Interreg Italy - Croatia ADRIGREEN

EUROPEAN UNION

Environmental performance assessment of Adrigreen airports

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General information about Adrigreen airports

Bari Airport

Managing Authority	Aeroporti di Puglia S.p.A.
Site	www.aeroportidipuglia.it
Country/EU Member State	Italy
Region/ City	Puglia / Bari Palese
Geographical coordinates	Lat: 41°08’19.88”N; Lon: 16°45’38.14”E
IATA code	BRI

Further information and description of Bari Airport area and surroundings

Bari Airport is located about 10 km from Bari center. In 2019, the city of Bari accounted for about 322,000 inhabitants, with a population density of about 2,746 people/km^2.

Lama Balice Regional Natural Park is nearby the Airport. This natural park can be defined as 'urban', due to its proximity to the city centers of Bari and Bitonto. The park has an extension of 495.2 hectares and a length of about 37 km. The Lama Balice Park is next to the Alta Murgia National Park.

There are no water basins nearby the Airport.

Cultural heritage sites nearby the Airport include Alberobello, Castellana Caves, the “Sassi di Matera”, several Romanesque cathedrals (e.g., Trani and Bari), and Castel del Monte.

Brindisi Airport

Managing Authority	Aeroporti di Puglia S.p.A
Site	www.aeroportidipuglia.it
Country/EU Member State	Italy
Region/ City	Puglia/ Brindisi
Geographical coordinates	Lat: 40°39’29”N; Lon: 17°56’48”E
IATA code	BDS

Further information and description of Brindisi Airport area and surroundings

Brindisi Airport is located about 2 km from Brindisi. The city of Brindisi has about 86,800 inhabitants, with a population density of about 260.7 people/km².

The Torre Guaceto Marine Protected Area is located about 13.5 km north-west along the coastline. This marine protected area represents one of the most important national parks with about 2,200 hectares of protected marine area and over 1,100 hectares of natural reserve.

The Regional Natural Park of Coastal Dunes is located about 40 km north-west along the coastline.

The Cillarese artificial lake is about 3 km from the Airport.

The so-called “contaminated sites of national interest” are significantly extended contaminated areas classified as dangerous by the Italian State and which require remediation to avoid environmental and health damage. The site of national interest of Brindisi covers an area of approximately 5,700 hectares and 5,600 hectares at sea, with a coastal development of approximately 30 km². In addition to the industrial area, the site of national interest includes the entire port and a strip of coastline.

There are several cultural heritage sites nearby the Airport, namely Via Appia "Regina Viarum", Salento territory and the various town centers characterized by the Lecce’s baroque architecture.

Dubrovnik Airport

Managing Authority	Dubrovnik Airport Ltd
Site	https://www.airport-dubrovnik.hr/en
Country/EU Member State	Croatia
Region/ City	Dubrovnik-Neretva County/ Čilip
Geographical coordinates (Lat, Lon)	Lat: 42.5568; Lon: 18.2677
IATA code	DBV

Further information and description of Dubrovnik Airport area and surroundings

Dubrovnik Airport is the second busiest airport in Croatia.

Dubrovnik Airport is located in Konavle Municipality about 22 km from the city of Dubrovnik, and about 7.5 km from Cavtat. The highway D8 connects Dubrovnik Airport to the entire region. Dubrovnik Airport covers an area of 1,930,000 m2 (i.e., 193 hectars).

The runway air corridor runs above Cavtat, a tourist centre located northwest from the Airport. Other settlements in close vicinity of Dubrovnik Airport are Moi, Ilipi and Zvekovica.

In the area of Konavle Municipality, pursuant to the Nature Protection Act, three protected areas have been proclaimed:

- Islands of Mrkan, Bobara and Supetar – special zoological-ornithological reservation – Cavtat;
- Konavoski dvori – significant landscape – Ljuta
  (surface area of 793.15 ha, and located approximately 7 km southeast of the Airport);
- Šipun cave – geomorphologic-hydrologic natural monument – Cavtat
  (located approximately 3 km northwest of the Airport).

Pescara "Abruzzo" Airport

Managing Authority	Società Abruzzese Gestione Aeroporto S.p.a.
Site	http://www.abruzzoairport.com/web/guest/home
Country/EU Member State	Italy
Region/ City	Abruzzo/Pescara
Geographical coordinates	Lat: 42°26'14"N; Lon: 014°11'14"E
IATA code	PSR

Further information and description of Pescara Airport area and surroundings

Abruzzo Airport is located

Abruzzo Airport is located about 4km from Pescara center and about 13km from Chieti center. The city of Pescara has about 120,000 inhabitants, with a population density of about 3,530 people/km². The city of Chieti has about 50,000 inhabitants, with a population density of about 850 people/km². The San Giovanni Teatino and Pineta Dannunziana nature reserves are nearby the Airport.

Pula Airport

Managing Authority	Pula Airport Ltd.
Site	https://airport-pula.hr/en/
Country/EU Member State	Croatia
Region/ City	Istrian Region, Ližnjan
Geographical coordinates	Lat: 44° 53′ 37″ N; Lon: 13° 55′ 20″ E
IATA code	PUY

Further information and description of Pula Airport area and surroundings

Pula Airport is located about 6 km from Pula city center. In 2011, the city of Pula had about 57,460 inhabitants, with a population density of about 1,100 people/km². In 2019, the Istrian Region had about 209,000 inhabitants, with a population density of about 1,050 people/km2.

The Pula Airport is located at the southern tip of the Istrian peninsula nearby Adriatic Sea.

Brijuni Islands (National Park) and Veruda Marina are the natural reserves nearby the Airport.

There are several cultural heritage sites nearby the Airport, namely the Arch of Sergius, the Temple of Roma and Augustus, and Twin gates of Porta Gemina.

Rimini Airport

Managing Authority	AIRiminum 2014 SpA
Site	http://riminiairport.com/en/
Country/EU Member State	Italy
Region/ City	Emilia Romagna/Rimini
Geographical coordinates	Lat: 44° 01' 10'' N; Lon: 12° 36' 34'' E
IATA code	RMI

Further information and description of Rimini Airport area and surroundings

Rimini Airport is located about 6km from Rimini center. In 2019, the city of Rimini had about 151,200 inhabitants, with a population density of about 1,100 people/km². The city of Riccione is located about 4km from the Airport. In 2018, Riccione had about 35,000 inhabitants with a population density of about 2,000 persons/km². Both Rimini and Riccione boast highly crowded summer seaside holidays.

There are several natural reserves in Rimini county, namely the Sasso Simone e Simoncello Park, the Cave of Onferno, the Conca river Provincial Reserve, and Rio Melo and Rio Calamino areas of ecological and environmental importance.

There are more than 10 water basins in the municipality of Rimini, the Marecchia being the major one. Marano, Rondella, Roncasso, and Rio dell'Asse are the water basins nearby the Airport.

The main archeological sites nearby Rimini are the Roman amphitheater, the Roman domus, the surgeon’s Roman domus, an icehouse in Montescudo, and the ‘’San Lorenzo in strada’’ archeological site.

Materials and methods

The Environmental Assessment document was built to keep most information anonymous. Thus, the Result and Conclusion sections do not contain any reference to airport names but only anonymous abbreviations (namely A1, A2, etc.). Each partner received its own entry and can understand its own environmental performance.

The only information that refers to specific ports and airports are online on the website https://interpass.adrioninterreg.eu.

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 Annex section.

Airports' 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 Airports Council International (ACI) Airport Carbon and Emissions Reporting Tool (ACERT) (ACI 2018):

- Scope 1: emissions owned or controlled by the airport operator;
- Scope 2: emissions from the off-site generation of electricity purchased by the airport operator.

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

The carbon footprint of an airport is the sum of GHG emissions caused by activities at the airport and under the airport's control (ACI 2012).

The data provided by the airports were not sufficient to assess the carbon footprint. Therefore, the information provided in terms of CO_2 or equivalent CO_2 (CO_2eq) in the Results' section shall be meant as GHG performance of the single or cumulated activities of the airport.

The greenhouse warming potential of CH_4 and N20 is expressed in terms of CO_2eq, according to the following values (Forster et al. 2007):

- CO_2: GHG warming potential equal to 1;
- CH_4: GHG warming potential equal to 25;
- N20: GHG warming potential equal to 298.

Greenhouse gases emissions deriving from company operated vehicles electricity and fossil fuel consumption

The CO2 emissions were evaluated according to a Tier 1 approach (Ntziachristos et al. 2019), as follows:

$$E = \sum_j FC_j \times EF_j \quad (1)$$

where E is emission of CO2 deriving from fuel consumption [kg]; FC_j is the fuel consumption related to the j-fuel [kg]; EF_j is the fuel consumption-specific emission factor of j-fuel reported in Table 1. For the density of the fuel, the values reported in Table 2 were considered (Airports council international 2018).

Table 1 Tier 1 CO2 emission factors (EFs) for different road transport fossil fuels. Adapted from Ntziachristos et al. (2019).

Subsector units	Fuel	EF kg CO2/kg fuel
All vehicle type	Diesel	3.169
All vehicle type	Petrol (gasoline)	3.169

Table 2 Fuel density. (Airports council international 2018).

Fuel	Density kg/m3
Diesel	840
Petrol (gasoline)	730

GHG emissions deriving from the consumption of electricity for company operated vehicles were calculated according to the equation and the EFs reported for GHG emissions deriving from electricity consumption.

Greenhouse gases emissions deriving from fuel for heating buildings

The GHG emissions deriving from the consumption of fuel for heating the buildings of the terminals were evaluated with the ACERT toolkit (ACI 2018), with the emission factors reported in Table 3.

Table 3 Emission factors (EFs) related to the fuel used for heating the buildings of the terminals. Adapted from Airports council international (2018).

Small commercial combustion plant	Natural gas [m3]	EF CO2 [kg/m3]	EF CH4 [kg/m3]	EF N2O [kg/m3]
		1.88496	0.000168	0.00000336
	Gasoline/diesel oil/heating oil [l]	EF CO2 [kg/l]	EF CH4 [kg/l]	EF N2O [kg/l]
		2.676492	0.0003612	2.1672E-05

Greenhouse gases emissions deriving from electricity consumption

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

$$E = \sum_j C_j \times EF_j \qquad (2)$$

where E is emission of CO2eq deriving from electricity consumption [kg]; C_i is the consumption related to that sort of electricity *j* [kWh]; EF_j 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 null whenever related to electricity produced from renewable energy sources and/or electricity generated in-house by wind turbines, photovoltaic panels, and hydroelectric power plants.

For example, A5 and A6 airports purchased electricity produced from a mix of renewable energy sources in 2018.

To account for CO2 savings deriving from local electricity production from renewables and local consumption, the estimated CO2 related to the same amount of kWh production but from fossil fuel were subtracted to the total. For example, A5 and A6 airports produced and consumed photovoltaic electricity in 2018.

Table 4 Default emission factors for renewable energy sources, local electricity production. Adapted from (Koffi et al. 2017).

Renewable energy sources	EF [Mg CO2eq/MWh]	Electricity generation	EF [Mg CO2eq/MWh]
Solar thermal	0	Wind	0
Geothermal	0	Hydroelectric	0
		Photovoltaic	0

Table 5 National emission factors (EFs) for electricity consumption in Croatia and Italy in 2013: Standard approach based on the IPCC (2006). Retrieved from Koffi et al. (2017).

Country	EF [Mg CO2eq/MWh]
Croatia	0.205
Italy	0.344

Greenhouse gases emissions deriving from water consumption

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

$$E = W \times EF \quad (3)$$

where E is the emission of CO2eq deriving from water consumption, [kg CO2eq]; W is the volume of drinking water consumed [m3]; 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 airports' GHG emissions.

Greenhouse gases emissions deriving from waste production

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

$$E_i = W_i \times EF_i \quad (4)$$

where E_i is the emission of CO2eq deriving from the 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, [gCO2eq/kg waste].

Table 6 Emission factor associated to the different fractions of waste produced. Table adapted from Oficina Catalana del Canvi Climàtic (2019).

Waste fraction	EF [gCO2eq/kg waste]
Glass containers	30.5
Paper/cardboard	56.41
Organic municipal solid waste	362.11
Rest fraction (general waste, not sorted collection)	645.18

Performance indicators

To compare the energy and environmental performances of airports, GHG emissions and consumption of electricity and fuel were expressed also per activity factors (e.g., number of passengers) or values related to the size of the infrastructures (Table 7 and 8).

Table 7 Airports' consumption of electricity, water, and production of waste.

Scope	Passengers/year [-]
Water consumption [l]	l/passenger
Waste production [g]	g/passenger
Electricity consumption [kWh]	kWh/passenger

Table 8 Airports' GHG emissions expressed per activity factors and size of the terminals.

GHG emissions deriving from	Passengers/year [-]	Air-conditioned spaces [m3]	Heated spaces [m3]
Water consumption [CO2eq]	CO2eq/passenger	-----	-----
Waste production [CO2eq]	CO2eq/passenger	-----	-----
Electricity consumption [CO2eq]	CO2eq/passenger	CO2eq /m3	-----
Fuel for heating buildings [CO2eq]	CO2eq/passenger	-----	CO2eq /m3
Fuel and electricity for company operated vehicles [CO2eq]	CO2eq/passenger	-----	-----

A2 airport did not indicate the size air conditioned and heated spaces. The volume of the air-conditioned and heated spaces was obtained multiplying the known area by an assumed height of the terminal. Given the geometry of the terminal of A2 airport, it is likely that the cooled and heated volumes were underestimated. Therefore, the energy and environmental performance, which are expressed per volume of the terminal of A2 airport, may be underestimated (e.g., within Figures 39, 40, 50, 51, and 53b).

Results

Water consumption at Adrigeen airports

Water leakages were reported by A3 and A4 airports. Specifically, there were water leakages between 2016 and 2018 at A4 airport and between 2016 and 2017 at A3 airport (Fig.1).

Water leakages were considered as incidents that are going to be avoided due to appropriate actions undertaken by the airports. Therefore, the performance of each airport, in terms of water consumption, was evaluated regardless of water leakages.

In terms of absolute water consumption (Fig.2), the airports ranked in 2018 as A5>A4>A6>A3>A1>A2.

In 2018, water consumption per passenger ranked as A4>A2>A3>A1>A5>A6 (Fig.3).

Between 2016 and 2018, the mean water consumption per passenger of the airports ranked as A1≅A2>A3>A4>A5>A6 (Fig.4). At A5 and A6 airports, the mean values of water consumption per passenger were below the overall mean value by 5.1 and 11.3 l/passenger, respectively while at A1, A2, A3, and A4 airports, the mean values of water consumption per passenger were between 2.5 and 3.7 l/passenger above the overall mean value.

Figures 5–10 show comparisons between the airport’s value of water consumption per passenger and the overall mean value of the corresponding year from 2016 to 2018.

Four airports organize training and education of airport staff related to water protection, namely A1, A4, A5, and A6 airports. A1 airport reported an annual frequency of staff training.

Monitoring of water consumption is done at A1, A3, and A4 airports. For example, A1 airport has a telemetry system for water management.

Three airports reported having in place or planning to implement initiatives to reduce water consumption. For example, A2 and A4 planned to install tap sensors. Furthermore, A4 airport equipped the infrastructure with a biological wastewater treatment plant for treatment and reuse of wastewater. Only A4 airport reuse wastewater following treatment for watering the surrounding greenery. A3 airport is going to launch a leakage management strategy. A5 and A6 airports harvest and reuse rainwater.

Surface water quality monitoring and groundwater quality monitoring are performed at four airports, namely at A1, A4, A5, and A6. A1 airport routinely does the quality monitoring.

Protection of groundwater from pollution is done at four airports, namely at A1, A4, A5, and A6. Specifically, A5 and A6 airports accomplish groundwater protection through rainwater harvesting.

Oil-water separators were installed at A1 airport to protect groundwater and to manage runoff water pollution.

No runoff water management is done at A2 airport, whereas the other 5 airports manage runoff water. For example, at A3 airport an oil separator treats the water runoff collected from the air side areas where fueling and de-icing are performed. At A4 airport, rainwater runoff is drained from the entire apron and the parking area through a separate rainwater sewerage system connected to separators which lead to the water body recipient.

A2 and A3 airports utilize herbicides to maintain open air spaces, whereas the other four airports do not use any herbicide. A5 and A6 airports use fertilizers to maintain open air spaces, whereas the other four airports do not use any fertilizer.

There could be potential seasonal contamination resulting from aircraft de-icing operation at four airports, namely A1, A4, and A5 airports.

Only A2 airport reported a potential episode of accidental contamination resulting from leakage of fuels in 2018, whereas the other five airports had no episodes of accidental contamination in the time period 2016–2018.

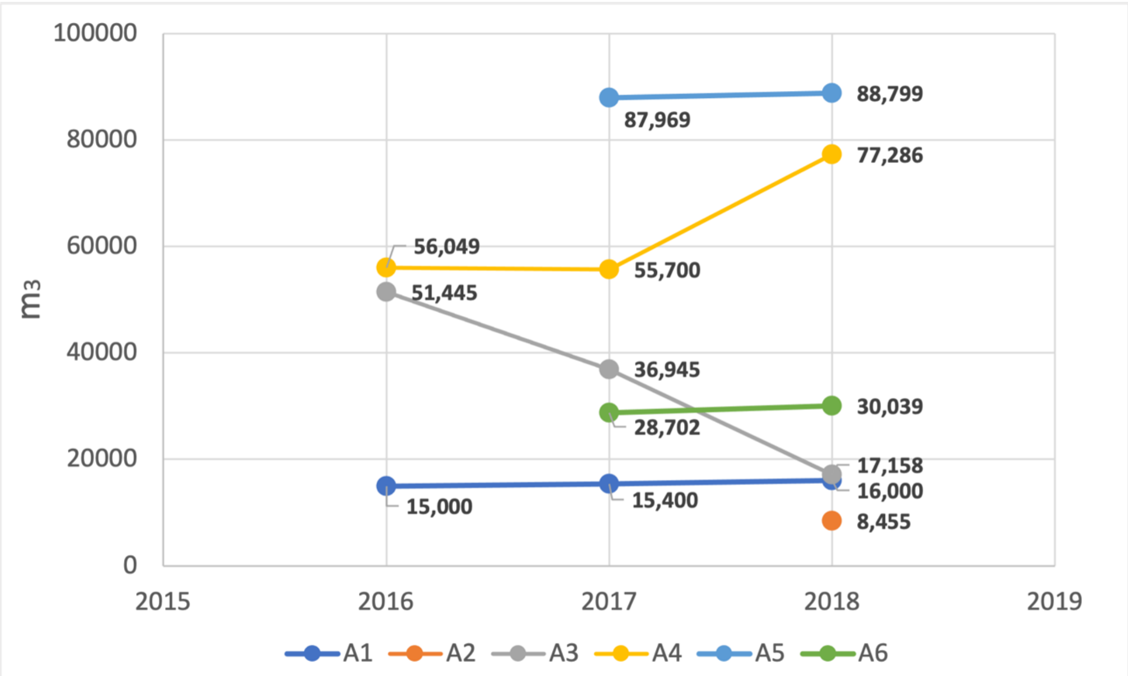


Figure 1 Airports' fresh water consumption. Leakages, incidents, and flushing WERE NOT comprised.

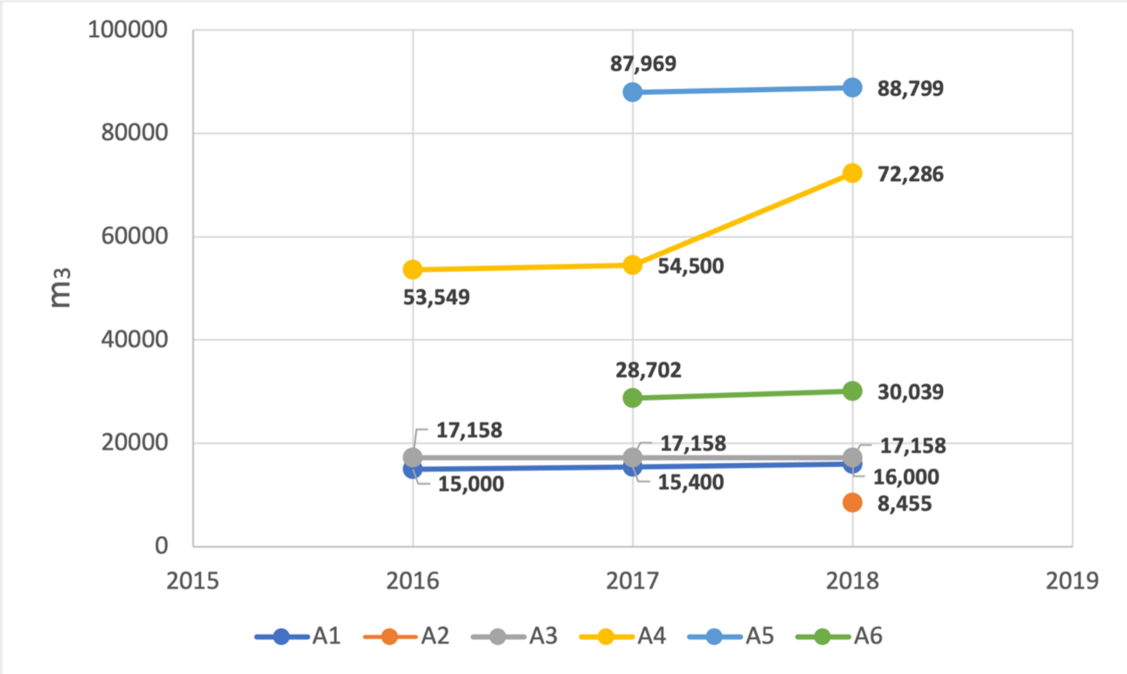


Figure 2 Airports' fresh water consumption. Leakages, incidents, and flushing WERE comprised.

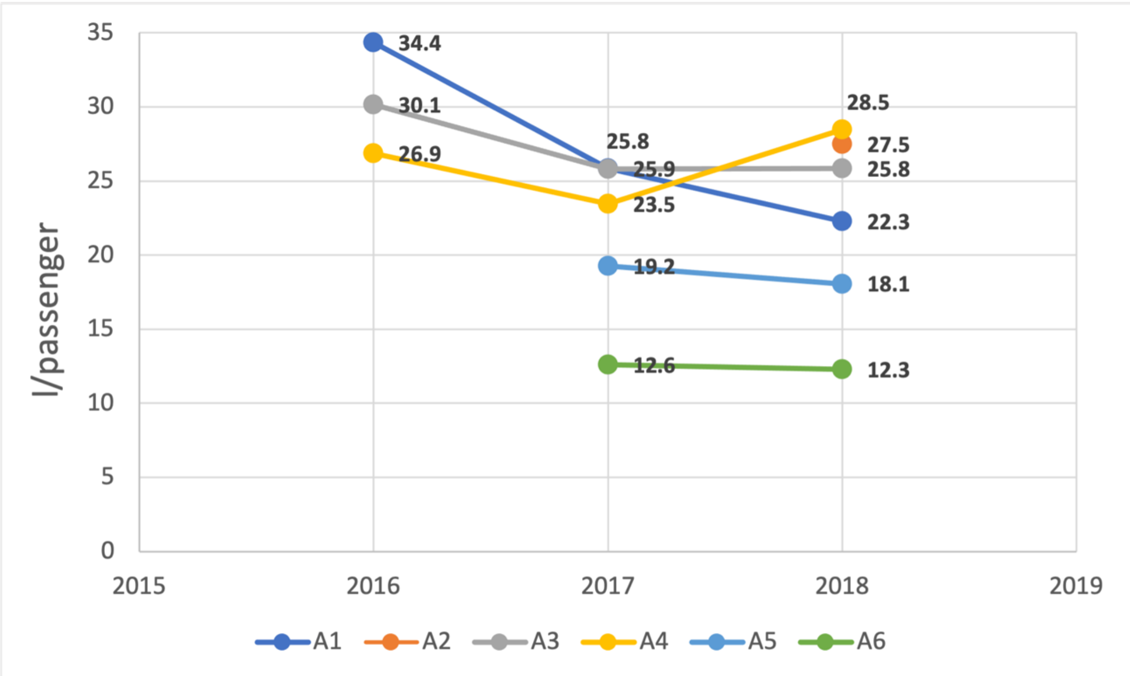


Figure 3 Airports' fresh water consumption per passenger. Leakages, incidents, and flushing were not comprised.

