting vehicles, moving vehicles) and for other equipment (e.g. boiler, hydraulic pump).

We recommend collecting such info at the service and operational services department or at maintenance department.

Data will be used in order to evaluate the environmental externalities (e.g. airborne pollution) deriving from "other" port vehicles in the reference year.

- Table 3.1. Fuel sold as fuel type and unit. Data about fuel types and quantities sold to surface vehicles, fishing fleet, yachting sailing, cruise, ferries, etc.:
    - Specify year
    - Surface vehicles
    - Fishing fleet
    - Yachting Sailing
    - Cruise
    - Ferries
    - Other
    - Total

- Table 3.2. Motor vehicles for surface operations. Data about motor vehicles (e.g. lifting vehicle, passenger shuttle) for surface operations in use at the port.

  - Type of vehicle
  - Manufacturer
  - Year of production
  - Utilization [km/year]
  - Utilization [hour/year]
  - Fuel/Energy consumption [g/hour] or [kWh]
  - Engine, power/displacement, fuel, emission standard
  - Airborne emissions (specify type and quantity)

- Table 3.3. Other (port equipment). Data about other equipment (e.g. hydraulic pump) in use within the port.
  - Type of vehicle
  - Manufacturer
  - Year of production
  - Utilization [hour/year]
  - Fuel/Energy consumption [g/hour] or [kWh]
  - Engine, power/displacement, fuel, emission standard
  - Airborne emissions (specify type and quantity)

4. Energy

This datasheet contains all information about port energy consumption, renewable energy and initiatives to reduce the energy consumption, to improve energy efficiency and increase share of renewable energy.

We recommend collecting such info at the service and operational services department, environment office, other management offices (e.g. service and operational services department, and port real estate department) or at finance department (e.g. electricity bills).

Data will be used in order to evaluate the energy performance of the port infrastructure in order to create port ecological profiles criteria.

- Table 4.1. Energy-input. This table reports data about:
  - heating-related consumptions and costs of different fuels in use within the port in 2016, 2017, and 2018;
  - consumptions and costs of climate relevant gases (e.g. acetylene) in use within the port in 2016, 2017, and 2018;
  - consumptions and costs of different fuels related to company operated vehicles within the port in 2016, 2017, and 2018.

- Table 4.2. Electricity. This table reports data about: consumption and cost for the electricity consumed within the port in 2016, 2017, and 2018:
  - for vehicles
  - for heating/air conditioning
  - overall total
- Table 4.3. Energy generation from renewables. This table reports data about the energy produced from renewable sources in 2016, 2017, and 2018 as

  - Biogas
  - Wood chips
  - Wood pellets
  - Charcoal
  - On shore wind energy
  - Photovoltaic energy
  - Solar energy
  - Thermal energy
  - Geothermal energy
  - Hydrothermal energy
  - Wave power
  - District heating (e.g. cogeneration, trigeneration, geothermal, hydrothermal)

- Table 4.4. Info about renewable energy as
  - Share of renewable energy in total energy consumption
  - Renewables provided to electric vehicles
  - Total production of renewable energy by the organisation
  - Revenues from selling renewable energy

- Table 4.5. Advanced initiatives (planned or implemented). This table reports qualitative information (no/ yes) about planned initiatives or implemented initiatives and the degree of completion. List follows
  - Improvements in management systems and energy facilities
  - Use of renewable energy technologies
  - Quay electrification / Cold ironing
  - Use of combined heat and power (CHP) plants and combined cooling heat and power (CCHP) plants
  - New operational and maintenance procedures to improve and optimize energy efficiency and improvements in heating, ventilation and air conditioning (HVAC) and lighting
  - Improvement of energy efficiency for public lightning (e.g. LED lighting)
  - Improvement of efficiency of cargo transport
  - Switching from carriers, hybrid vehicles, trailers, tractors and forklift trucks and cranes that use diesel fuels to those that use bio-fuels or are powered by electricity generated from renewable sources
  - Are there any available charging stations for electric vehicles?
  - Are there any plans for installing charging stations for electric vehicles?
  - Other technologies and projects applicable within the port (specify and add lines)
  - Are there any plans for installing charging stations for electric vehicles?