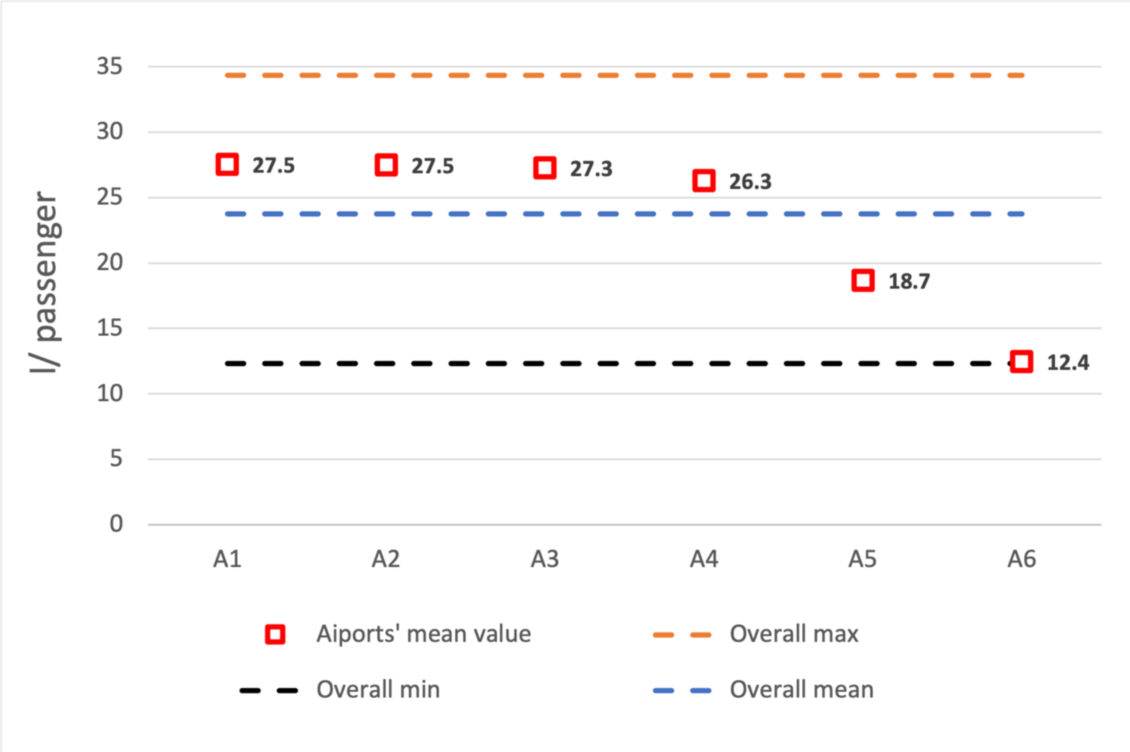


Figure 4 Airports' mean water consumption and overall mean, lowest, and highest water consumption per passenger in the time period 2016–2018. Leakages, incidents, and flushing were not comprised.

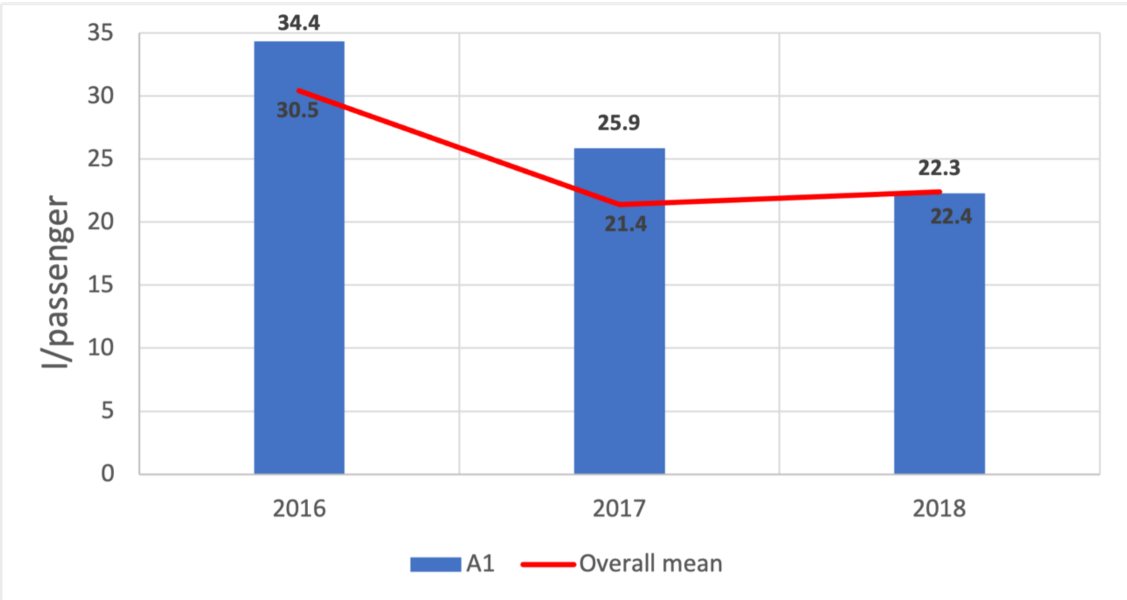


Figure 5 A1 airport's water consumption per passenger. Leakages, incidents, and flushing were not comprised.

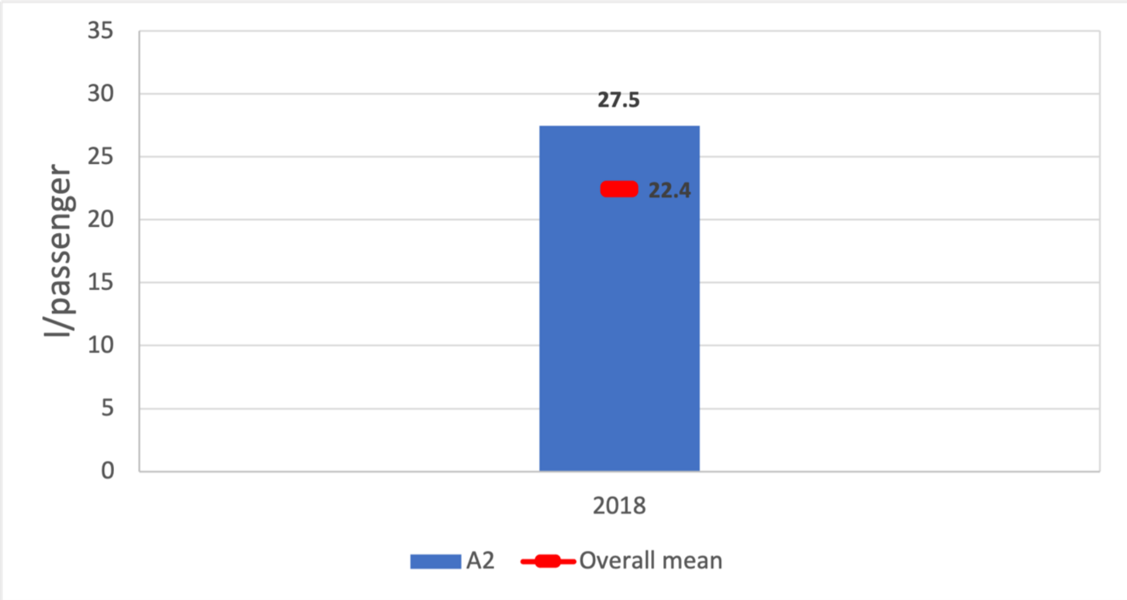


Figure 6 A2 airport's water consumption per passenger. Leakages, incidents, and flushing were not comprised. 2016 and 2017 data were unavailable.

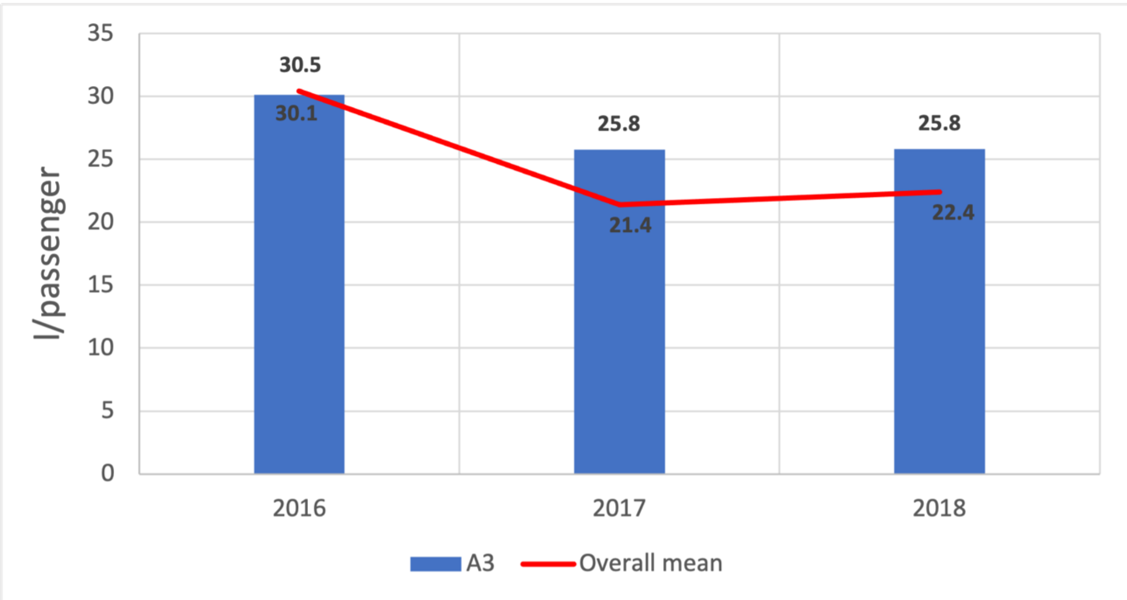


Figure 7 A3 airport's water consumption per passenger. Leakages, incidents, and flushing were not comprised.

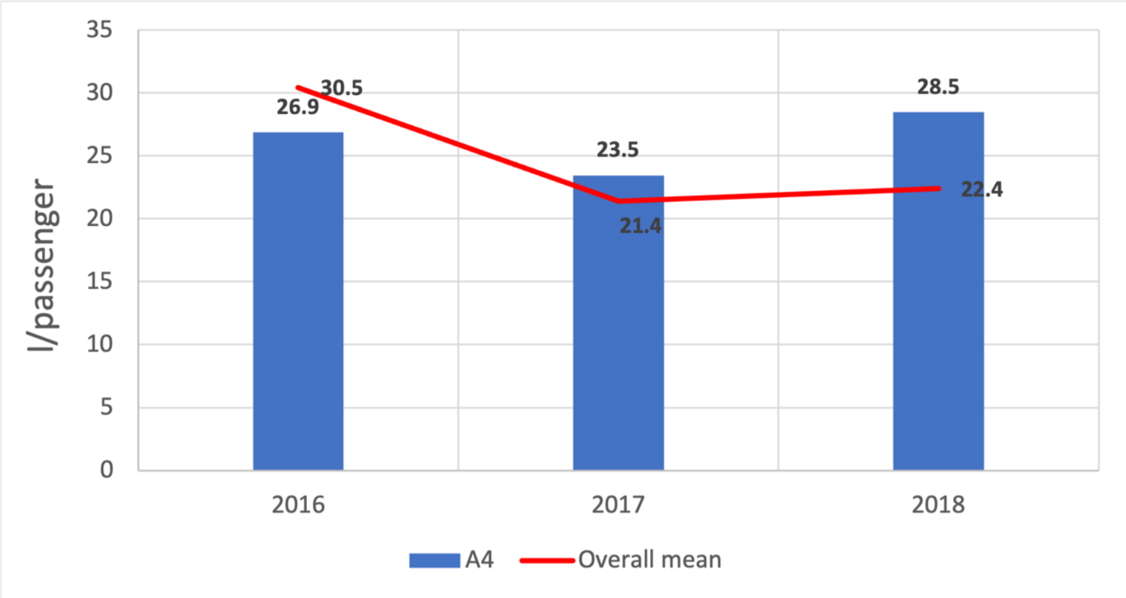


Figure 8 A4 airport's water consumption per passenger. Leakages, incidents, and flushing were not comprised.

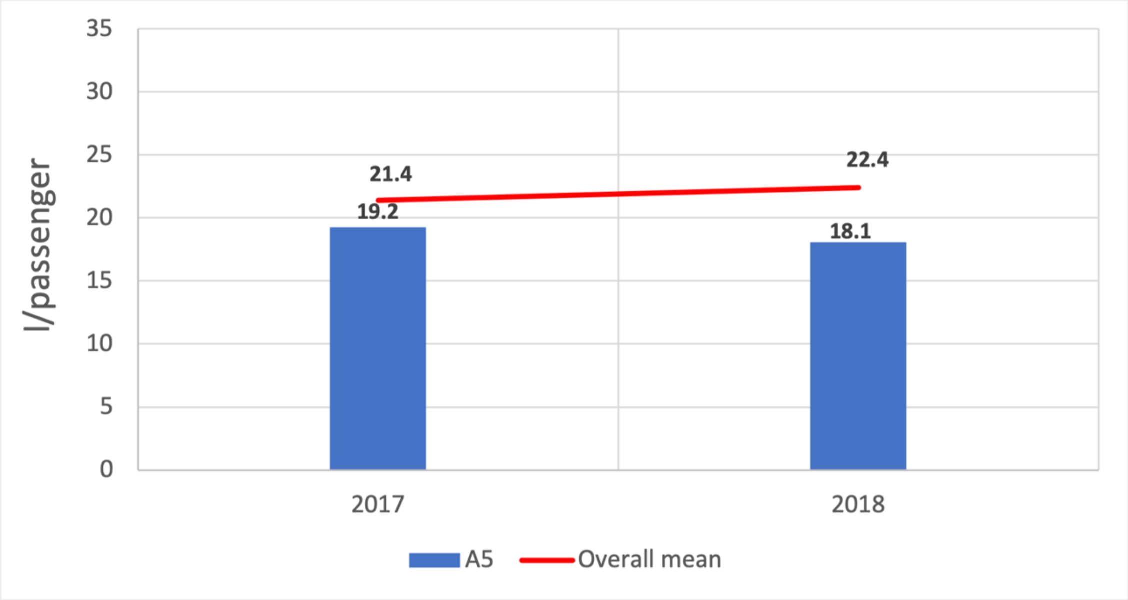


Figure 9 A5 airport's water consumption per passenger. Leakages, incidents, and flushing were not comprised. 2016 data were unavailable.

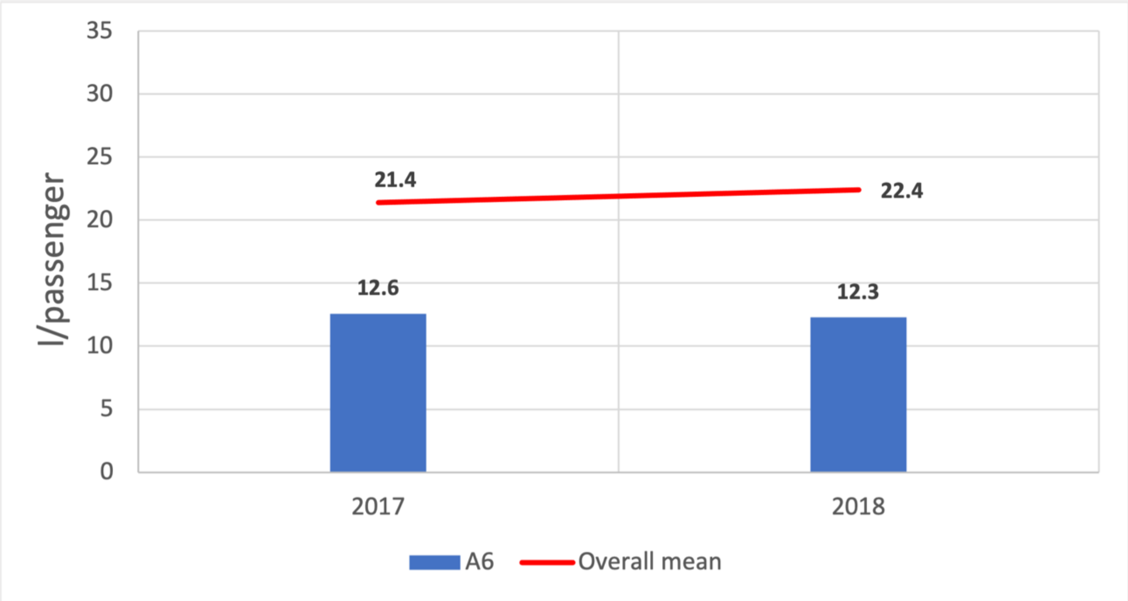


Figure 10 A6 airport's water consumption per passenger. Leakages, incidents, and flushing were not comprised.

Waste produced at Adrigeen airports

A2 and A6 airports did not provide any information about the quantities and fractions of waste produced. Moreover, data about quantities and types of waste produced are sparse because of the different types of waste collection implemented at each airport. For example, the fractions of metal and plastic are collected together at A5 airport. Therefore, it would be difficult to compare the quantities of metal and plastic collected at A5 airport with the respective ones collected at the other airports.

Therefore, only a few comparisons are presented regarding the quantities of waste fractions produced at Adrigreen airports.

In 2018, the quantity of paper and cardboard produced per passenger ranked as follows: A3>A4>A5>A1 (Figures 11–14).

In 2018, the quantity of metal produced per passenger ranked as follows: A3>A1>A4 (Figs. 11–13). A3 airport reported to have recycled old machineries in the time period 2016–2018.

At A4 airport (Fig.13), the annual quantities of waste produced depend on the volume and number of passengers and the type of service provided for the handling of aircraft, passenger, and cargo ground.

A5 airport aims at improving separate waste collection from 66 to 67% of the total waste in 2021.

Table 9 shows the waste fractions that Adrigreen airports have reported as recycled.

Table 9 Resume of the waste fractions recycled at the Adrigreen airports.

Airport	Paper	Cardboard	Metal	Plastic	Glass	Organic fraction	Hazardous waste
A1	Yes	Yes	Yes	No	No	No	No
A2	Yes	No	Yes	No	No	No	No
A3	No	No	Yes	No	No	No	No
A4	Yes	Yes	Yes	No answer	No answer	Yes	Yes
A5	Yes	Yes	Yes	Yes	Yes	Yes	Yes
A6	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Legend

Red	No
Green	Yes
White	No answer

Between 2016 and 2018, none of the airports had in place economic incentives for recycling more and generating less waste. For example, with the pay-as-you-throw program the companies located at the airport would be charged according to the amount of municipal solid waste produced.

A1, A2, A5, and A6 airports operate a centralized waste management system.

Regarding aircraft waste advanced handling, at A1 airport the preparation for recycling of waste from aircraft is aimed at separating cardboard waste.

Regarding the waste prevention initiatives in place at the airports, disposable cutlery and beverages were replaced with easily degradable materials at A1 airport. Moreover, training of employees on recycling is held at A5 and A6 airports.

Regarding waste mitigation measures in place at the airports, instructions for waste separation are displayed inside the passenger terminal of A1, A5, and A6 airports.

A4 airport has plans for installing more recycling bins and for improving the handling of waste food and green waste.

Besides benchmarks, it should be outlined that A5 has a top separation and recycling scheme implemented within all airport areas. It should be considered as a possible example of BAT implementation.

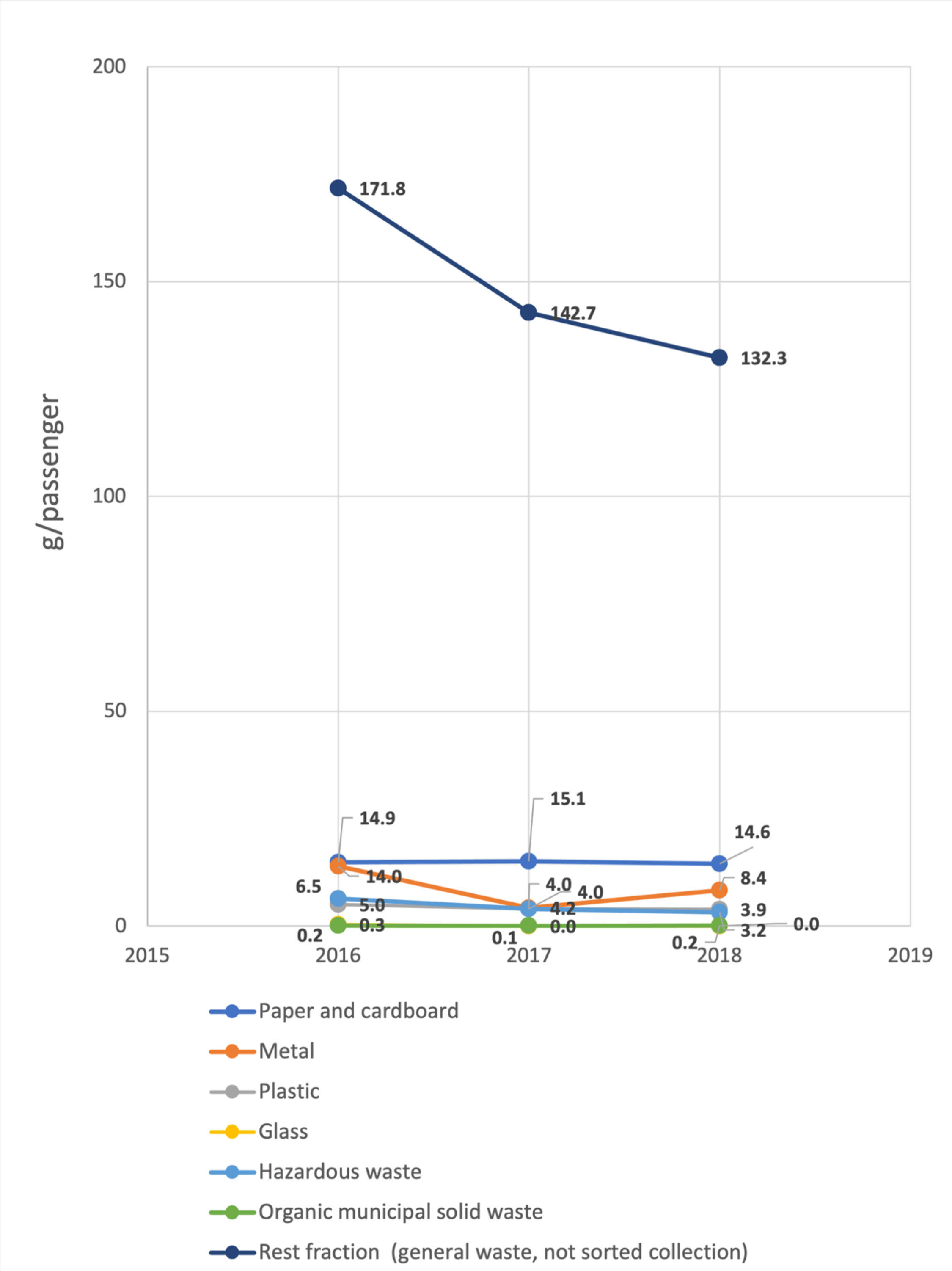


Figure 11 Fractions of waste produced per passenger at A1 airport.

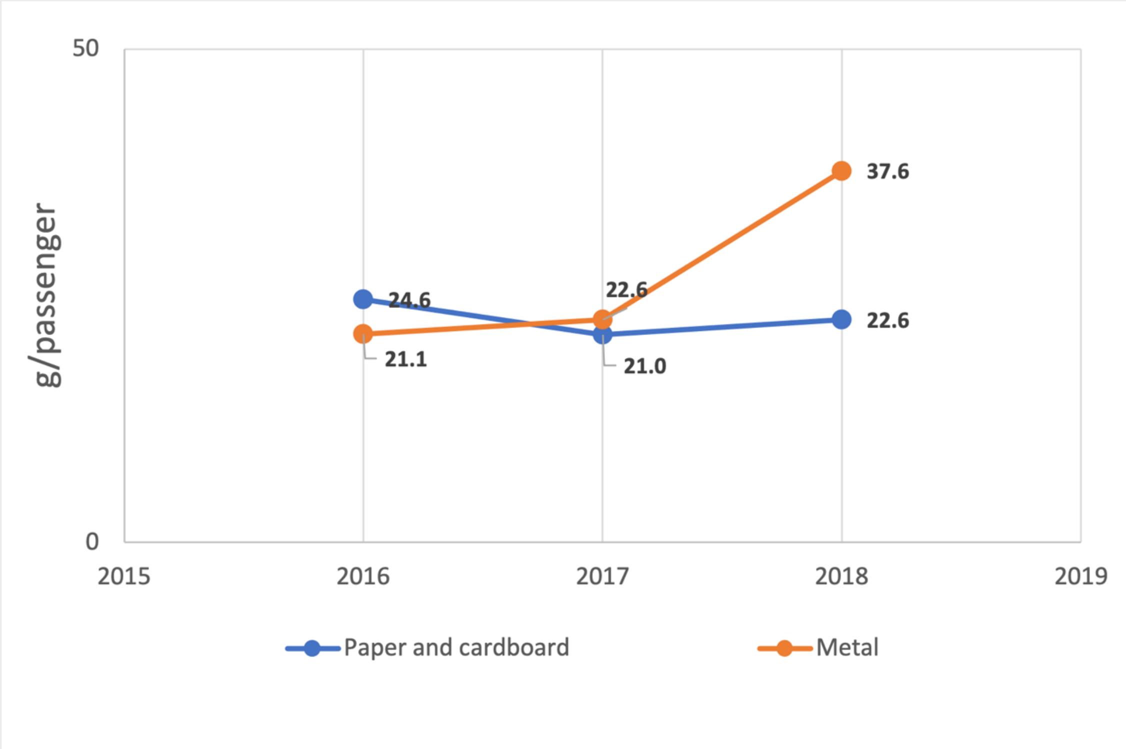


Figure 12 Fractions of waste produced per passenger at A3 airport.

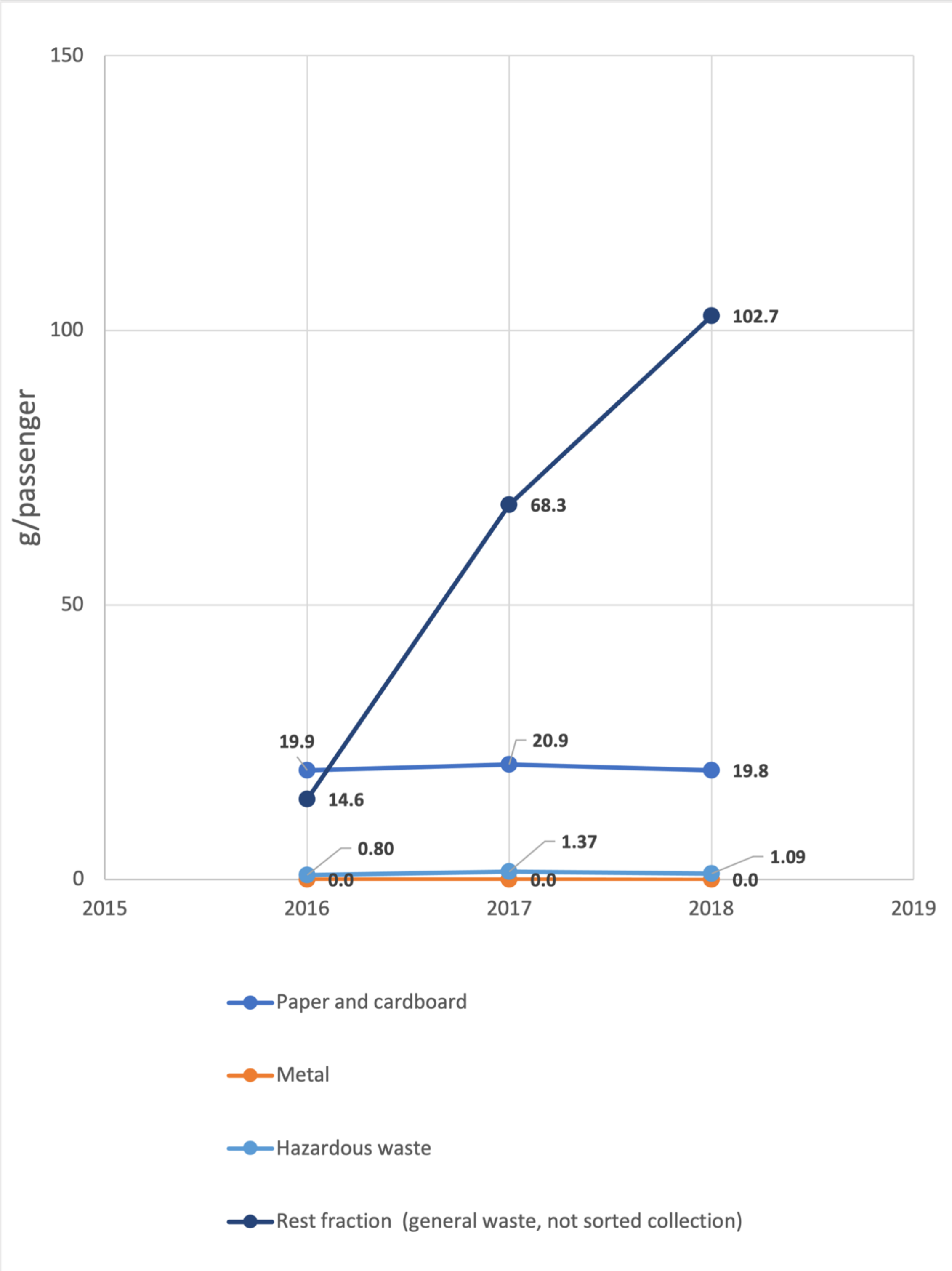


Figure 13 Fractions of waste produced per passenger at A4 airport.

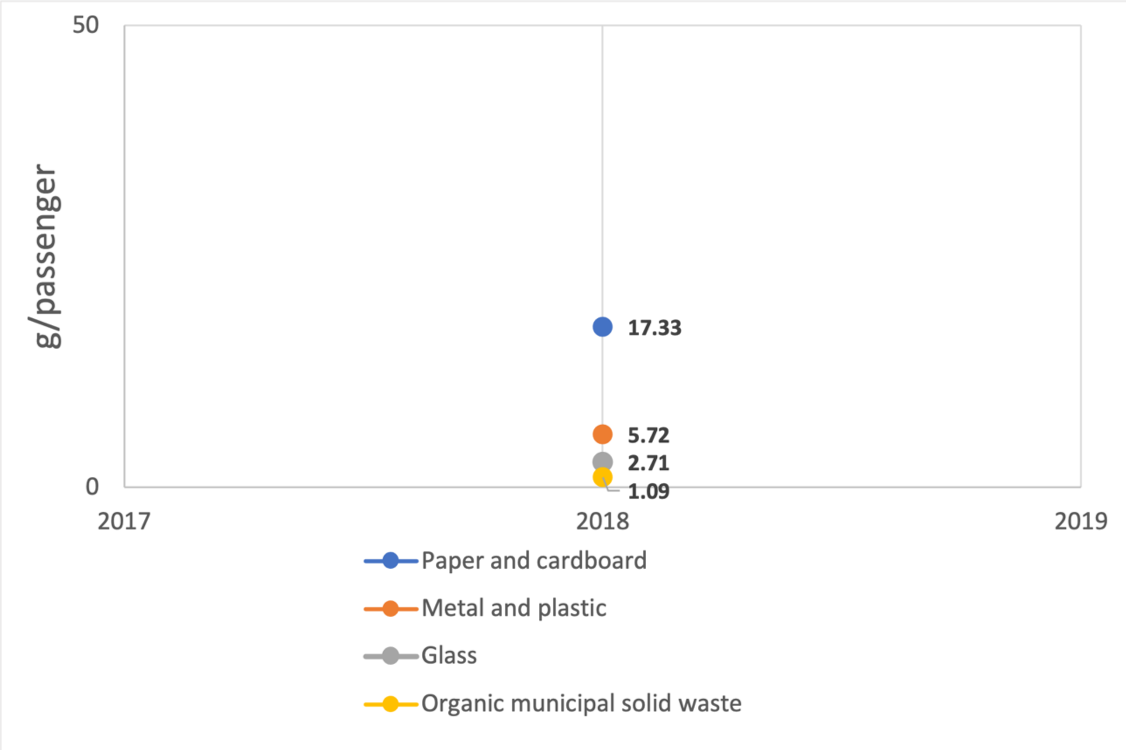


Figure 14 Fractions of waste produced per passenger at A5 airport. 2016 and 2017 data were unavailable.

Electricity consumption at Adrigeen airports

In 2018, the total amount of electricity consumption was in the range 1,500,000–13,000,000 kWh, with the ranking A5>A4>A6>A1>A2>A3.

In 2018, the electricity consumption per passenger ranked as A2>A5>A1>A3>A4>A6 (Fig.15).

Between 2016 and 2018 the mean electricity consumption per passenger ranked as A2>A1>A5>A3>A6>A4 (Fig.16). At A1 and A2 airport, the mean values of electricity consumption per passenger were above the overall mean value by 0.1 and 2.3 kWh/passenger, respectively. On the contrary, at A3, A4, A5, and A6 airports, the mean values of electricity consumption per passenger were between 0.1 and 0.7 kWh/passenger below the overall mean value.

Figures 17–22 show comparisons between the airport's value of electricity consumption per passenger and the overall mean value of the respective year from 2016 to 2018.

In 2018 A1 airport was below the mean value by 0.4 kWh/passenger. On the contrary, A2 airport was above the mean value by 2.5 kWh/passenger in 2018.

Regarding the use of renewable energy technologies, photovoltaic systems have been in use since 2017 at A5 and A6 airports. At A3 airport, a photovoltaic system will become operational in 2021. At A4 airport, a photovoltaic system was installed as part of the project "Development and rreconstruction of XXXXXXXXX Airport''. A1 airport is considering production/purchase of energy from renewable sources.

All the Adrigreen airports installed LED lighting to improve the energy efficiency. A1 airport reported that LED lighting represents about 50% of the lighting system.

A2 airport has plans for replacing the lighting towers with energy saving ones.

Benchmarks show very similar electricity consumption per passenger for all airports but A2 whose scores are much higher. Such benchmarks become less similar when biased per square meters.

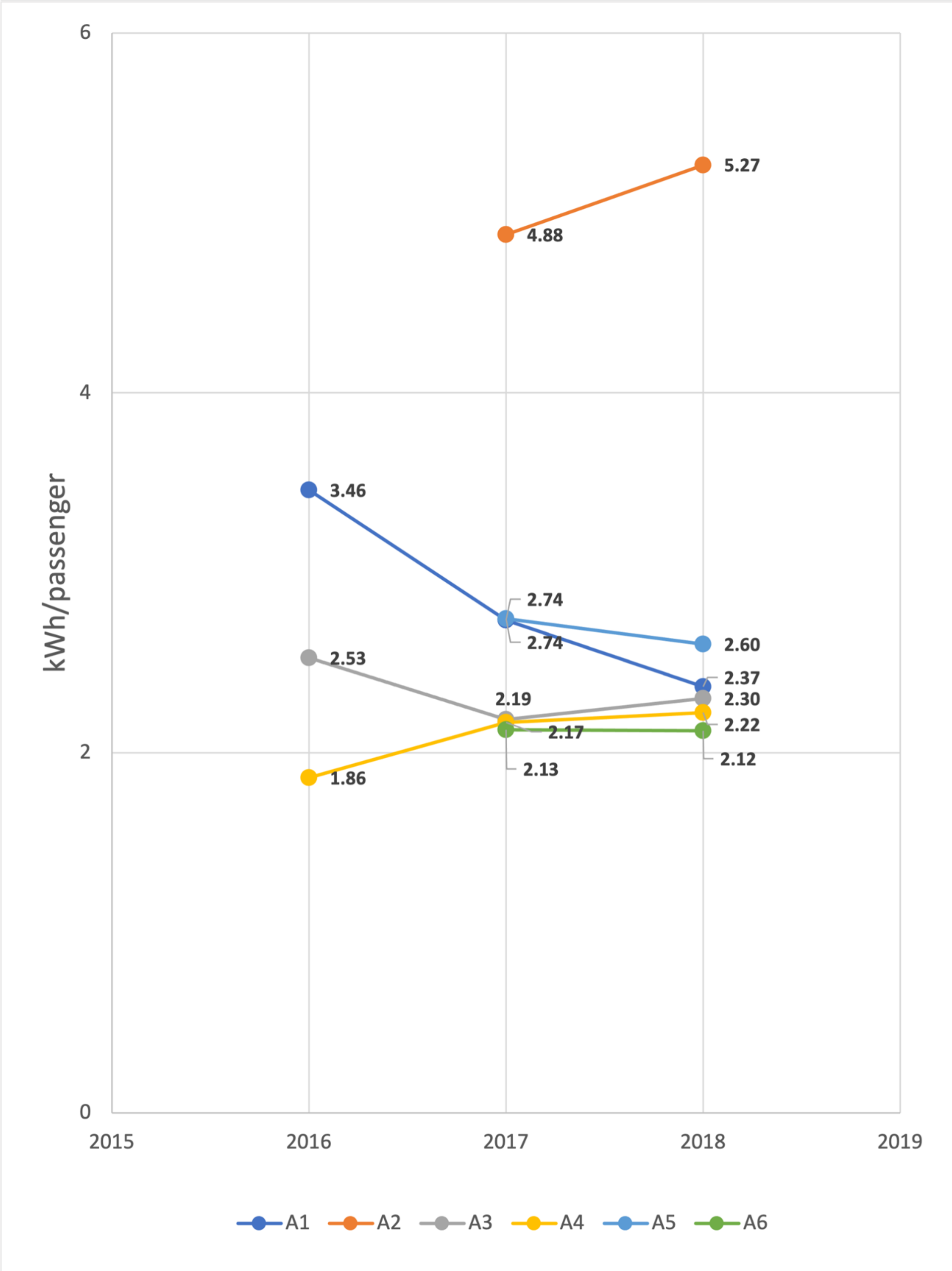


Figure 15 Airports' electricity consumption per passenger.

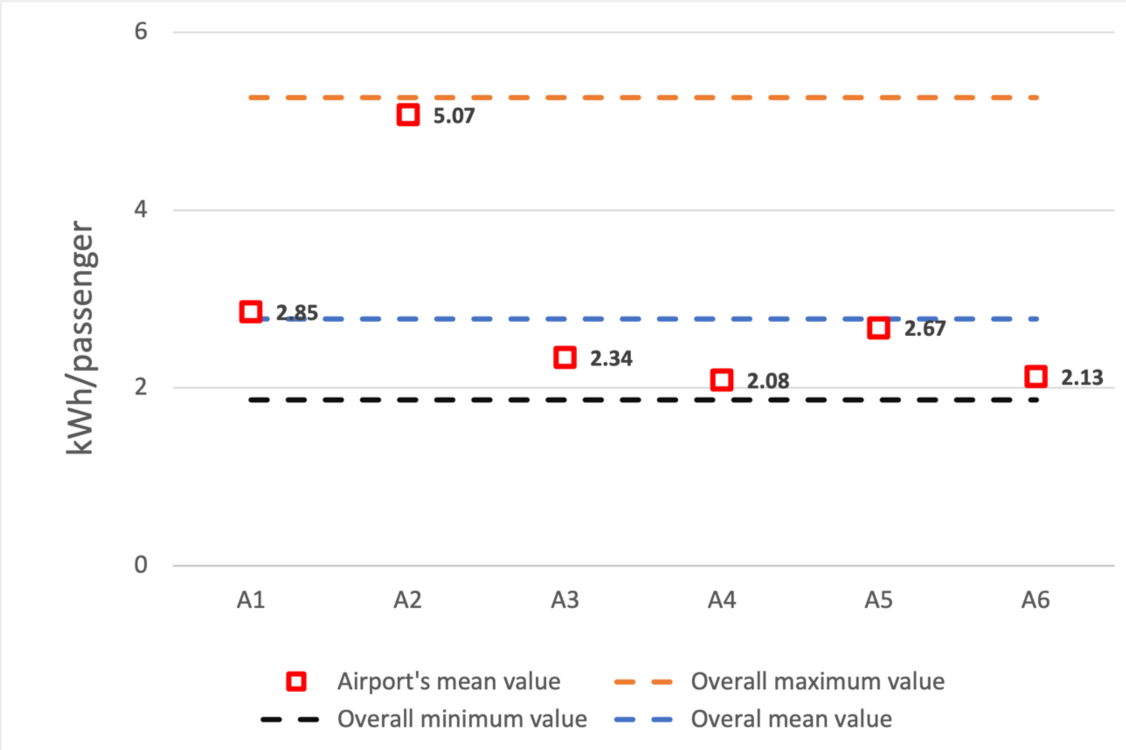


Figure 16 Airports' mean electricity consumption and overall maximum, minimum and mean electricity consumption values per passenger in the time period 2016–2018.

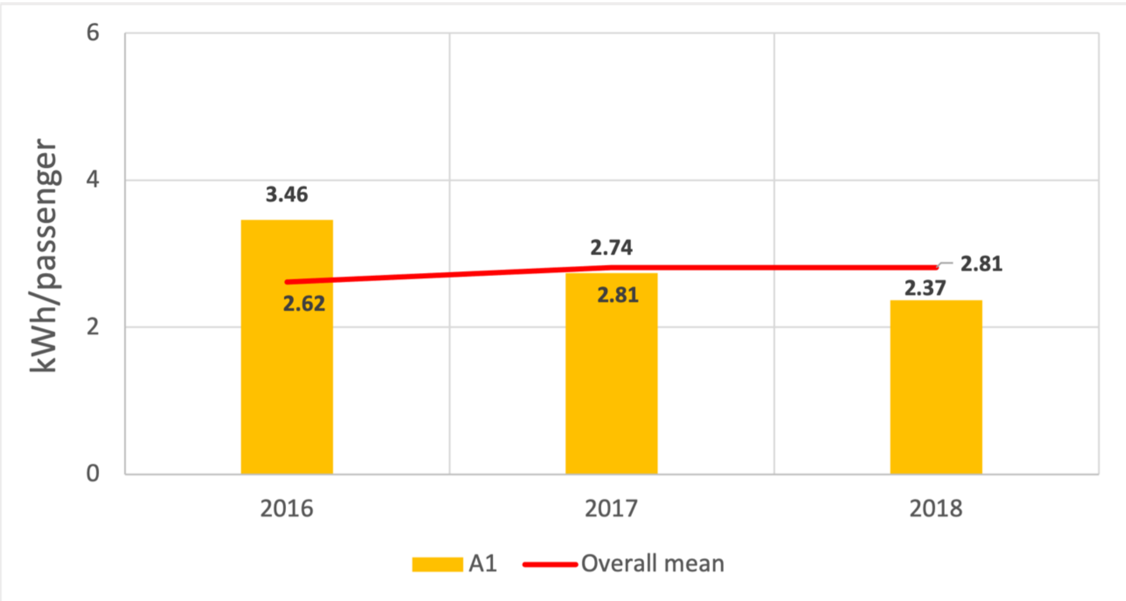


Figure 17 A1 airport's electricity consumption per passenger.

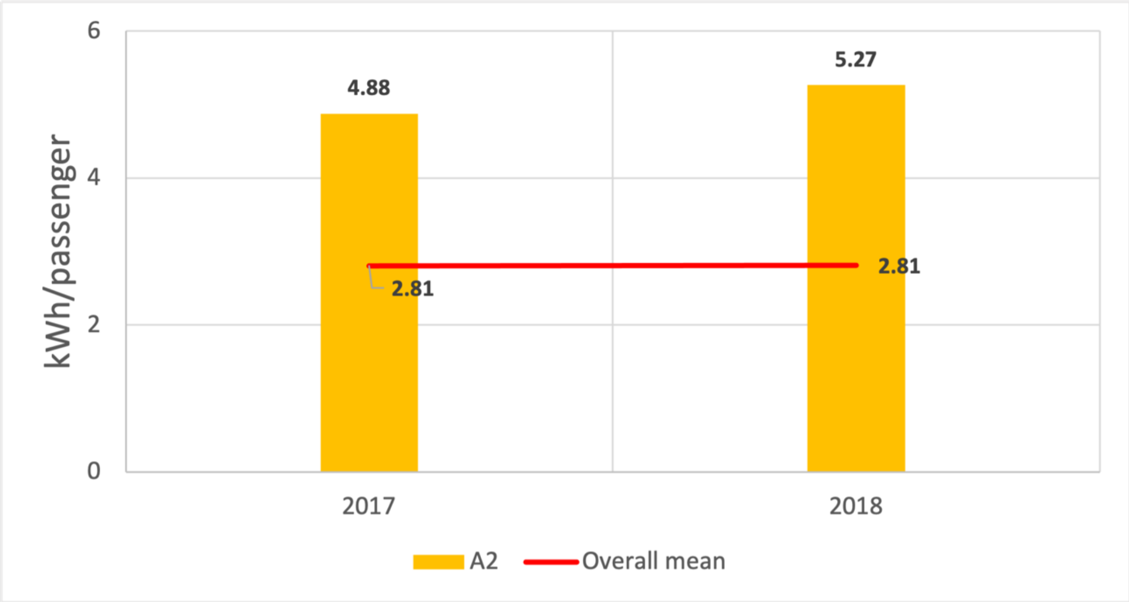


Figure 18 A2 airport's electricity consumption per passenger. 2016 data were not available.

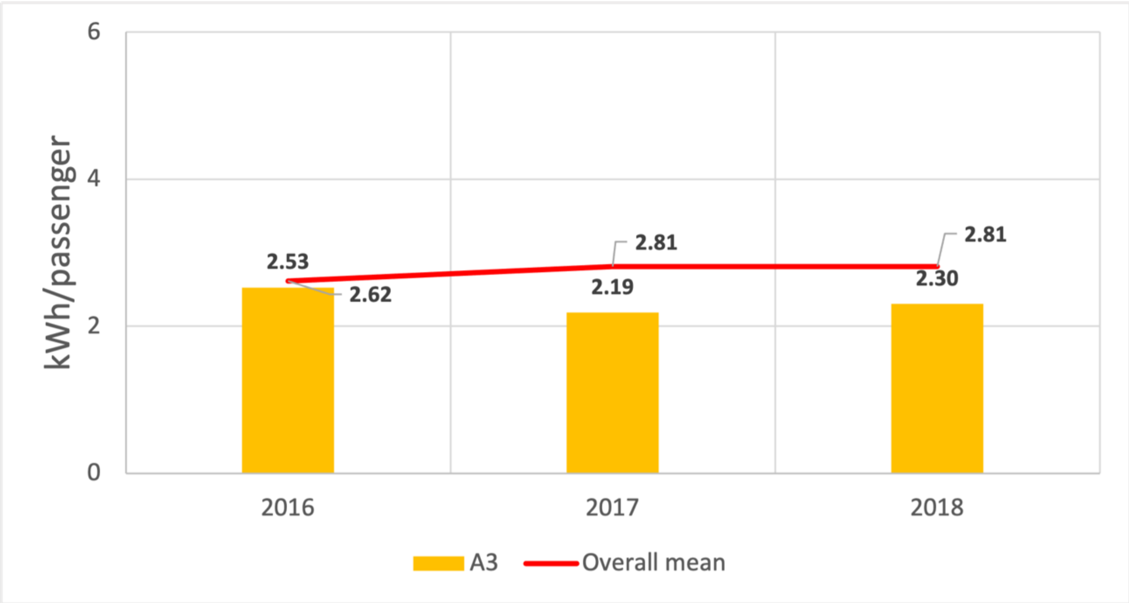


Figure 19 A3 airport's electricity consumption per passenger.