5. Water

This datasheet contains all information about water consumption, wastewater discharge, water contamination events and a series of good practice to reduce the impact on water.

We recommend collecting such info at the service and operational services department, the environment office, other management offices (e.g. service and operational services, port real estate department) or at finance department (e.g. water bills).

Data will be used in order to evaluate the water footprint of the port infrastructure, in order to create port ecological profiles criteria.

This datasheet reports any relevant information for computing water management (consumption, treatment, and discharge). Furthermore, any relevant information for computing water contamination deriving from daily activities or sporadic and unintentional events.

Finally, there is a list of planned/implemented initiatives to reduce the impact on the hydrosphere.

- Table 5.1. Water consumption. This table reports data relevant to calculate the total volume of water use and water intake, and total water cost in 2016, 2017, and 2018 as
    - Drinking water, local supplier
    - Drinking water, own well
    - Process water, own well
    - Rainwater collected and used for sanitary purposes
    - Rainwater collected for other use (e.g., watering, vehicle washing, flushing of toilets)
    - Leakages, incidents, flushing in regard of fresh water supply

- Table 5.2. Wastewater. This table reports data relevant to calculate the volume of water according to the different types of discharge
    - Public sewer & treatment system
        - Sanitary waste waters (local)
        - Process waters
        - Ballast waters
        - Sanitary waste waters from boats
    - Own treatment system
        - Sanitary waste waters
        - Process waters
        - Ballast waters
        - Sanitary waste waters from boats
    - Rainwater discharged (direct discharge underground)
    - Rainwater discharged (direct discharge in surface water)
    - Process waters collected for re-use/recycle

- Table 5.3. Chronic contamination. Information about daily activities or frequent events that are potential non-point sources of water contamination:
    - Run-off water management
    - Accidental water discharge during the maintenance of ships (e.g., boats and vehicles)
    - Any fertilisers to maintain open air spaces
    - Any herbicides, insecticides, pesticides to maintain open air spaces
    - Others (please specify)

- Table 5.4. Accidental contamination. Information about sporadic and unintentional events that are potential sources of water contamination:
    - Leakage of fuels
    - Leakage of sludge
    - Leakage of transported fluids
    - Ballast water discharge
    - Wastewater discharge
    - Firefighting (specify materials: add rows)

- Table 5.5. Initiatives to reduce the impact on hydrosphere. Information about planned/implemented initiatives relevant to improve the water footprint of the port and port activities:
    - Reduction in water consumption
    - Wastewater reuse following treatment (wastewater and sewage treatment plants) (e.g. for irrigation, flushing of toilets, vehicle washing, etc.)
    - Use of rainwater (e.g. see above)
    - Protection of groundwater from pollution
    - Protection of marine water from pollution
    - Monitoring of water consumption
    - Monitoring the quality of surface water and groundwater
    - Training and education of port staff

6. Waste

This datasheet contains all information about waste produced and recycled and some required information about port waste management.

We recommend collecting such info at the service and operational services department, the environment office, other management offices (e.g. service and operational services, port real estate department) or at finance department (garbage fees, etc.).

Data will be used in order to evaluate the waste management performance of the port, in order to create port ecological profiles criteria.

This datasheet reports any relevant information for computing the fractions of waste produced at the port, the amount of waste recycled, and the amount of waste treated according to the waste management in use. In addition, waste trends are estimated for the time interval 2016—2108.

Finally, any relevant descriptive or qualitative information are reported about implemented or planned initiatives for managing the waste produced or collected at the port, and waste mitigation/waste prevention strategies.