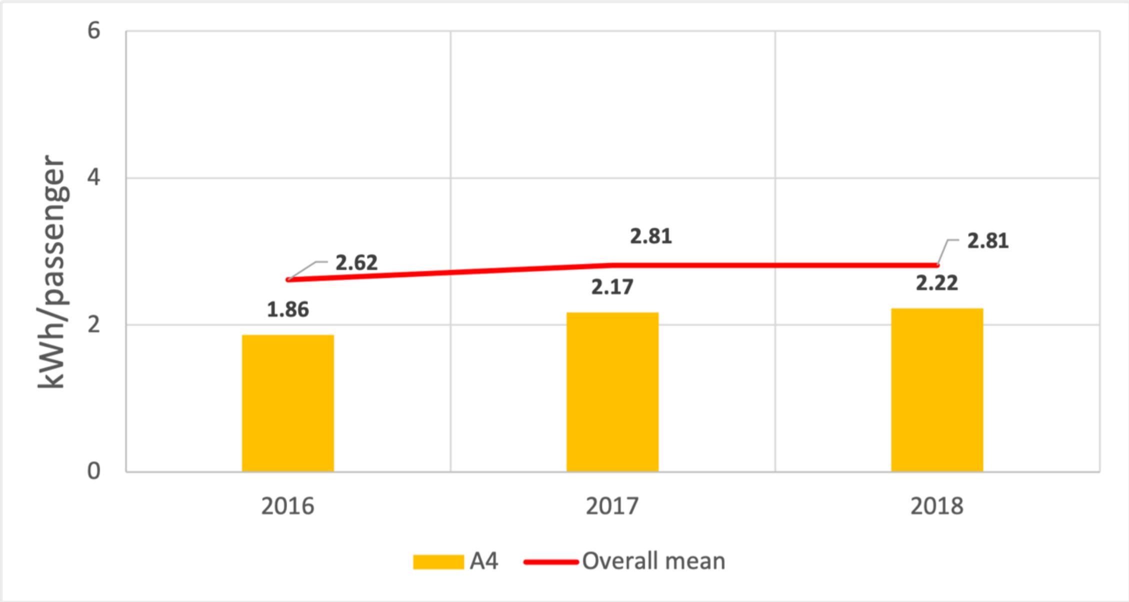


Figure 20 A4 airport's electricity consumption per passenger.

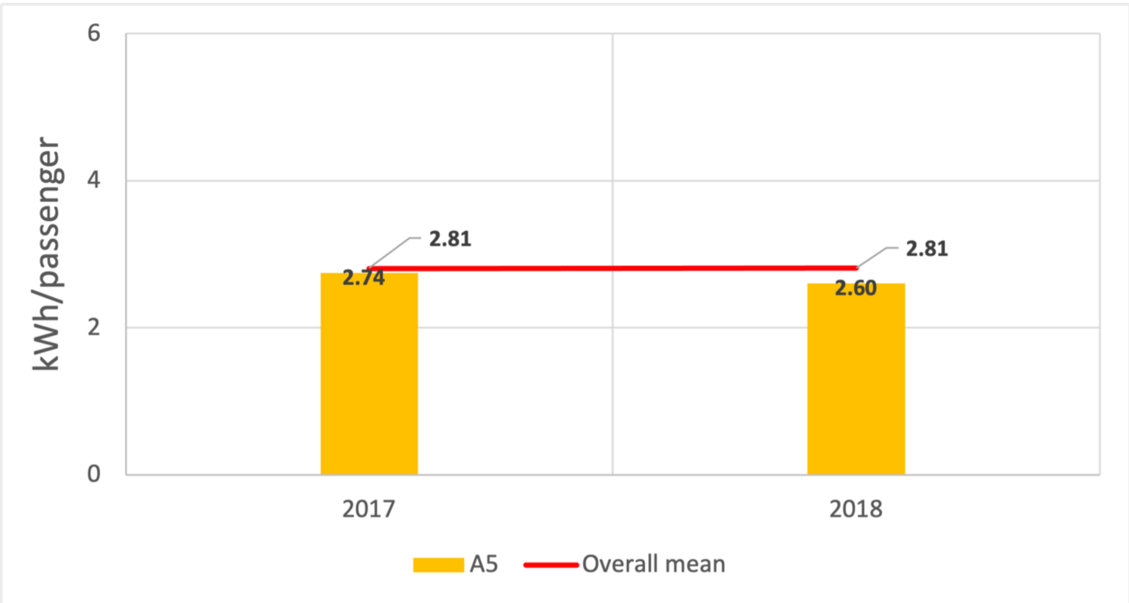


Figure 21 A5 airport's electricity consumption per passenger. 2016 data were not available.

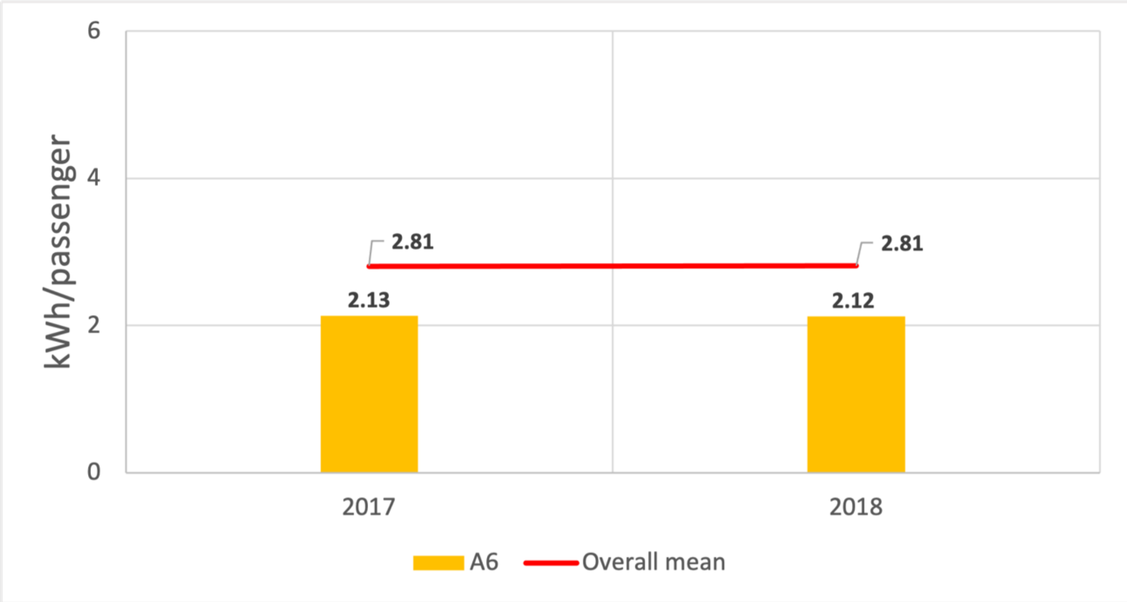


Figure 22 A6 airport's electricity consumption per passenger. 2016 data were not available.

Greenhouse gases emissions deriving from water consumption at Adrigreen airports

In 2018, GHG emissions deriving from water consumption ranked as A5>A4>A6>A3>A1>A2 (Fig.23).

In 2018, GHG emissions deriving from water consumption per passenger ranked as A4>A2>A3>A1>A5>A6 (Fig.24).

Between 2016 and 2018 the mean GHG emissions deriving from water consumption per passenger ranked as A3>A1≅A2≅A4>A5>A6 (Fig.25). At A3 airport, the mean value of GHG emissions deriving from water consumption per passenger was above the overall mean value by about 0.02kg CO2eq/passenger. At A1, A2, A4, A5 and A6 airports the mean values of GHG emissions deriving from water consumption per passenger were up to about 0.01 kg CO2eq/passenger below the overall mean value.

Figures 26–31 show comparisons between the airports' GHG emissions deriving from water consumption per passenger and the overall mean value of the corresponding years from 2016 to 2018.

In 2018 the A3 airport's value of GHG emissions deriving from water consumption per passenger was similar to the overall mean value.

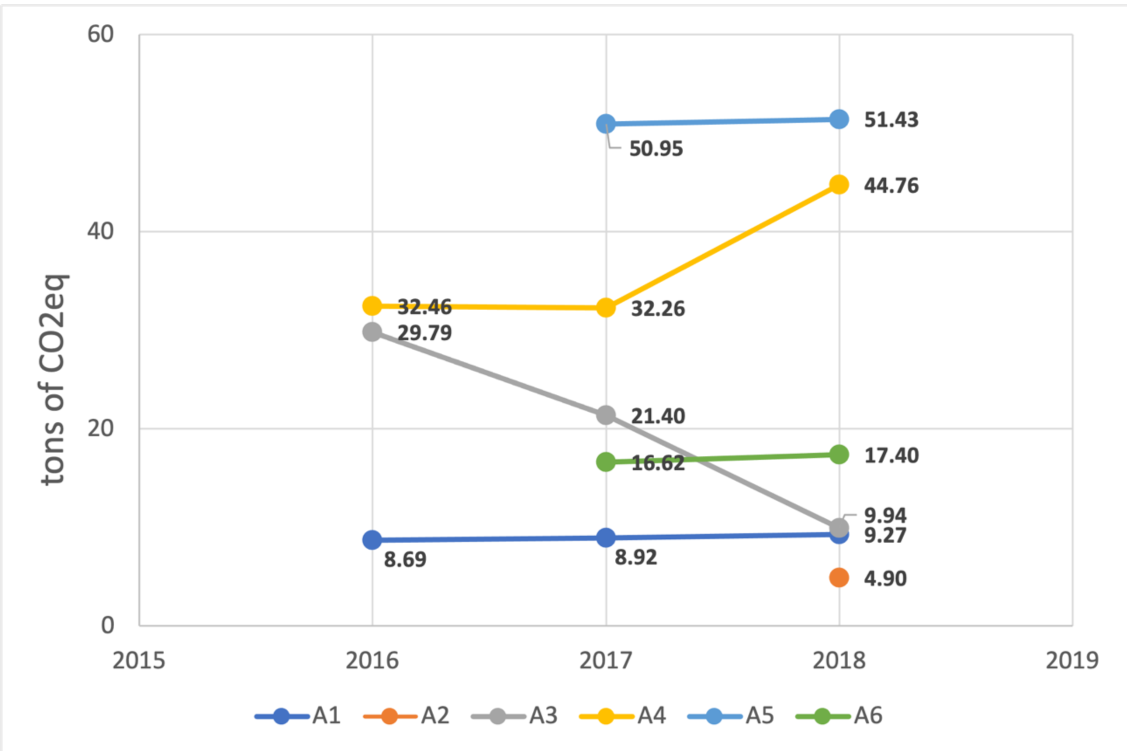


Figure 23 Airports' GHG emissions deriving from water consumption.

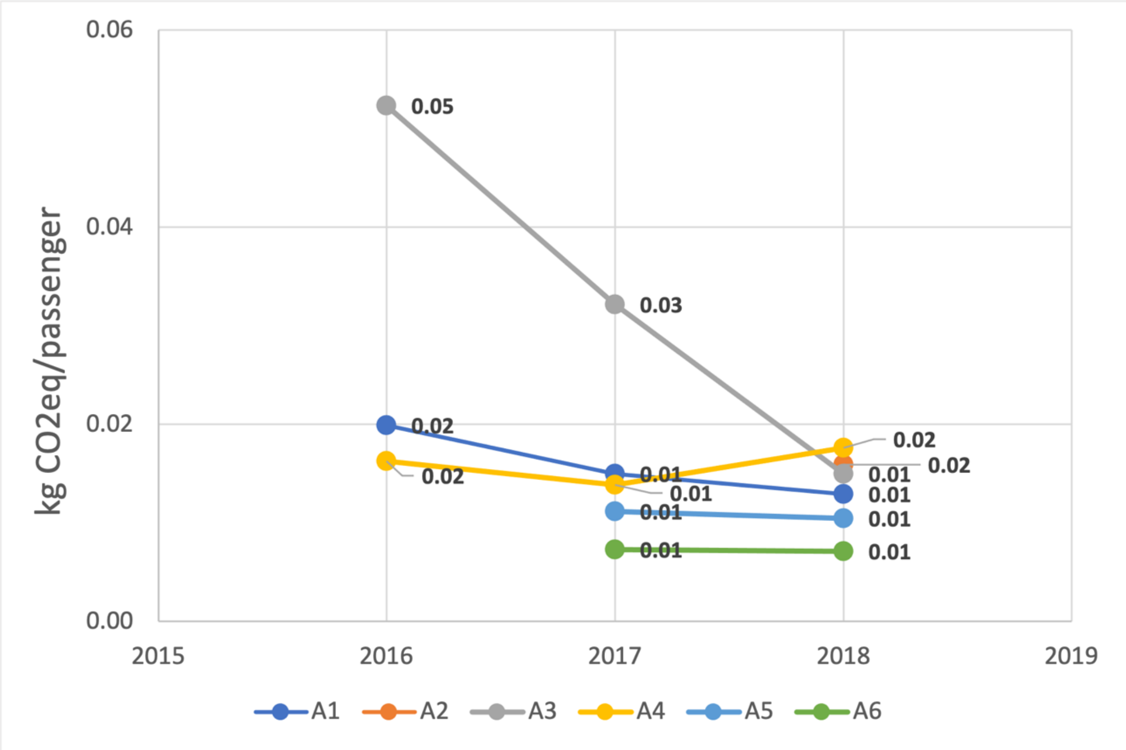


Figure 24 Airports' GHG emissions deriving from water consumption per passenger.

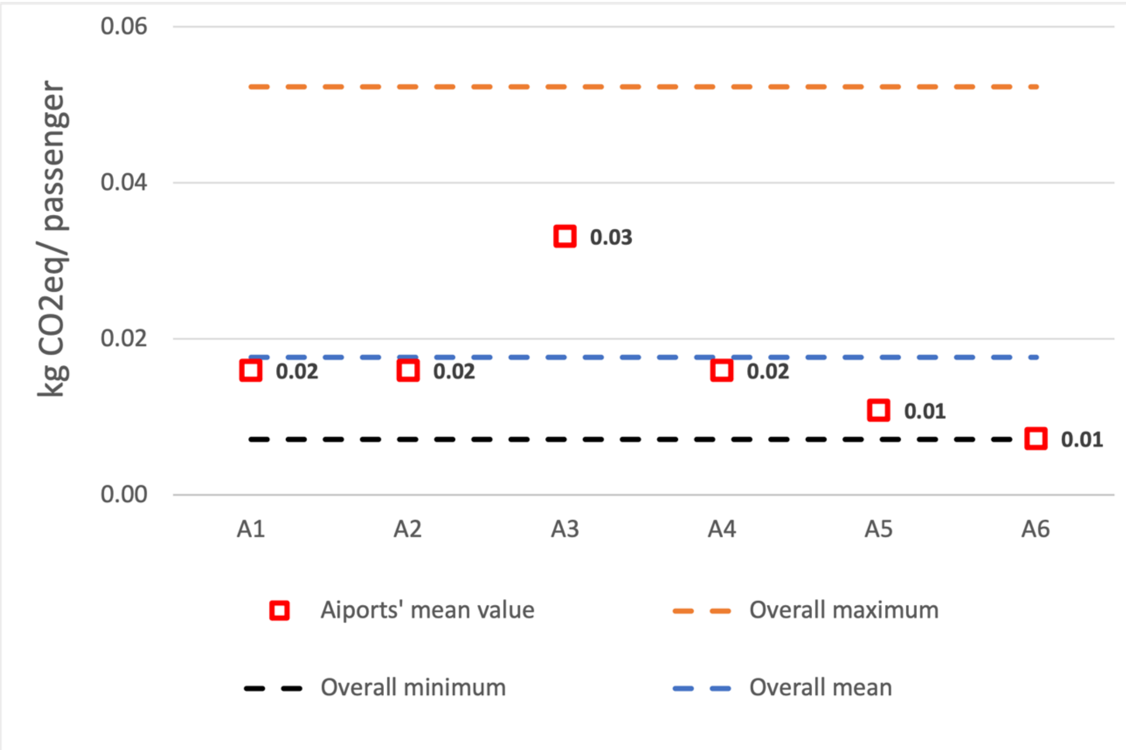


Figure 25 Airports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from water consumption per passenger 2016–2018.

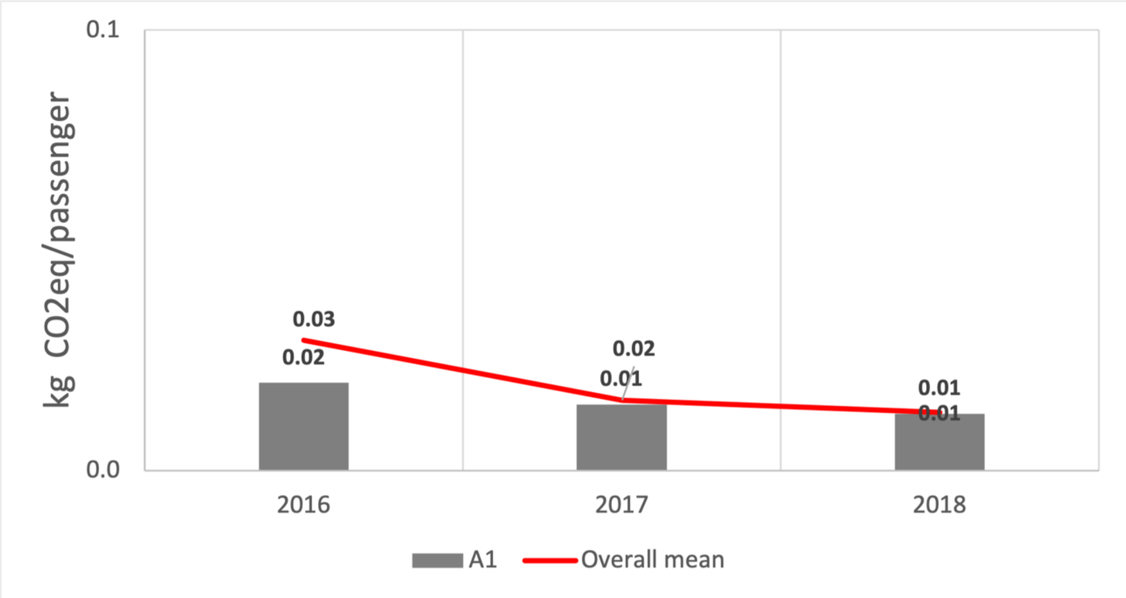


Figure 26 A1 airport’s GHG emissions deriving from water consumption per passenger.

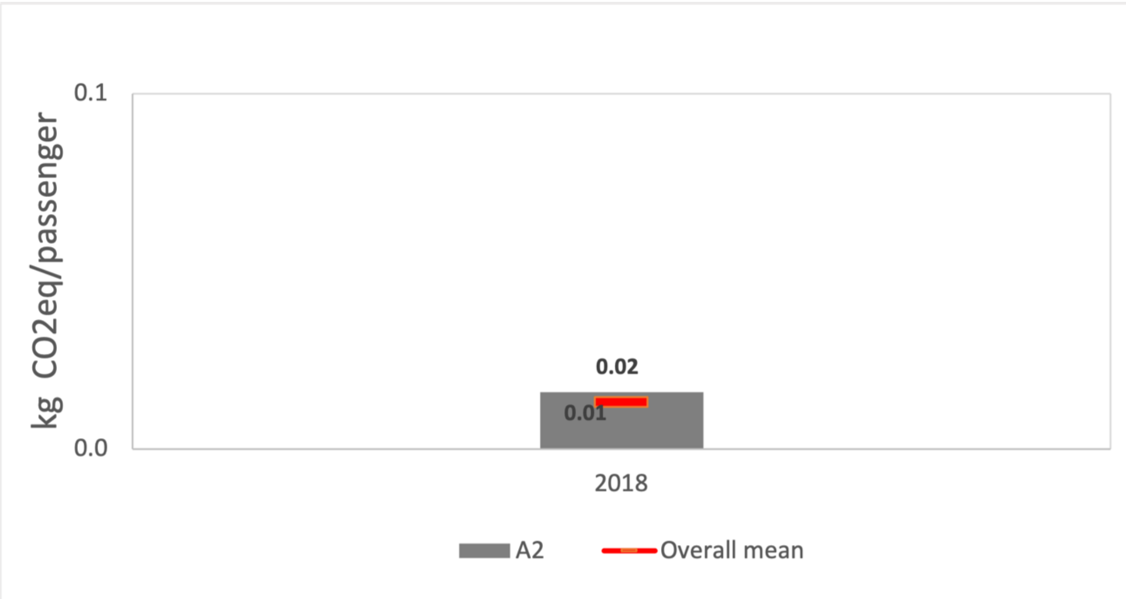


Figure 27 A2 airport’s GHG emissions deriving from water consumption per passenger.

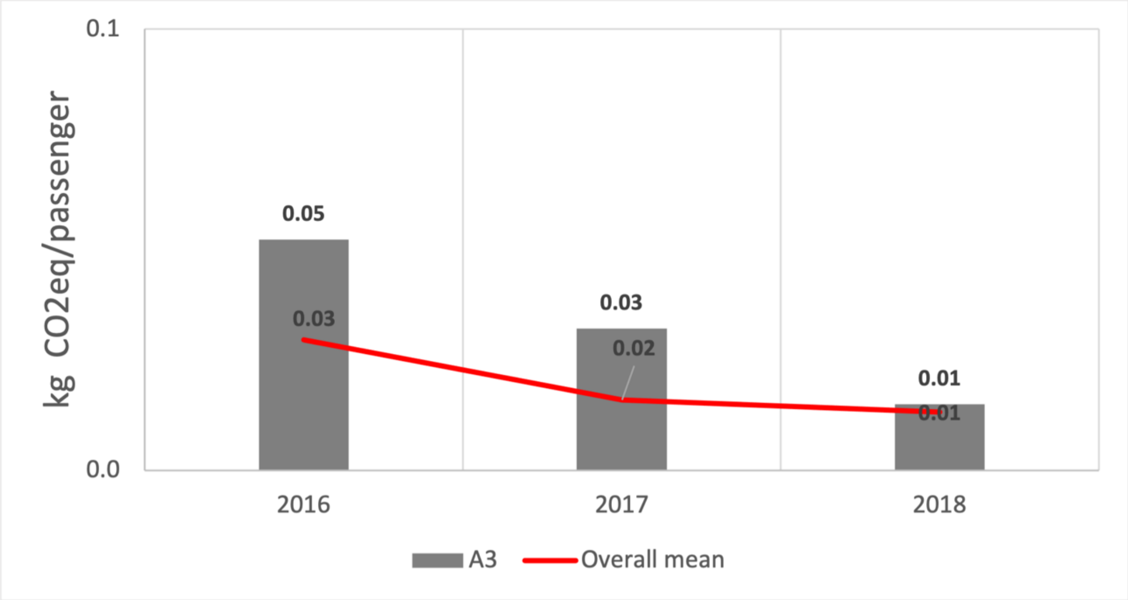


Figure 28 A3 airport’s GHG emissions deriving from water consumption per passenger.

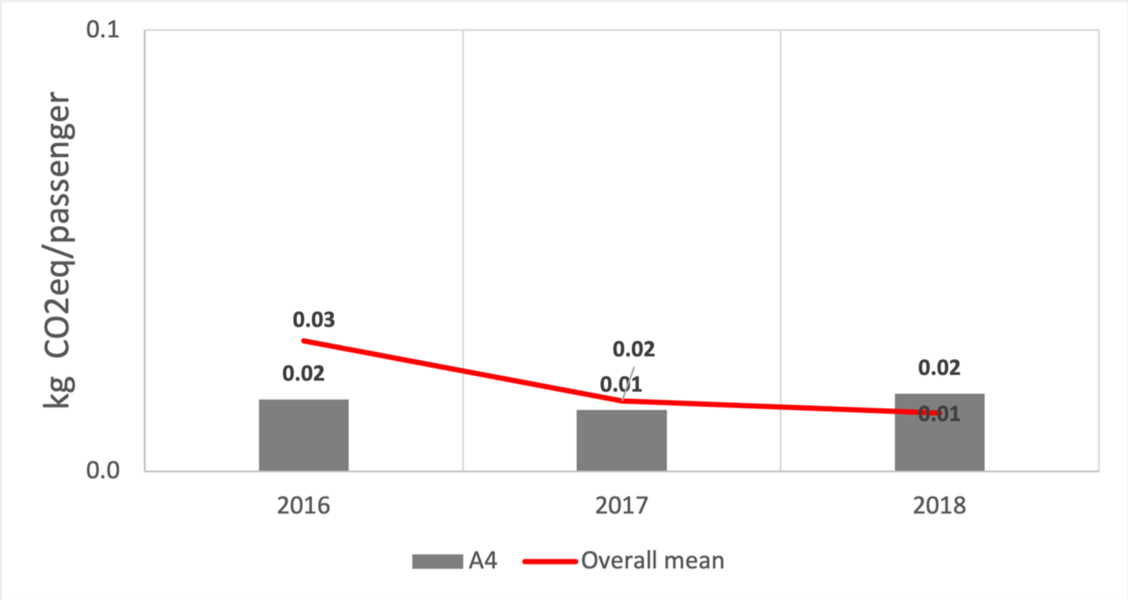


Figure 29 A4 airport’s GHG emissions deriving from water consumption per passenger.

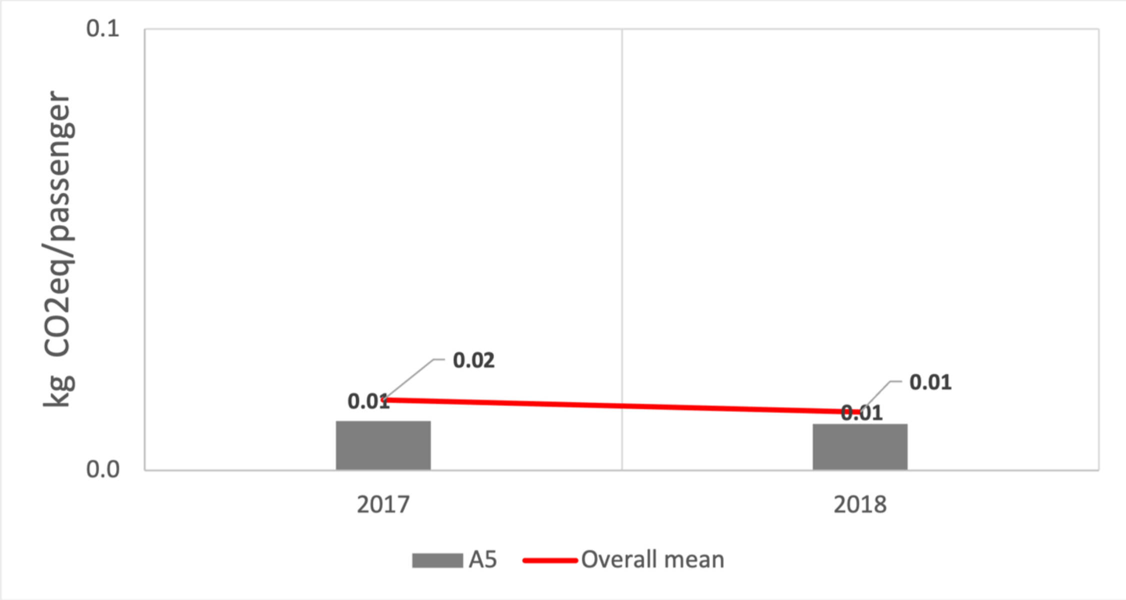


Figure 30 A5 airport’s GHG emissions deriving from water consumption per passenger.

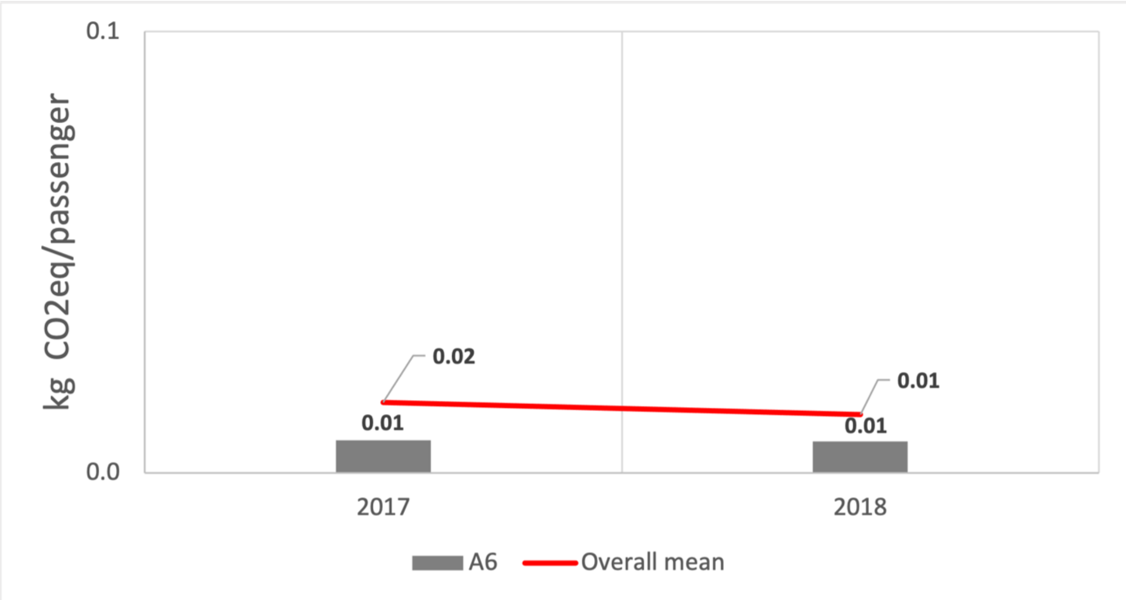


Figure 31 A6 airport’s GHG emissions deriving from water consumption per passenger.

Greenhouse gases emissions according to the fractions of waste produced at Adrigreen airports

A few comparisons are presented between the quantities of GHG emissions related to the waste fractions produced at the Adrigreen airports in the time period 2016–2018.

At A1 airport, GHG emissions related to the production of different waste fractions (i.e., paper and cardboard, organic municipal solid waste, and ‘rest’ fraction) ware between 48.9 and 61.9 tons of CO2eq/year in the time period 2016–2018 (Fig.32). Considering these three waste fractions, rest fraction was the highest contributor to GHG emissions with about 99%, followed by paper and cardboard (about 1%).

At A3 airport, GHG emissions of about 0.8 tons of CO2eq/year were due to the production of the paper and cardboard waste fraction in the time period 2016–2018 (Fig.33).

At A4 airport, between 31.5 and 265.4 tons of CO2eq/year GHG emissions were due to the production of different waste fractions, namely paper and cardboard, organic municipal solid waste, and rest fraction in the time period 2016–2018 (Fig.34). Considering these three waste fractions, rest fraction was the highest contributor to GHG emissions with about 60–63%, followed by organic municipal solid waste 33–36%, and paper and cardboard (1–7%).

In 2018, GHG emissions of about 29.4 tons of CO2eq were due to the production of the different waste fractions at A5 airport, namely glass containers, paper and cardboard, and organic municipal solid waste (Fig.35). Considering these three waste fractions, organic municipal solid waste was the highest contributor to GHG emissions with about 97%, followed by glass containers (2%), and paper and cardboard (1%).

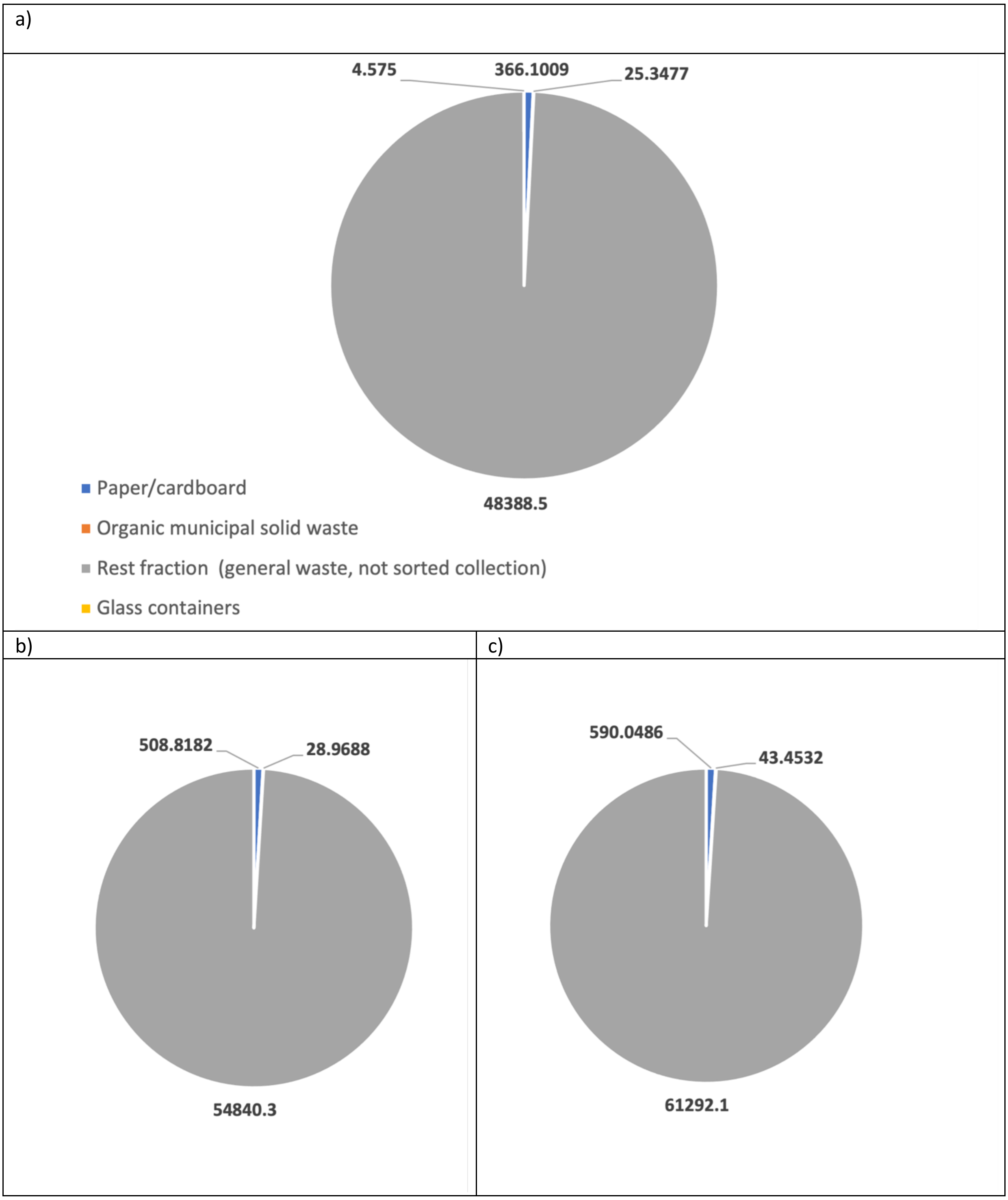


Figure 32 GHG emissions [kg CO2eq] according to the fractions of waste produced at A1 airport in 2016 (a), 2017 (b), and 2018 (c). In 2017 and 2018 the fraction of waste related to glass containers was reported to be none.

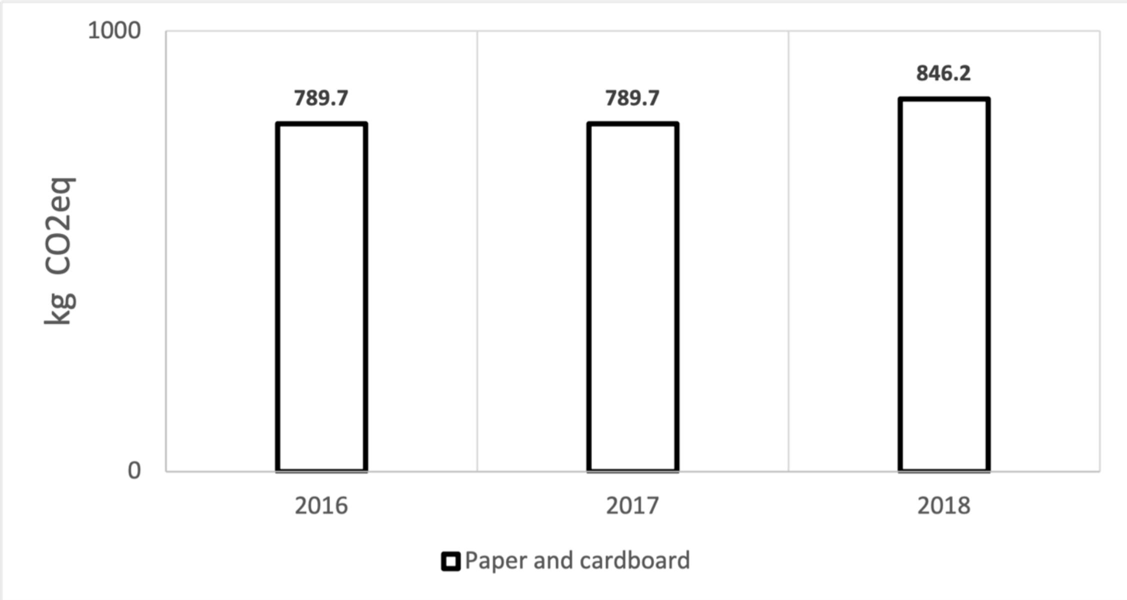


Figure 33 GHG emissions according to the fractions of paper and cardboard waste produced at A3 airport. The fractions of waste related to glass containers, organic municipal solid waste, and rest fraction (general waste, not sorted collection) were not reported.

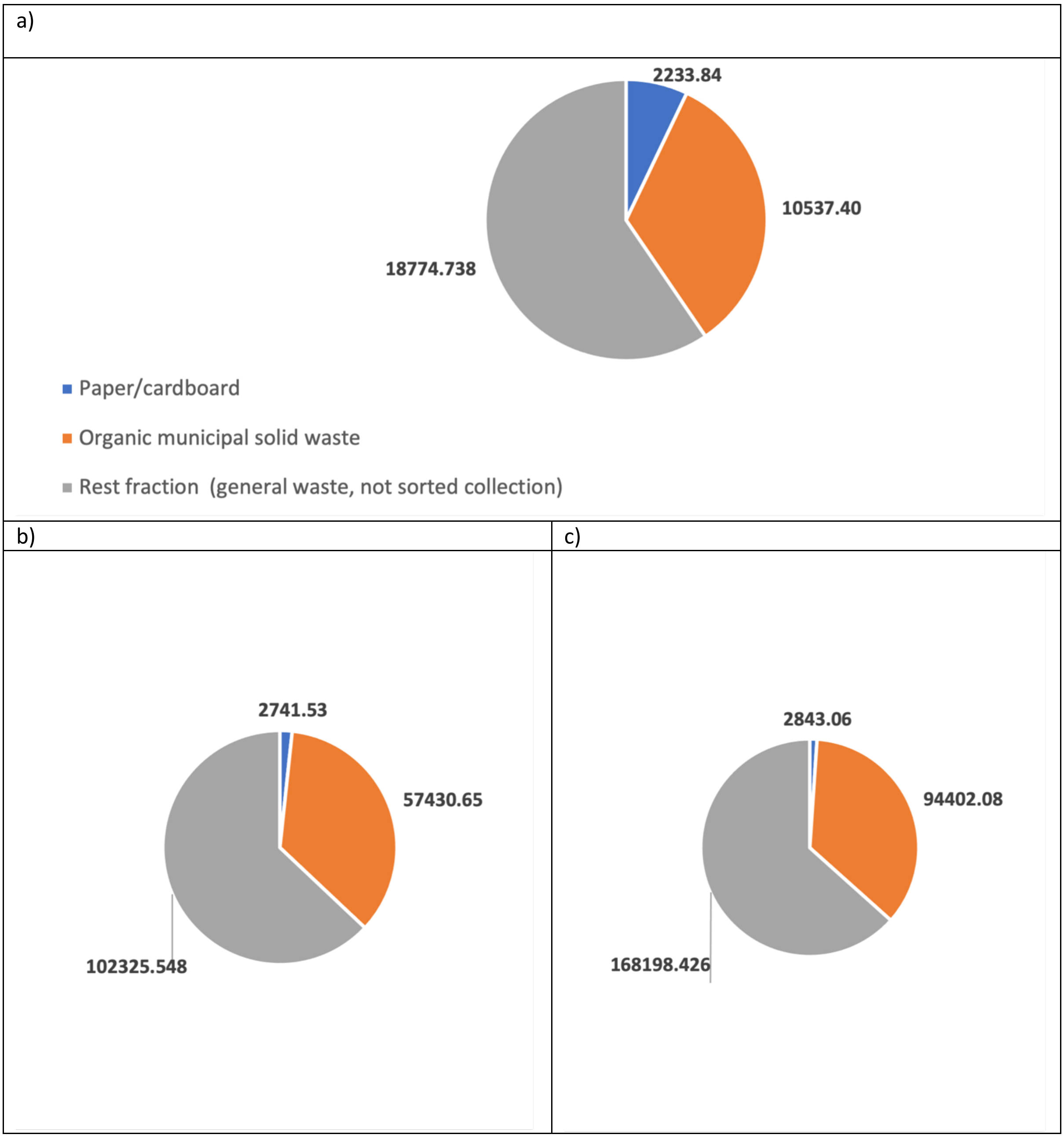


Figure 34 GHG emissions [kg CO2eq] according to the fractions of waste produced at A4 airport in 2016 (a), 2017 (b), and 2018 (c). The fraction of waste related to glass containers was not reported.

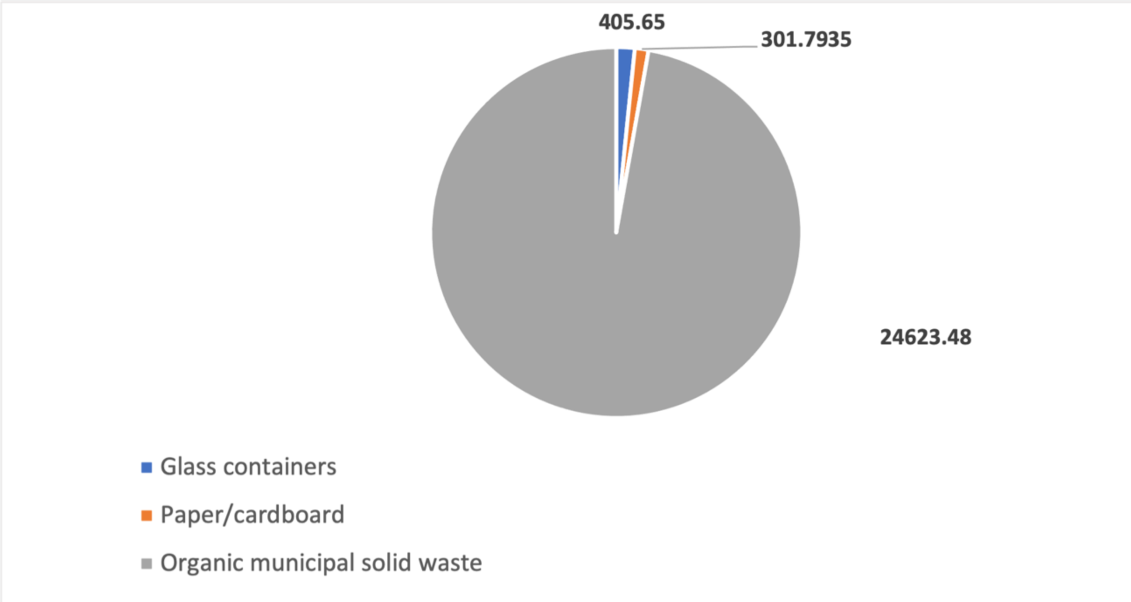


Figure 35 GHG emissions [kg CO2eq] according to the fractions of waste produced at A5 airport in 2018. The fraction of waste related to rest fraction (general waste or not sorted collection) was not reported.

Airports' greenhouse gases emissions deriving from electricity consumption

In 2018, GHG emissions deriving from electricity consumption ranked as A4>A2>A3>A1>A5>A6 (Fig.36).

In 2018, GHG emissions deriving from electricity consumption per passenger ranked as A2>A3>A1≅A4>A5>A6 (Fig.37).

A5 and A6 airports' GHG emissions deriving from electricity consumption were null or negative in 2017 and 2018. These two airports purchased electricity that came from a mix of renewable energy sources in 2018. Furthermore, photovoltaic electricity was produced and consumed at A5 and A6 airports in 2017 and 2018.

Electricity produced by renewable energy sources was assumed to produce no GHG emissions. To account for the CO2 savings deriving from local electricity production from renewables (e.g. photovoltaic) and local consumption, the estimated amount of CO2 emissions related to the same amount of kWh produced from non-renewables was subtracted to the total.

Between 2016 and 2018 the mean GHG emissions deriving from electricity consumption per passenger ranked as A2>A3>A1>A4≅A5>A6 (Fig.38). At A2 and A3 airports, the mean values of GHG emissions deriving from electricity consumption per passenger were above the overall mean value by about 1.1 and 0.1 kg CO2eq/passenger, respectively while at A1, A4, A5 and A6 airports the mean values of GHG emissions deriving from electricity consumption per passenger were between 0.1 and 0.5 kg CO2eq/passenger below the overall mean value.

In 2018 the mean GHG emissions deriving from electricity consumption per volume of air-conditioned spaces ranked as A3>A4>A1>A2>A5>A6 (Fig.39).

Between 2016 and 2018 the mean GHG emissions deriving from electricity consumption per volume of air-conditioned spaces ranked as A3>A1>A4>A2>A6>A5 (Fig.40). At A1 and A3 airports, the mean values of GHG emissions deriving from electricity consumption per volume of air-conditioned spaces were above the overall mean value by about 0.6 and 4.2 kg CO2eq/m3, respectively. A4 airport's mean values of GHG emissions were above the overall mean value by about 0.2 kg CO2eq/m3 while A2, A5, and A6 airport's mean values of GHG emissions were between 2 and 3.2 kg CO2eq/m3 below the overall mean value.

Figures 41—46 show comparisons between the airport's GHG emissions deriving from electricity consumption and the overall mean value of the respective year from 2016 to 2018.

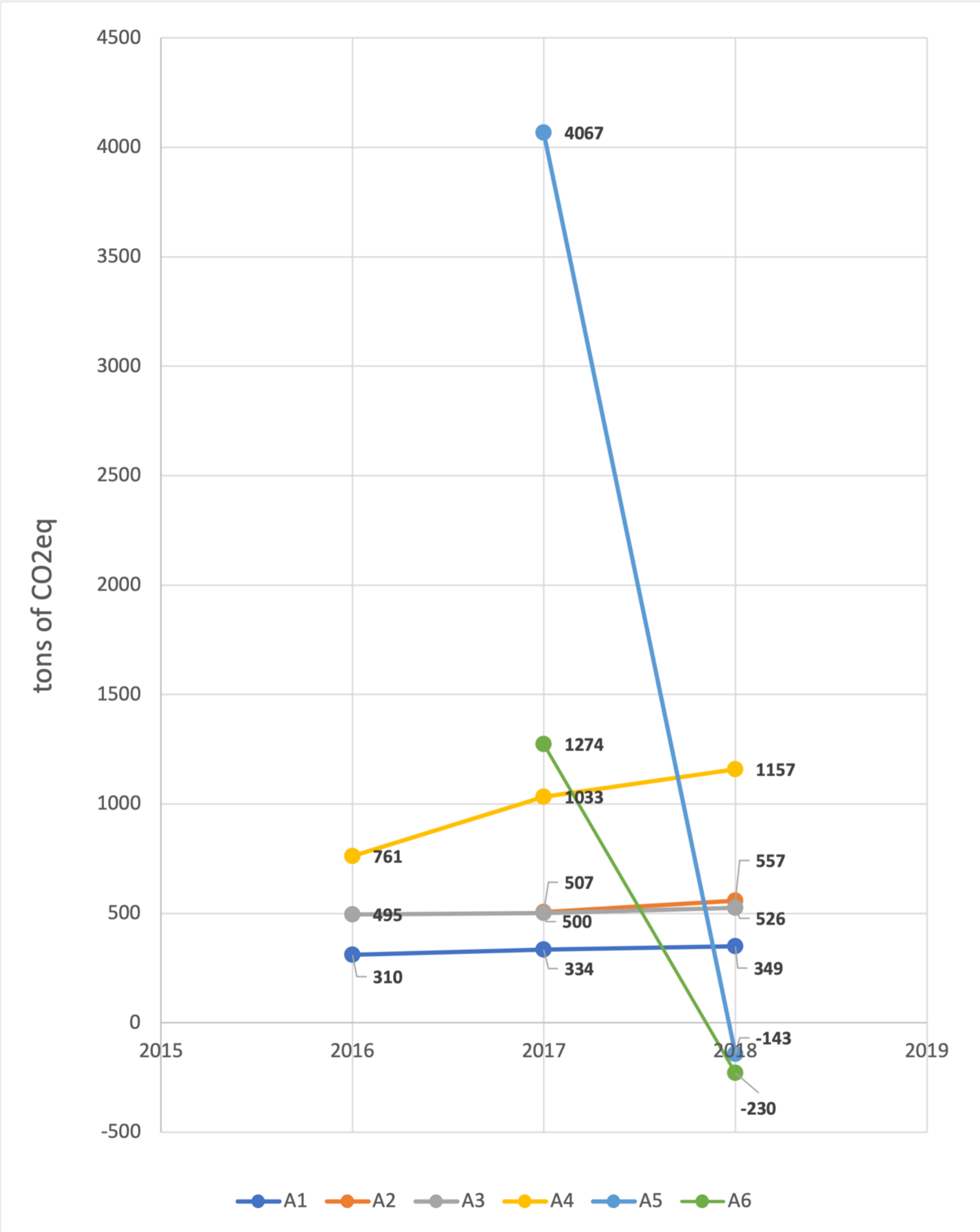


Figure 36 Airports' GHG emissions deriving from electricity consumption.