- Table 6.1. Waste produced. This table reports the amount of different types of waste produced in 2016, 2017, and 2018
    - Paper
    - Cardboard
    - Metal
    - Plastic

- Glass
- Hazardous waste
- Organic fraction
- Municipal solid waste (non-recyclable)
- Other (please, specify)
- Total

- Table 6.2. Recycling. This table reports the amount of different types of waste recycled in 2016, 2017, and 2018
  - Paper
  - Cardboard
  - Metal
  - Plastic
  - Glass
  - Hazardous waste
  - Organic fraction
  - Other (please, specify)

- Table 6.3. Waste management in use This table reports the amount of waste treated with the different types of waste management in use in 2016, 2017, and 2018.
  - Waste reused
  - Waste recycled
  - Waste to landfill
  - Waste incineration
  - Other (please, specify)

- Table 6.4. Economic incentives for recycling municipal solid waste. This table contains qualitative information about the economic incentives fostering best waste strategies.
  - Pay-as-you-throw
  - Other economic incentives for recycling municipal solid waste (add lines)

- Table 6.5. This table contains qualitative information about handling and disposal of dredged material, and reuse/recycle of waste from ships.
  - Is there a plan for dredging disposal?
  - Re-use of decontaminated sediment (e.g. material for the infrastructure and environmental engineering sectors)
  - Is the dredged material subject to analysis (e.g. assessment of physical, chemical, and biological properties)
  - Plans regarding preparation for reuse of waste from the ship
  - Plans regarding preparation for recycling of waste from ship

- Information box. Waste management at the port. Descriptive information for describing the implemented or planned initiatives for managing the waste produced or collected at the port. Information about
  1. What impact has the growth in passengers and ship calls had on the volume of waste generated at the port?

2. What type of waste management system (centralized, de-centralized, a combination of both) has been implemented at the port?
3. What systems are used to mitigate the impact of waste on the environment at the port?
4. Are any initiatives planned or in place to address marine litter and pollution?
5. Is there a waste reception infrastructure to collect ship waste (e.g. garbage, its oily sludge)?
6. Is it possible to collect ship wastewater (ballast water)?
7. Are any waste prevention in place at the port?
8. Are any waste mitigation measures in place at the port?

7. Noise

This datasheet contains all qualitative information about acoustic emissions, technical and operations solution to reduce impact.

We recommend collecting such info at the service and operational services department, the environment office, other management offices (e.g. service and operational services, harbour master office) or at the office in charge of the car fleet management (e.g. office under the finance department).

Data will be used in order to evaluate the noise management at the port infrastructure, in order to create port ecological profiles criteria.

- Table 7.1. Noise general information. Qualitative or descriptive information:
    - Are the acoustic emissions from the infrastructure monitored and controlled?
    - Are there any monitoring stations (e.g. sound level meters) placed according to the potential receptor? (If yes, please report in a map the location of the acoustic control terminals).
    - Are the noise measurements effected regularly (e.g., daily, monthly, etc.)?
    - When specific exceedances are detected, attempts are made to try to detect the cause and the appropriate corrective measures are taken.
    - Are any noise abatement requirements set by the authorities?
    - Is noise a potential risk factor for the port development (e.g. in relation to waterfront properties)
    - Are the noise policy and requirements in the port area harmonized with the EU rules (e.g. EU Environmental Noise Directive (2002/49/EC)?
    - Are there any action plans to mitigate potential noise problems in the urban area close to the port?
    - Is there a noise map of the port area?
    - Are there any plans for noise abatement measures?
    - Is there any type of cooperation with other port authorities regarding noise pollution? (Information exchange, collaborative projects, adoption of similar noise policies)
    - Are there any collaboration and communication strategies with the stakeholders involved in the noise problem?

- Table 7.2. Noise restrictions. A list of any port operation restrictions addressing noise nuisances should be reported
    - Are there any port operation restrictions because of noise nuisance? (add more lines)

- Table 7.3. Technical and operational solutions. A list of potential technical and operational solutions is reported
    - Ramp design (e.g. rubber linings and insulations onto the ramps; the form of the ramps)
    - Engagement and involvement of the personnel in applying more silent cargo handling methods (e.g. lower driving speed).
    - Low noise machinery and vehicle fleet
    - Onshore power supply used instead of auxiliary engines
    - Lower speed limits within the port area
    - Higher port fees against vessel noise or discount to low-noise vessels
    - Traffic arrangements to reduce the noise impact of the port coming from in/out shore side traffic (diverting the traffic to the port area in less sensitive area, installing physical obstacles forcing to lower speeds, arranging the queuing and parking areas for trucks and cars going to ships in a less disturbing way, silent asphalts).
    - Port layout such as noise walls and barriers, topographical formations (e.g. hills as noise barriers).