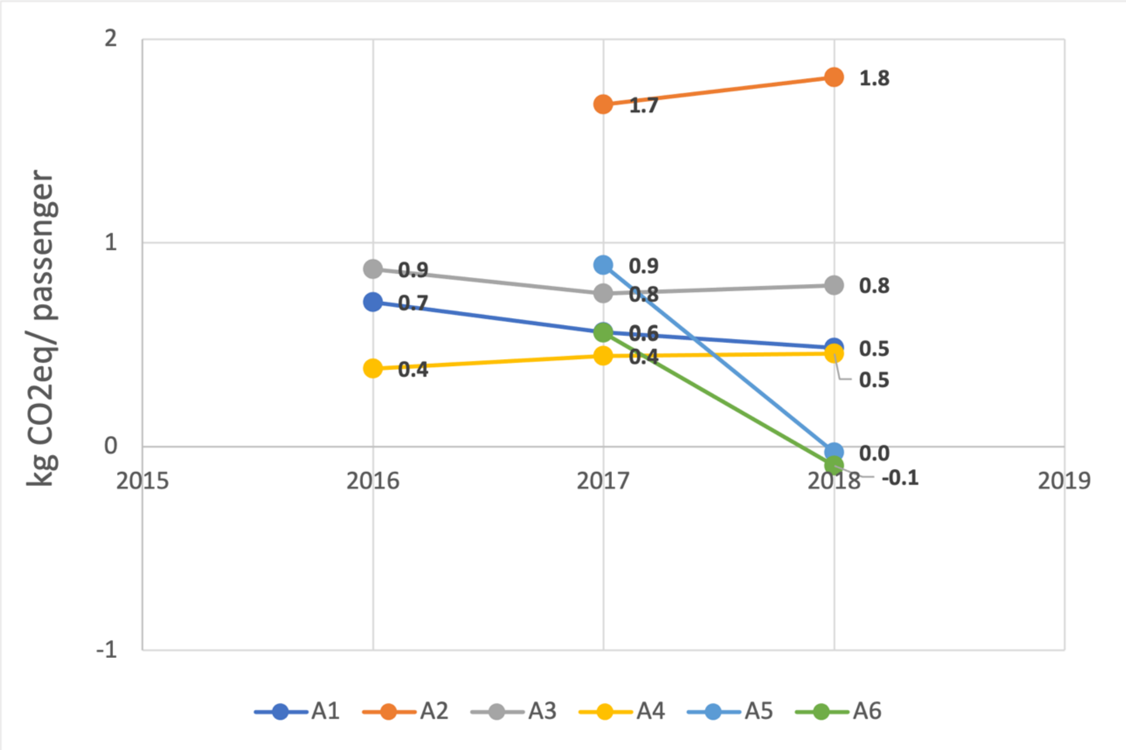


Figure 37 Airports' GHG emissions deriving from electricity consumption per passenger.

Figure 38 Airports’ mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from electricity consumption per passenger in the time period 2016–2018.

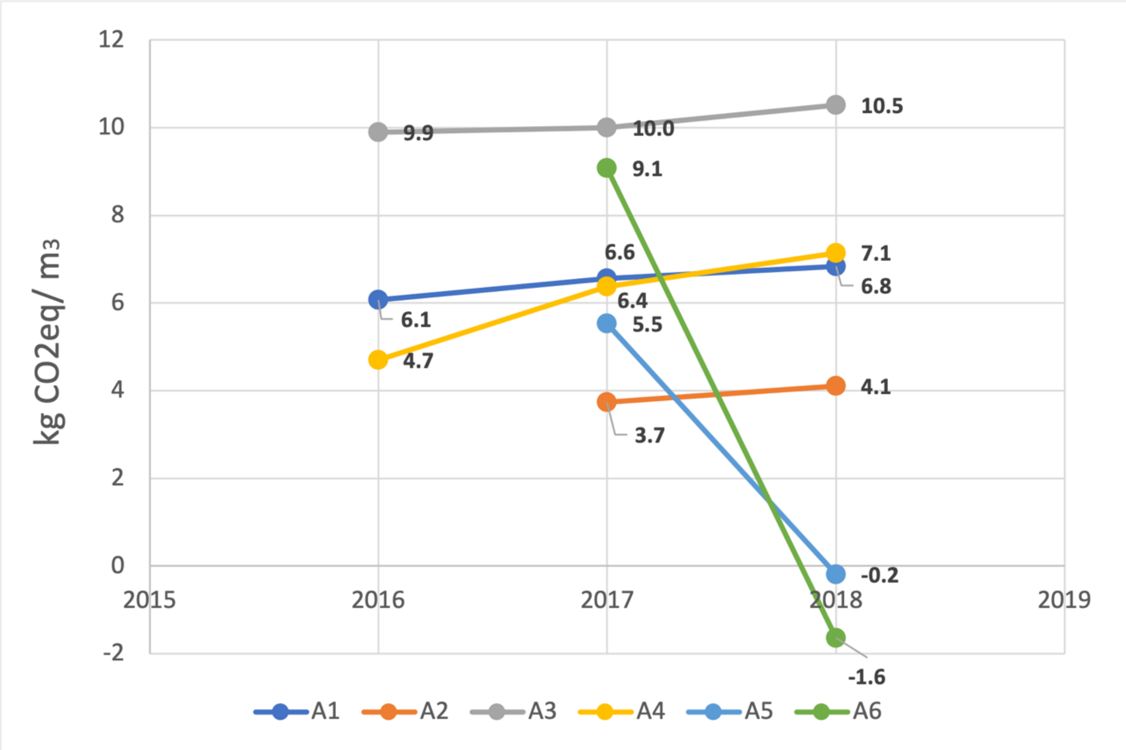


Figure 39 Airports' GHG emissions deriving from electricity consumption per volume of air-conditioned spaces.

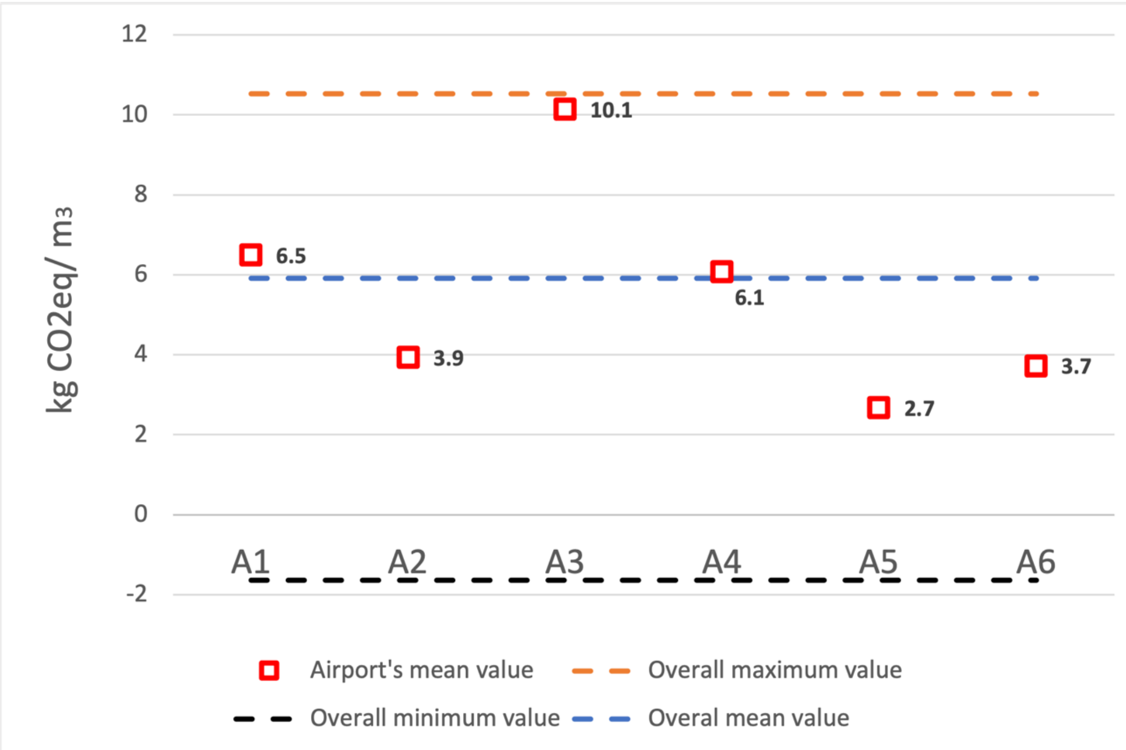


Figure 40 Airports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from electricity consumption per volume of air-conditioned spaces in the time period 2016–2018.

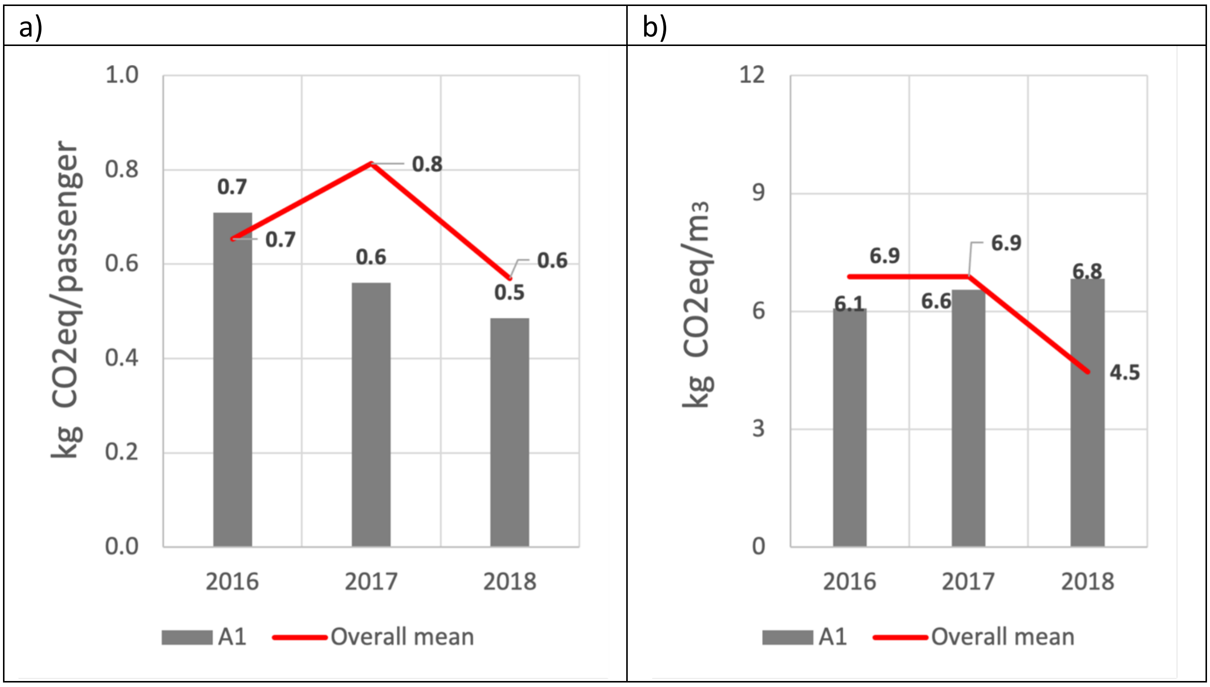


Figure 41 Comparison between overall mean and A1 airport's GHG emissions deriving from electricity (a) per passenger and (b) per volume of air-conditioned spaces.

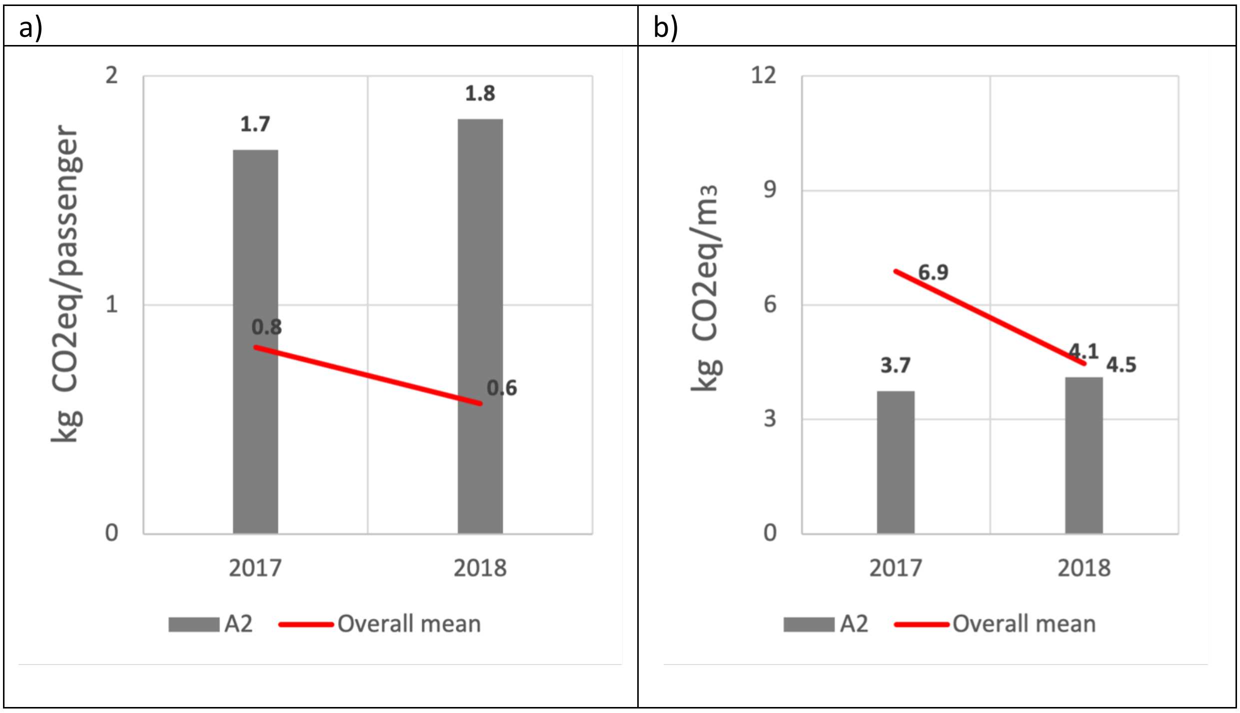


Figure 42 Comparison between overall mean and A2 airport's GHG emissions deriving from electricity (a) per passenger and (b) per volume of air-conditioned spaces.

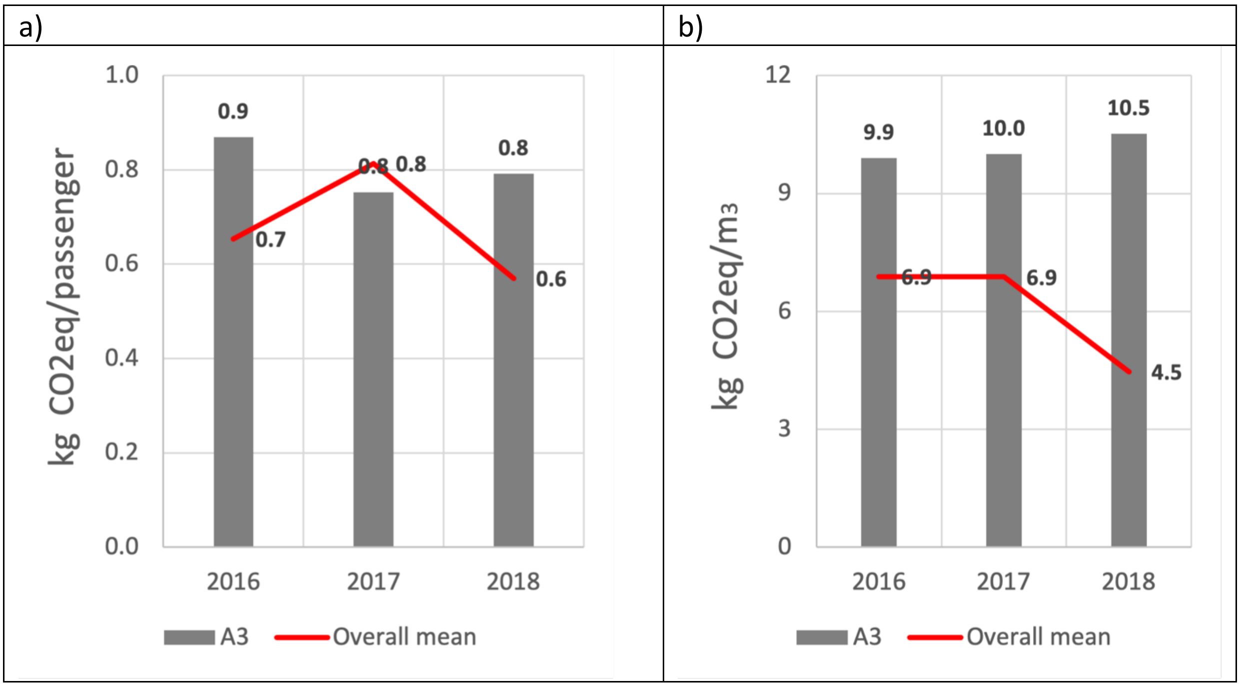


Figure 43 Comparison between overall mean and A3 airport's GHG emissions deriving from electricity (a) per passenger and (b) per volume of air-conditioned spaces.

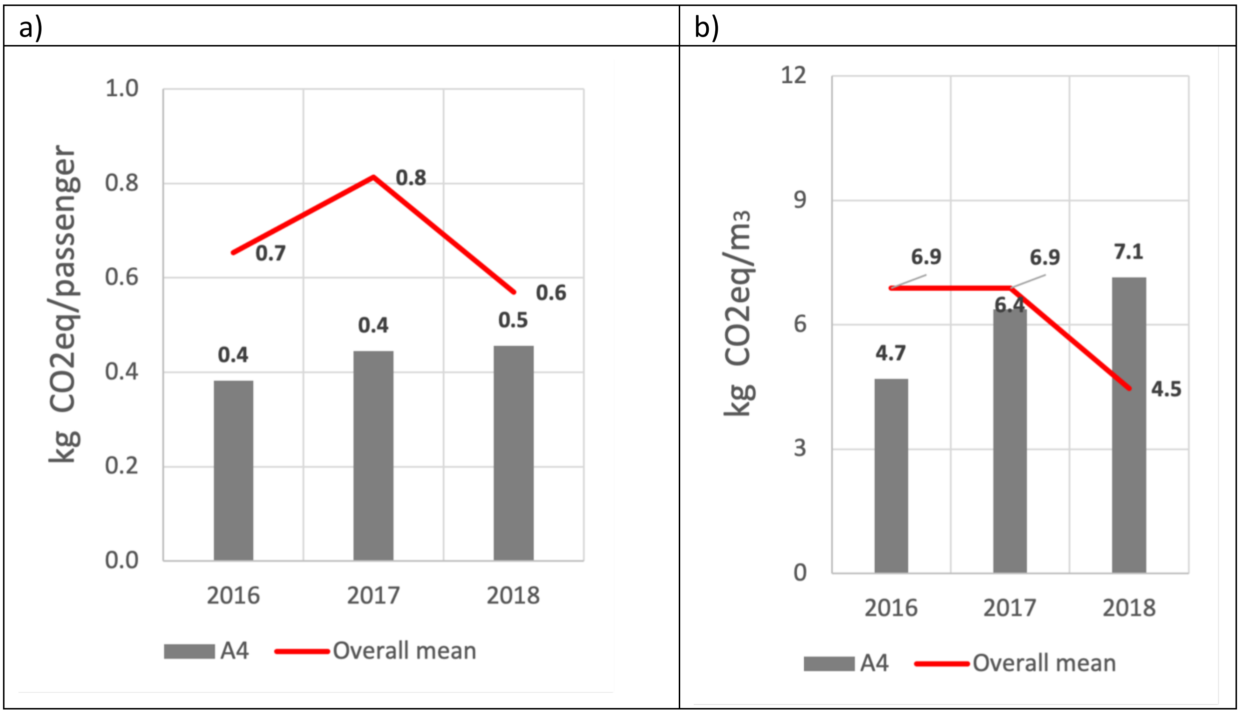


Figure 44 Comparison between overall mean and A4 airport's GHG emissions deriving from electricity (a) per passenger and (b) per volume of air-conditioned spaces.

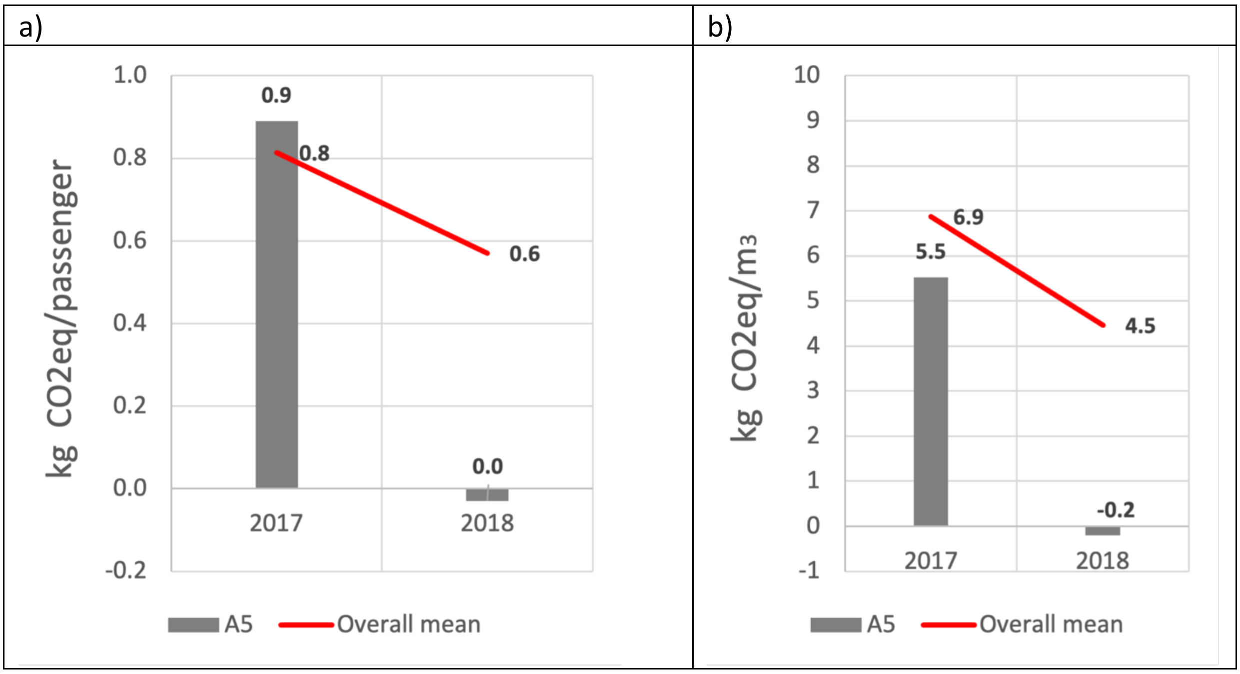


Figure 45 Comparison between overall mean and A5 airport's GHG emissions deriving from electricity (a) per passenger and (b) per volume of air-conditioned spaces.

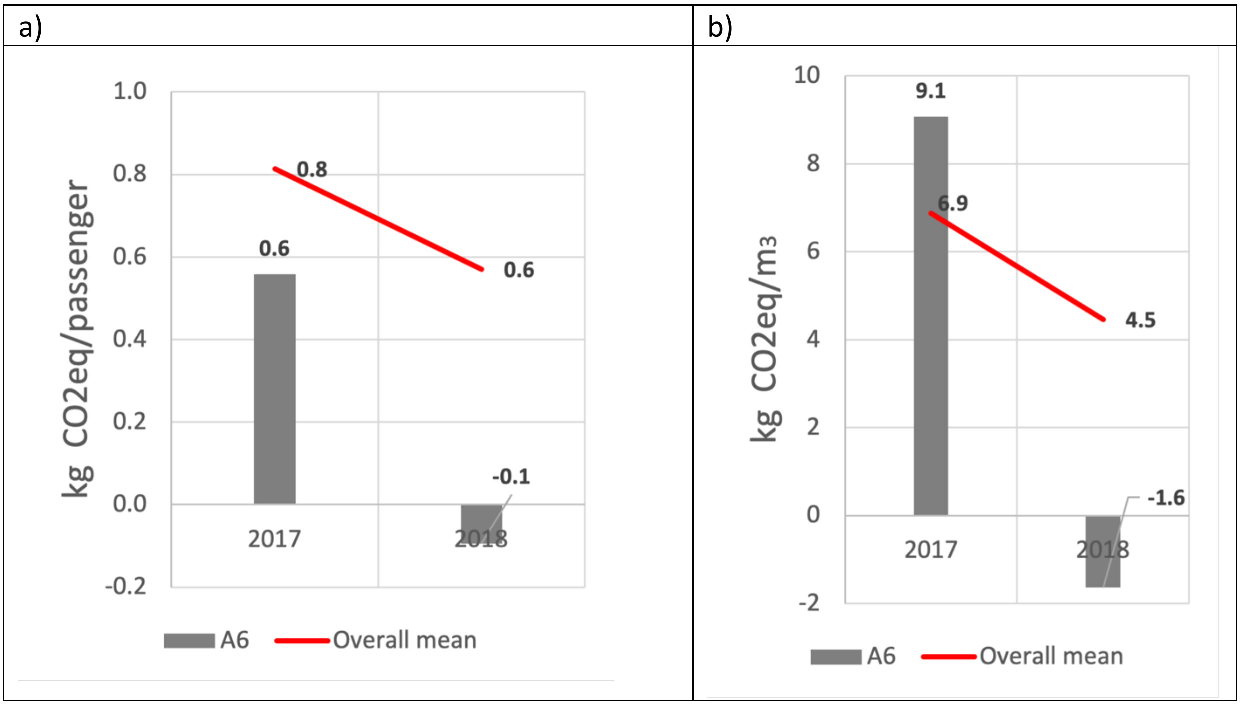


Figure 46 Comparison between overall mean and A6 airport's GHG emissions deriving from electricity (a) per passenger and (b) per volume of air-conditioned spaces.

Greenhouse gases emissions deriving from the fuel used for heating the buildings at Adrigreen airports

In 2018, airport's GHG emissions deriving from the fuel used for heating ranked as A5>A2>A4>A6>A3>A1 (Fig.47).

In 2018, GHG emissions deriving from the fuel used for heating per passenger ranked as A2>A3>A1≅A5>A4>A6 (Fig.48).

Between 2016 and 2018 the mean GHG emissions deriving from fuel used for heating per passenger ranked as A2>A3>A1≅A4>A5>A6 (Fig.49). A2 airport's mean value of GHG emissions deriving from fuel used for heating per passenger was above the overall mean value by about 1 kg CO2eq/passenger. A3 airport's mean value of GHG emissions deriving from fuel used for heating per passenger was similar to the overall mean value while at A1, A4, A5 and A6 airports the mean values of GHG emissions deriving from electricity consumption per passenger were between 0.1 and 0.3 kg CO2eq/passenger below the overall mean value.

In 2018 the mean GHG emissions deriving from fuel used for heating per heated spaces ranked as A2≅A3>A1>A4>A6>A5 (Fig.50).

Between 2016 and 2018, the mean GHG emissions deriving from heating fuel burnt per unit of heated spaces ranked as A3>A2>A1≅A4>A6>A5 (Fig.51). At A2 and A3 airports, the mean values of GHG emissions deriving from heating fuel burnt per unit of heated spaces were above the overall mean value by about 0.3 and 2.5 kg CO2eq/m3, respectively while A5 and A6 airport's mean values of GHG emissions were below the overall mean value by 2.3 and 1.6 kg CO2eq/m3, respectively. A1 and A4 airports' mean values of GHG emissions were below the overall mean value by about 0.1 kg CO2eq/m3.

Figures 52–57 show comparisons between the airport's GHG emissions deriving from heating fuel burnt per unit of heated spaces and the overall mean value of the corresponding years from 2016 to 2018.

At A1, A3, A4, A5, and A6 airports, new operational and maintenance procedures are in use to improve and optimize energy efficiency within heating, ventilation, and air conditioning. In the near future, A2 airport considers a CCHP (Combined Cooling Heat & Power) plant as an interesting option.

Regarding the initiatives to reduce energy consumption, A3, A4, and A5 airports have implemented actions for improvements in management systems and energy facilities. For example, new meters and a building management system were installed in the gates area of A3 airport. A4 airport rebuilt the terminal and equipped it with new equipment. A5 airport launched a plan for improving the energy efficiency of the passenger terminal and runways. Additionally, a cogeneration plant will enter service in 2021.

A5 and A6 airports carry out an energy audit every 4 years according to the national legislation in line with the EU Energy Efficiency Directive.

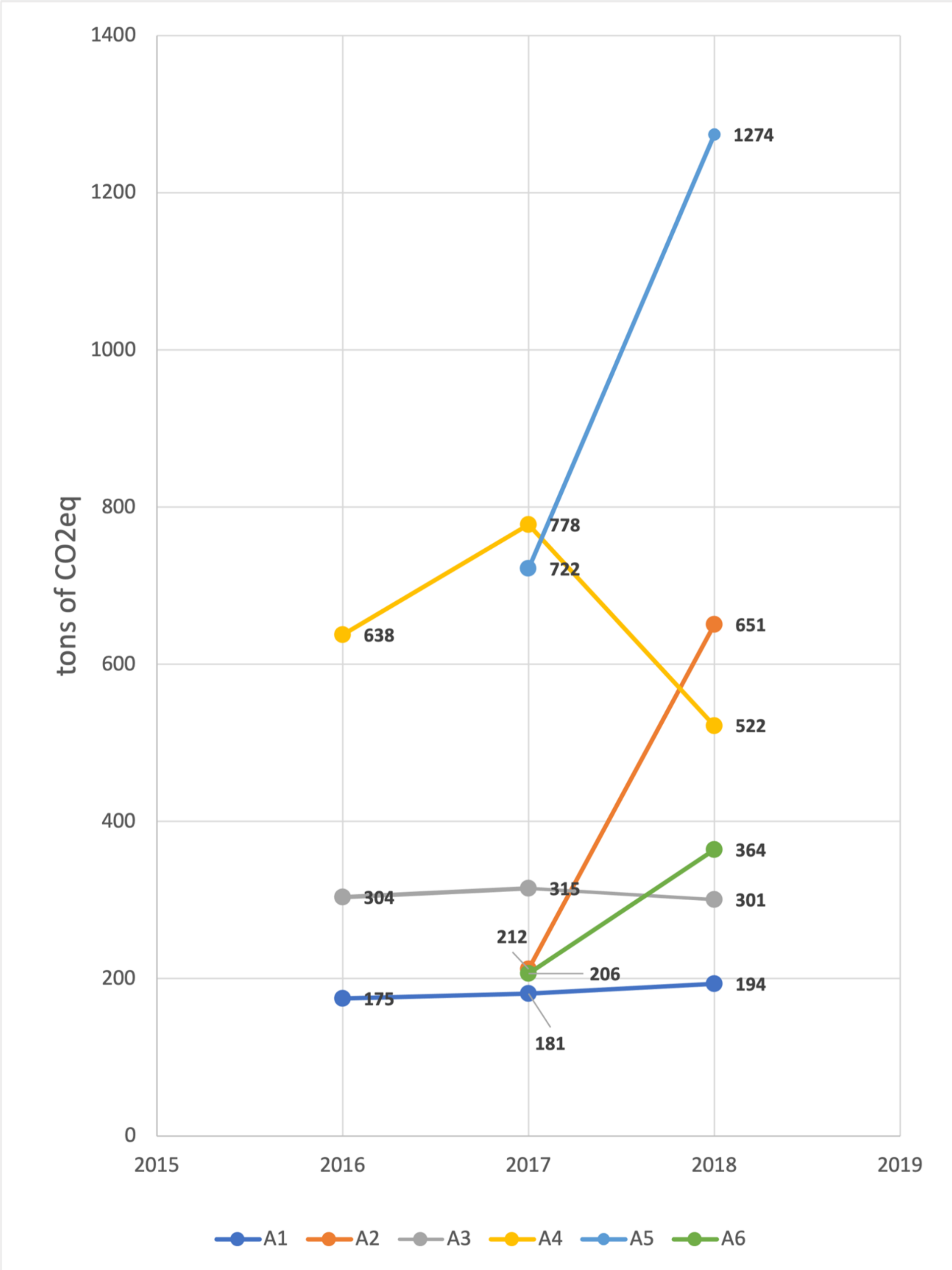


Figure 47 Airports' GHG emissions deriving from the fuel used for heating the buildings in the time period 2016–2018.

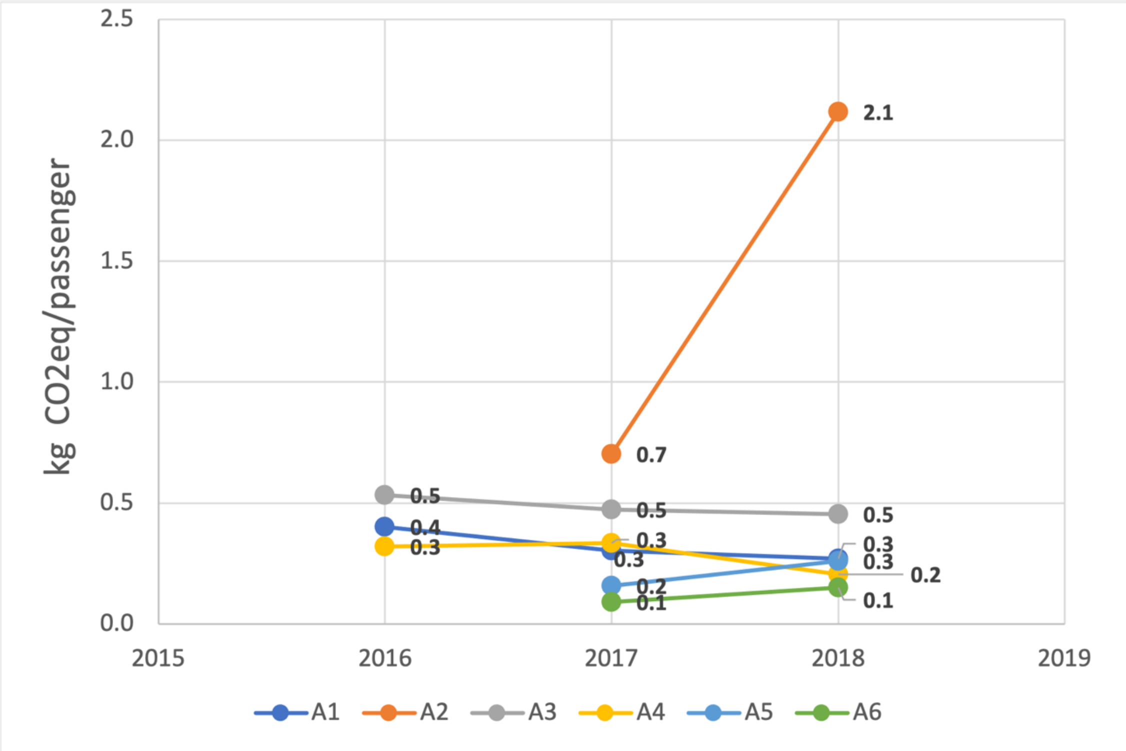


Figure 48 Airports' GHG emissions deriving from the fuel used for heating buildings per passenger in the time period 2016–2018.

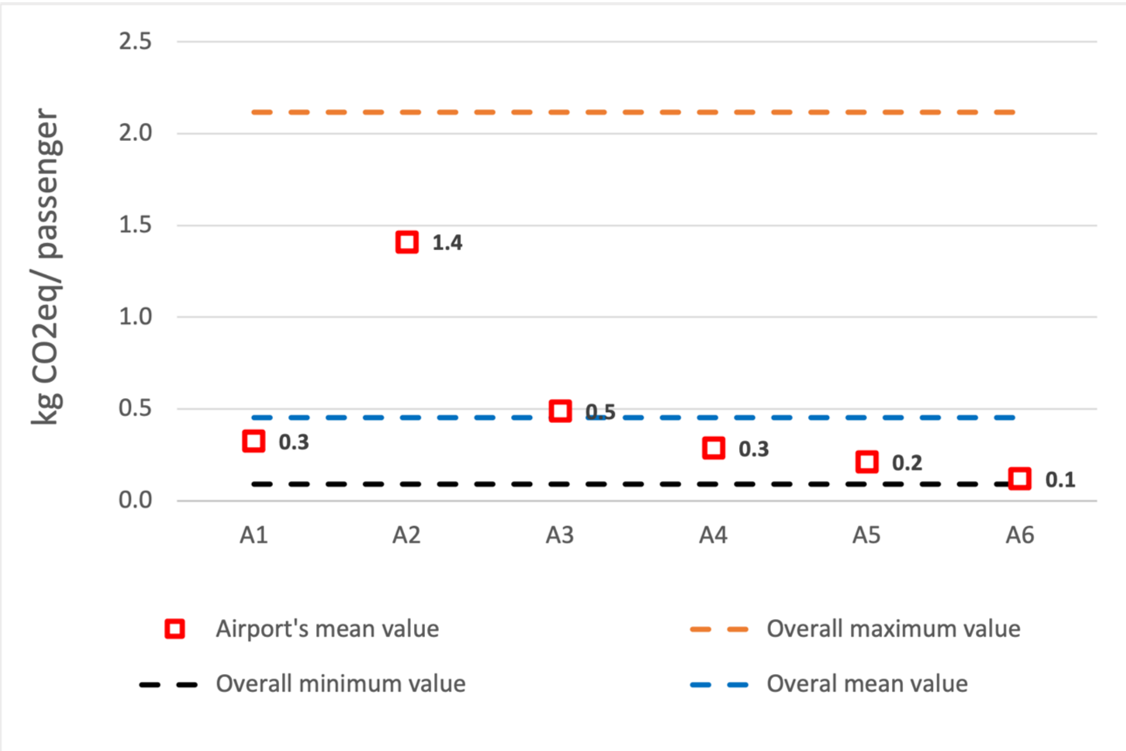


Figure 49 Airports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from the fuel used for heating buildings per passenger in the time period 2016–2018.

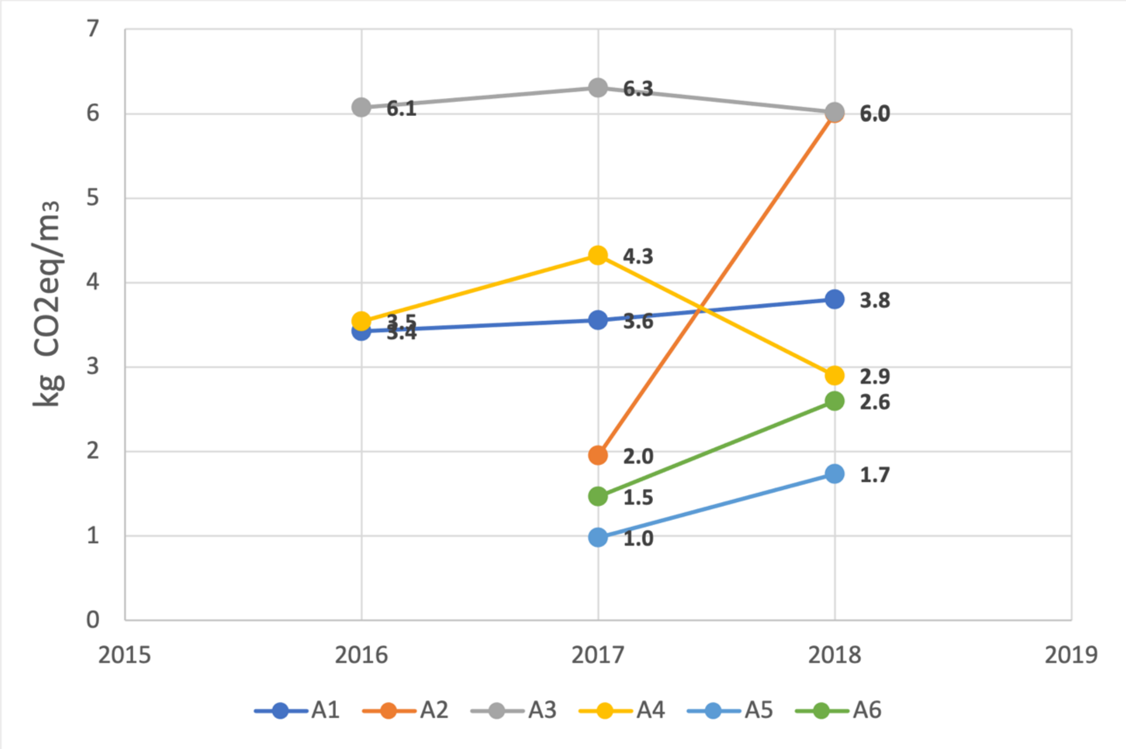


Figure 50 Airports' GHG emissions deriving from the fuel used for heating buildings per volume of the buildings.

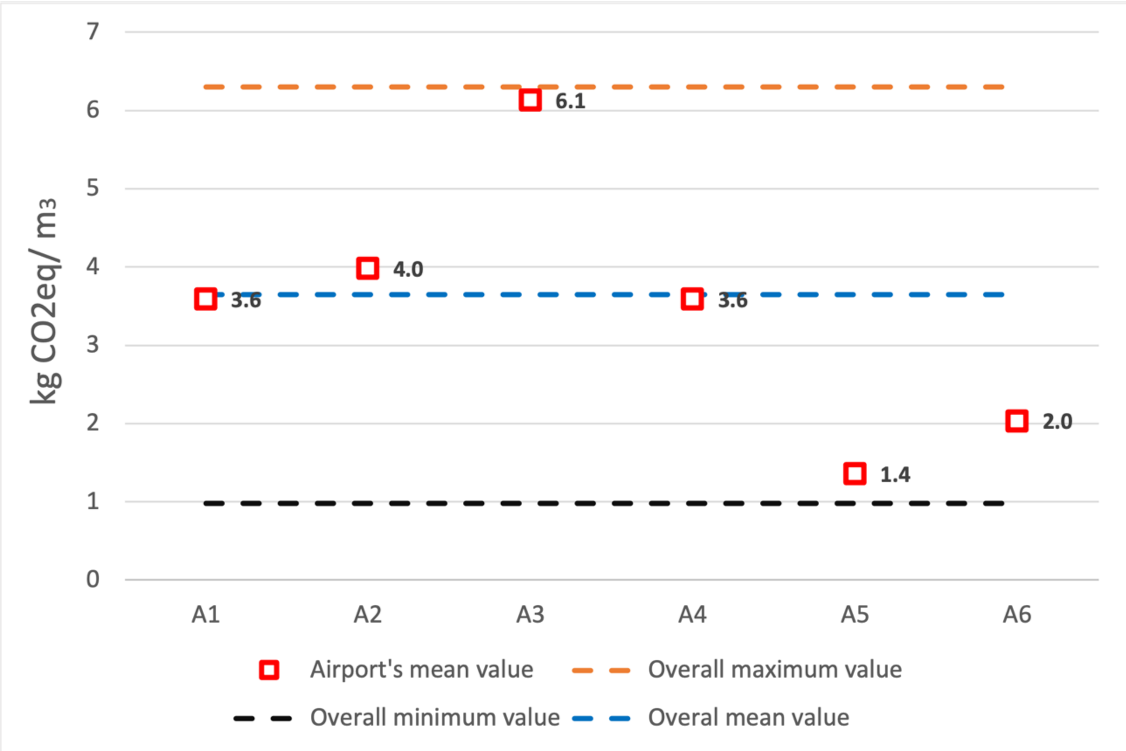


Figure 51 Airports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from the fuel used for heating buildings per volume of the buildings 2016–2018.

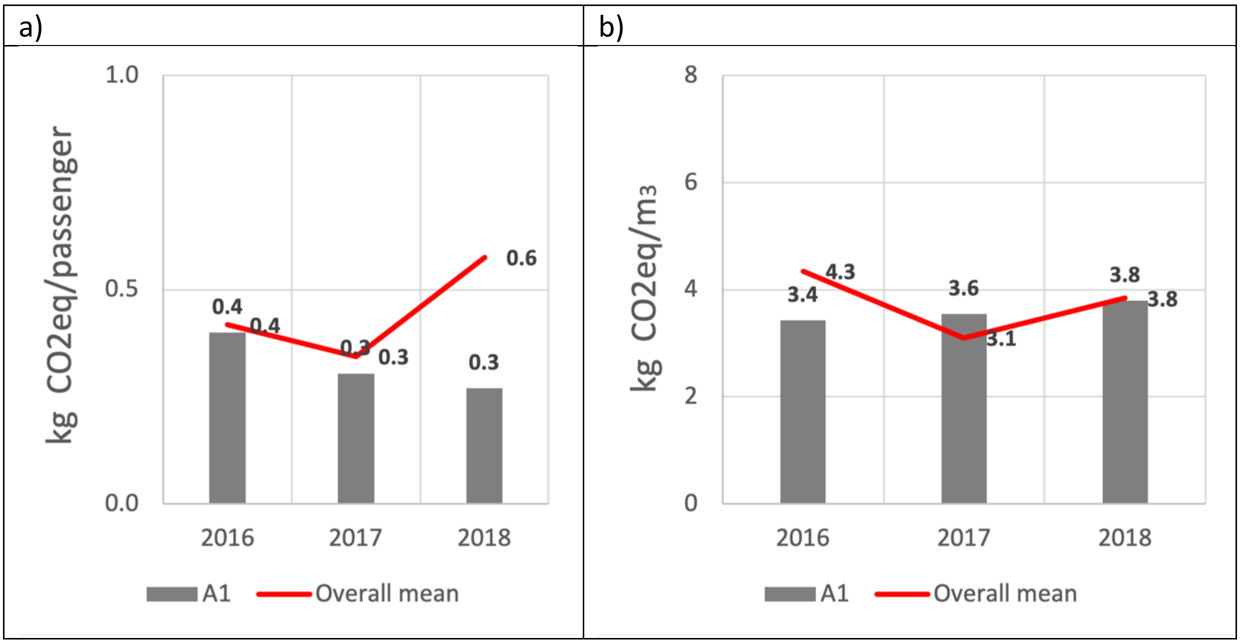


Figure 52 Comparison between overall mean and A1 airport's GHG emissions deriving from the fuel used for heating buildings (a) per passenger and (b) per volume of the buildings.

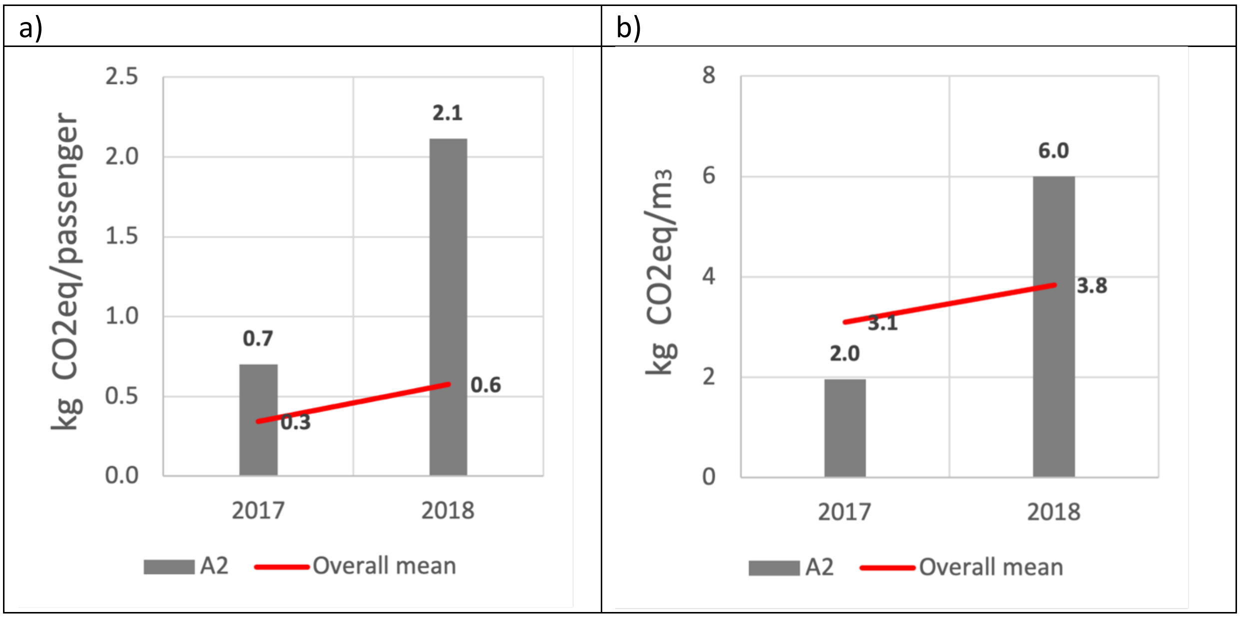


Figure 53 Comparison between overall mean and A2 airport's GHG emissions deriving from the fuel used for heating buildings (a) per passenger and (b) per volume of the buildings.