8. Air quality — GHG

This datasheet contains all information about air quality, monitoring stations and air quality management. We recommend collecting such info at infrastructure, spatial planning and environment department or any office in charge of spatial planning and the environment at the managing port authority.

Data will be used in order to evaluate the emissions of airborne pollutants and greenhouse gases deriving from port activities and to compare such evidence with data obtained through emission estimate procedures.

- Table 8.1. Air quality information. Qualitative and descriptive information about weather station and air quality monitoring network in the proximity of the port area
    - Is there an air quality monitoring network in the premises of the infrastructure?
    - Is there a weather station?
    - Are emissions of greenhouse gases evaluated?
    - Are the above mentioned data (weather and air quality) accessible to the public?
    - Is the port providing onshore power supply (cold-ironing) for vessels at berth?
    - Is the port planning to provide onshore power supply (cold-ironing) for vessels at berth?
    - Are environmental charges implemented by regional or local authorities.
    - Are there no-idling campaigns to reduce emission from vehicle? (e.g. in Italy it is recommended to turn engines off if vehicles stop for 10 seconds or longer).

- Table 8.2. Which parameters are measured, and what is the sampling frequency? Qualitative (no, yes) information about monitoring of air quality parameters and the frequency (e.g. hourly monitoring with fixed stations; daily monitoring with mobile stations, etc.):
    - PM10
    - PM2.5
    - NOX
    - SOX
    - VOC

- O3
- CO
- Other (please specify and add lines)

- Table 8.3. Greenhouse gases (GHG). The amount of CO2equivalents related to a given type of port activity and the percentage trend in the last 5 years:
  - CO2
  - CH4
  - N2O
  - Other (please specify and add lines)

- Information box. Air quality management. Description of the air quality monitoring network and weather stations which are relevant for the air quality management of the port area.

9. Multimodality

This datasheet contains all information about multimodality "to – from" and "from – to".

We recommend collecting info data about multimodal transport from the marketing promotion and commercial relations department, intermodal department or at related transport companies (e.g. transport enterprises, public transport operators, fleet managers/fleet operators).

Data will be used in order to evaluate the multimodality and integration of the port with other transport networks.

- Table 9.1. Transport ''From… — To port''. Quantitative and descriptive information about any types of transportation (e.g. BUS, Tram, Railways, Electric car, Private car) from nearby infrastructure hubs, cities, etc. to port area
  - Route (from-to)
  - Distance to nearest meeting point
  - Travel time
  - Capacity
  - Cost per passenger
  - Access for disabled
  - Frequency of service
  - Schedule Mon-Fri
  - Schedule Saturday
  - Schedule Sunday
  - Total weekly runs
  - Utilization rate

- Table 9.2. Transport ''To port — from….'' Quantitative and descriptive information about any types of transportation (e.g. BUS, Tram, Railways, Electric car, Private car) connecting the port area with nearby main destinations or infrastructure hubs.

- Route (from-to)
- Distance to nearest meeting point
- Travel time
- Capacity
- Cost per passenger
- Access for disabled
- Frequency of service
- Schedule Mon-Fri
- Schedule Saturday
- Schedule Sunday
- Total weekly runs
- Utilization rate

- Information box. Multimodality and integration of transport networks. Description of any intermodal activities already implemented, and the transport infrastructures network where the port area is integrated
    1. Description of any intermodal activities already implemented (map, utilization rate, and carrying and delivery capacity).
    2. Description of any transport infrastructures serving the port area.
    3. Description of any transport infrastructures reachable from the port area.