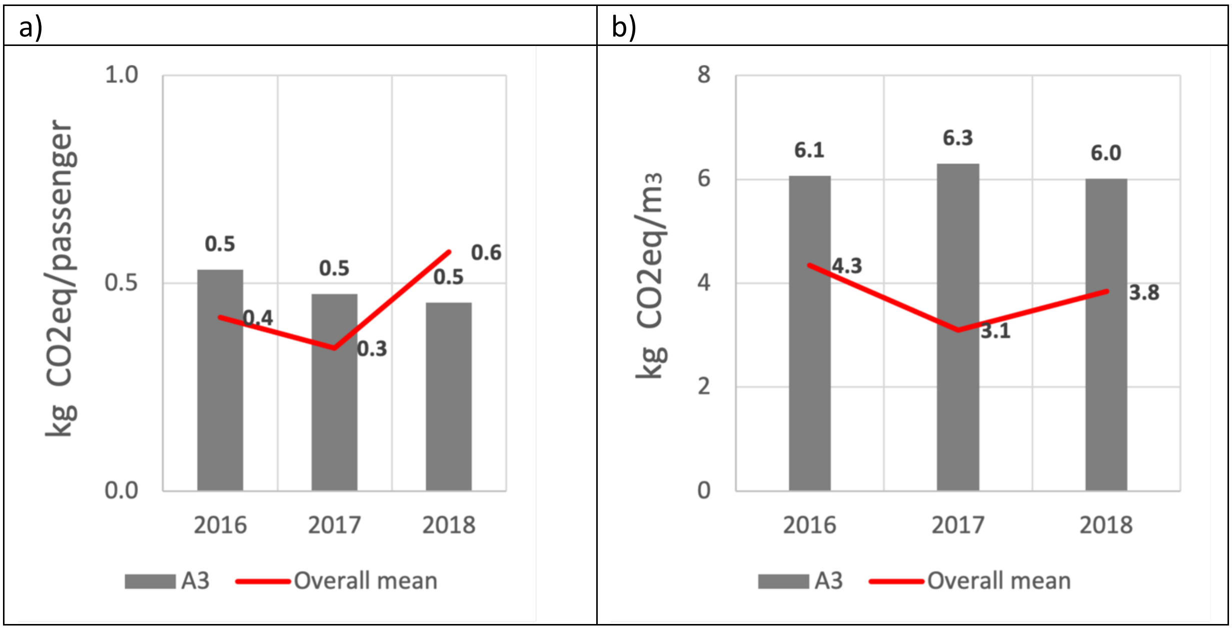


Figure 54 Comparison between overall mean and A3 airport's GHG emissions deriving from the fuel used for heating buildings per passenger and (b) per volume of the buildings.

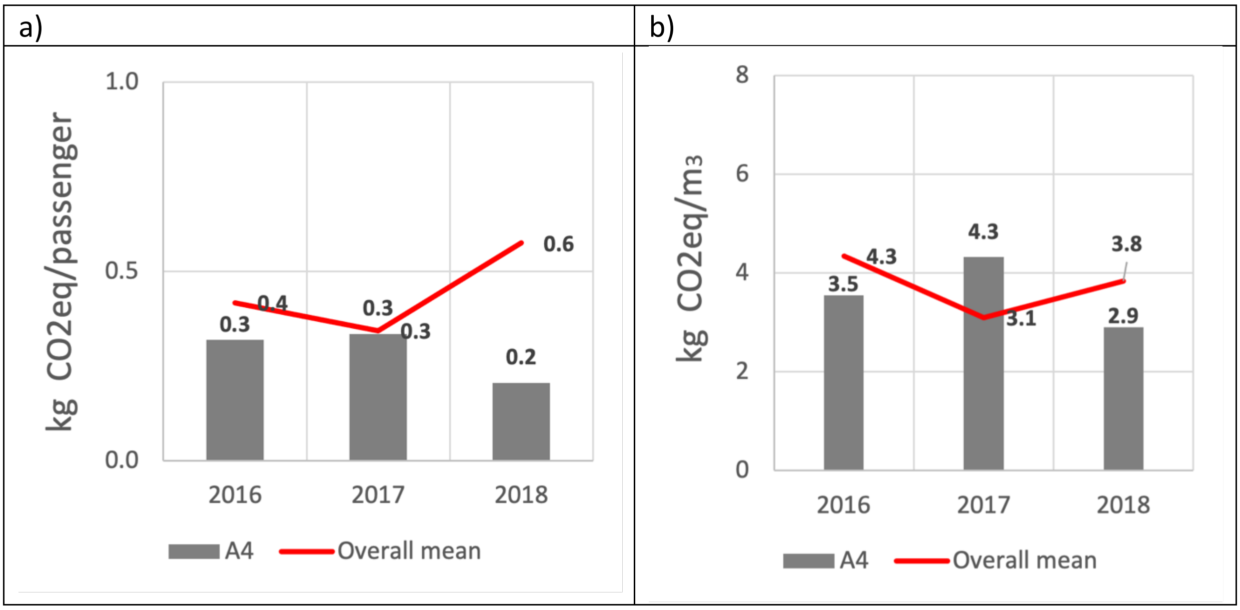


Figure 55 Comparison between overall mean and A4 airport's GHG emissions deriving from the fuel used for heating buildings per passenger and (b) per volume of the buildings.

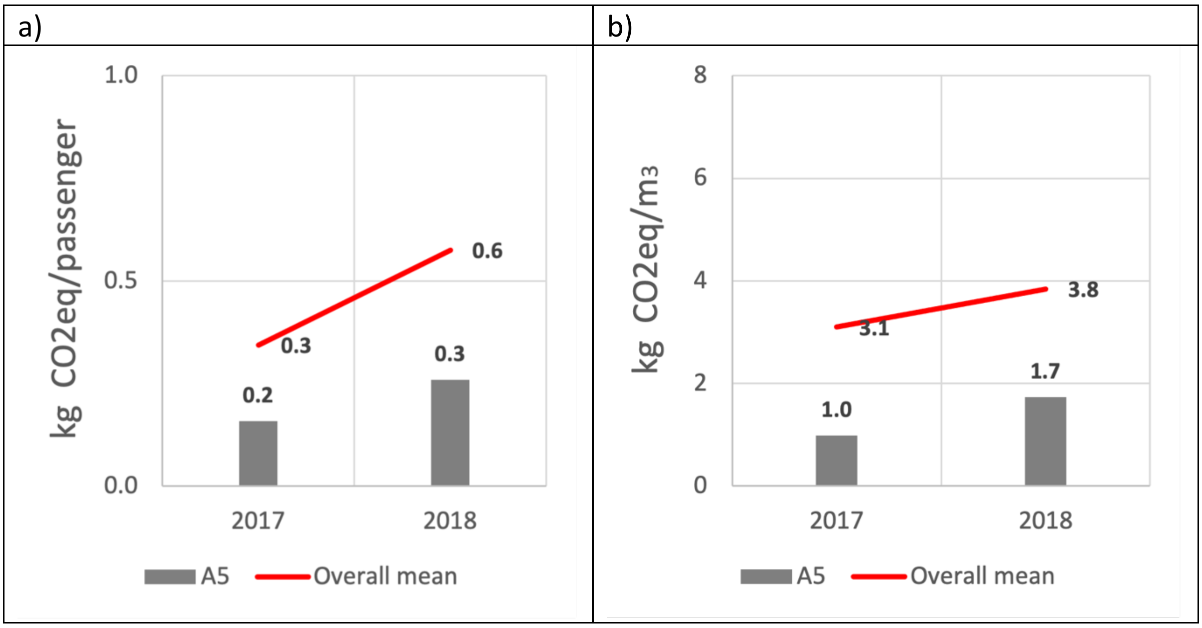


Figure 56 Comparison between overall mean and A5 airport's GHG emissions deriving from the fuel used for heating buildings per passenger and (b) per volume of the buildings.

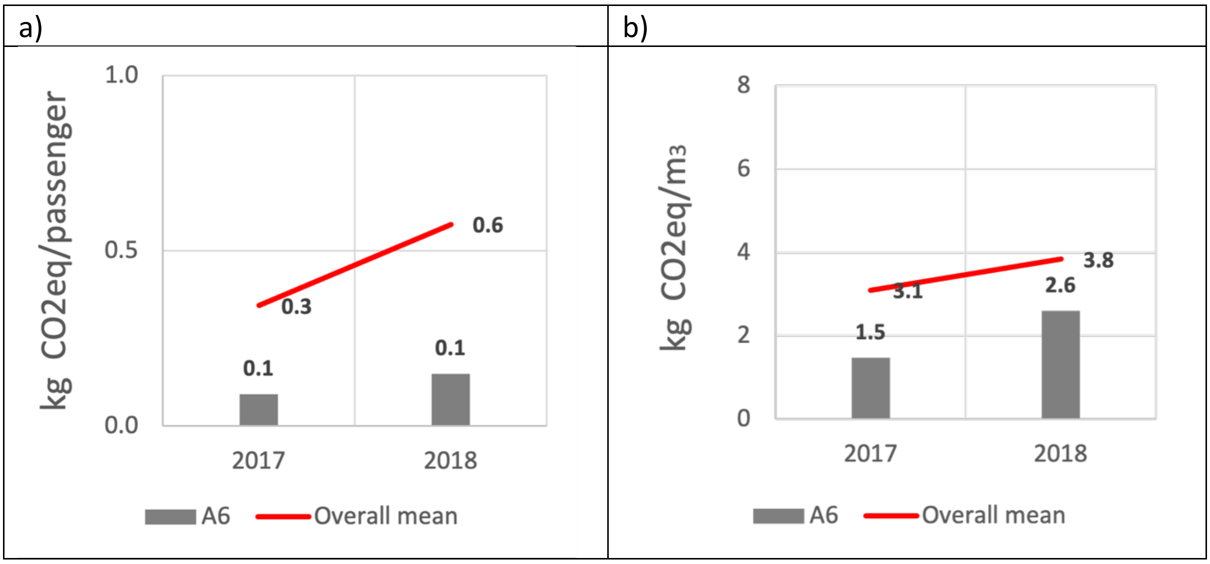


Figure 57 Comparison between overall mean and A6 airport's GHG emissions deriving from the fuel used for heating buildings per passenger and (b) per volume of the buildings.

Greenhouse gas emissions deriving from-company-operated vehicles electricity and fuel consumption at Adrigreen airports

In 2018, airport's GHG emissions deriving from company operated vehicles fuel comsumption ranked as A4>A1>A3>A2>A5>A6 (Fig.58).

At A1 airport, between 2 and 7 tons of CO2eq GHG emissions derived from the electricity consumption related to company operated vehicles in the time period 2016–2018 (Fig.59).

In 2018, airport's GHG emissions deriving from company operated vehicles' comsumption of fuel and electricity ranked as A4>A1>A3>A2>A5>A6 (Fig.60).

In 2018, airport's GHG emissions deriving from company operated vehicles' fuel comsumption per passenger ranked as A1>A2>A3≅A4>A5≅A6 (Fig.61).

At A1 airport, the GHG emissions due to electricity consumption related to company operated vehicles per passenger, were up to 0.01 kg CO2eq/passenger in the time period 2016–2018 (Fig.62).

In 2018, airport's GHG emissions deriving from company operated vehicles' fuel and electricity comsumption per passenger ranked as A1>A2>A3≅A4>A5≅A6 (Fig.63).

Between 2016 and 2018 the mean GHG emissions deriving from company operated vehicles' fuel and electricity comsumption per passenger ranked as A1>A2>A3≅A4>A5≅A6 (Fig.64).

Figures 65–70 show comparisons between the airport's GHG emissions deriving from company operated vehicles' consumption of electricity and fossil fuel per passenger and the overall mean value of the corresponding years from 2016 to 2018.

Airports A5 and A6 also focused on improving the efficiency of freight transport. A3 airport reported to have plans for the improvement of efficiency of cargo operations.

A1, A4, A5, and A6 airports are switching from carriers, hybrid vehicles, trailers, tractors, forklift trucks and cranes burning diesel fuels to vehicles burning biofuels or powered by electricity generated from renewable sources. For example, A4 airport purchased electric tractors for towing of baggage carts, and electric bicycles and scooters for the staff. Moreover, A4 airport is going to replace all existing diesel tractors and vehicles.

A3 airport has planned to replace some of the vehicles burning diesel fuels with devices powered by electricity.

Charging stations for electric vehicles are available at A1, A3, A4, A5, and A6 airports. For example, there are 7 charging stations for electric vehicles at A1 airport. A3 airport has 2 charging stations for the battery-powered tow tugs.

A2, A3, A4, A5, and A6 airports have plans for installing charging stations for electric vehicles. For example, car rentals are interested in installing charging stations at A2 airport. At A5 and A6 airports, sub-dealers are going to provide charging stations for electric vehicles.

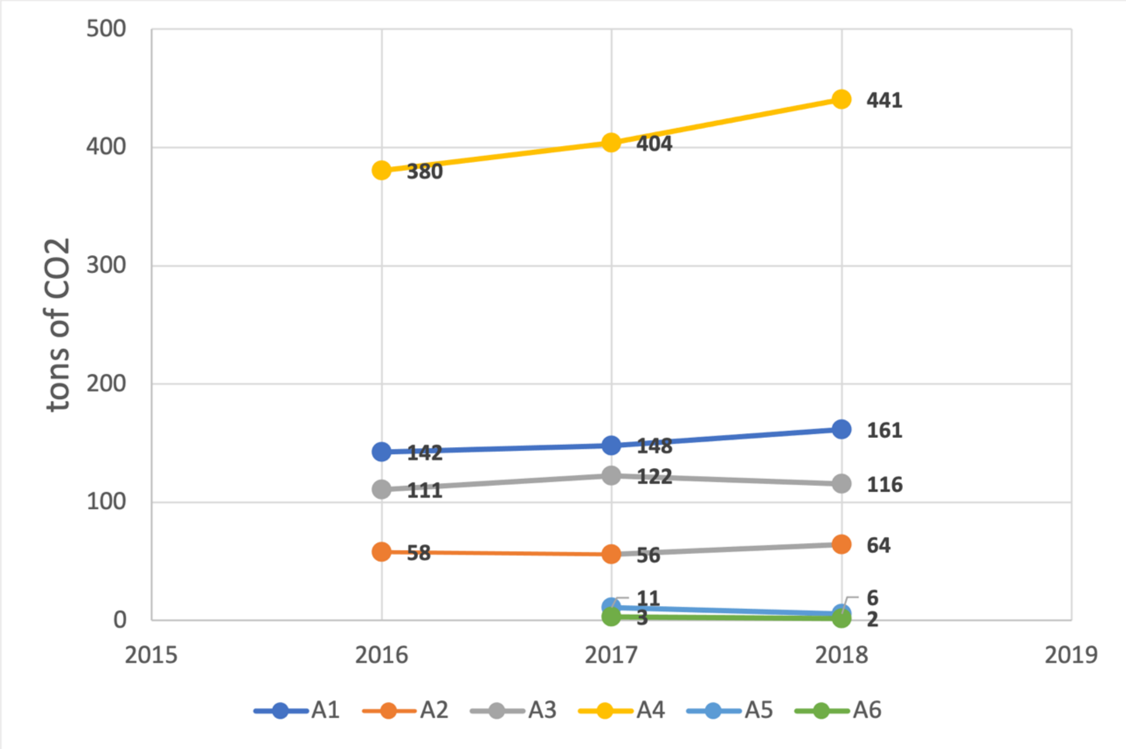


Figure 58 Airports' GHG emissions deriving from company-operated-vehicles fuel consumption.

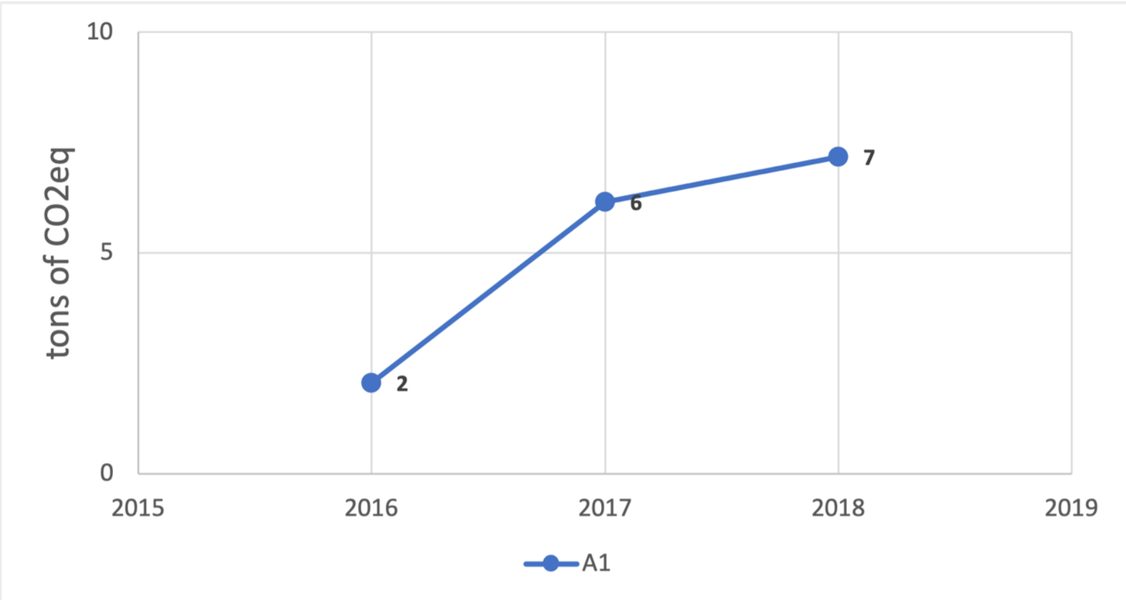


Figure 59 Airports' GHG emissions deriving from company-operated-vehicles electricity consumption. A1 airport was the only airport using electricity for some company operated vehicles in 2016–2018.

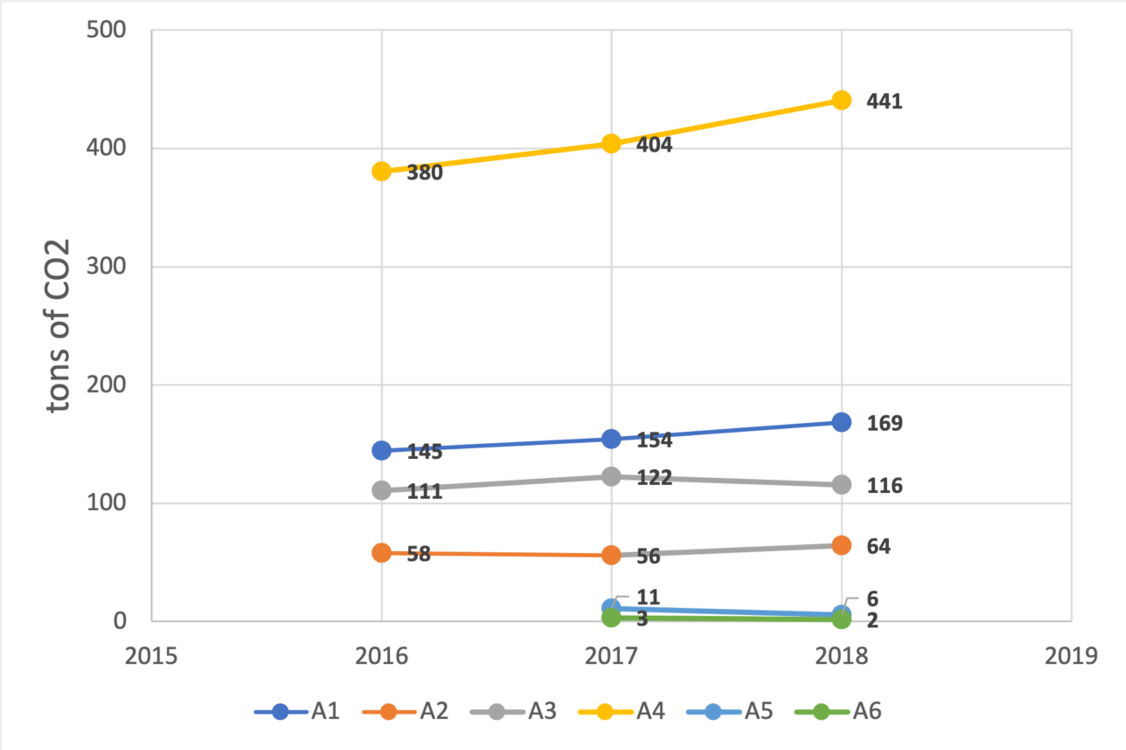


Figure 60 Airports' GHG emissions deriving from company-operated-vehicles electricity and fuel consumption.

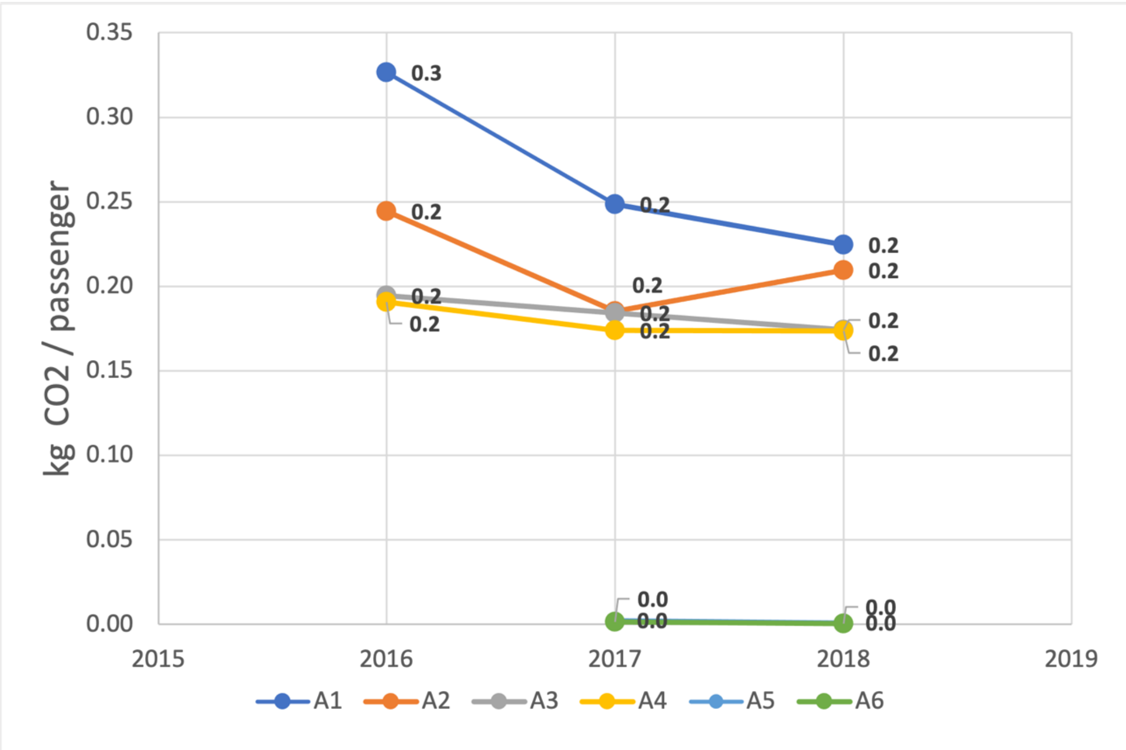


Figure 61 Airports' GHG emissions deriving from company-operated-vehicles fuel consumption per passenger. A6 and A5 series are close to zero and overlap.

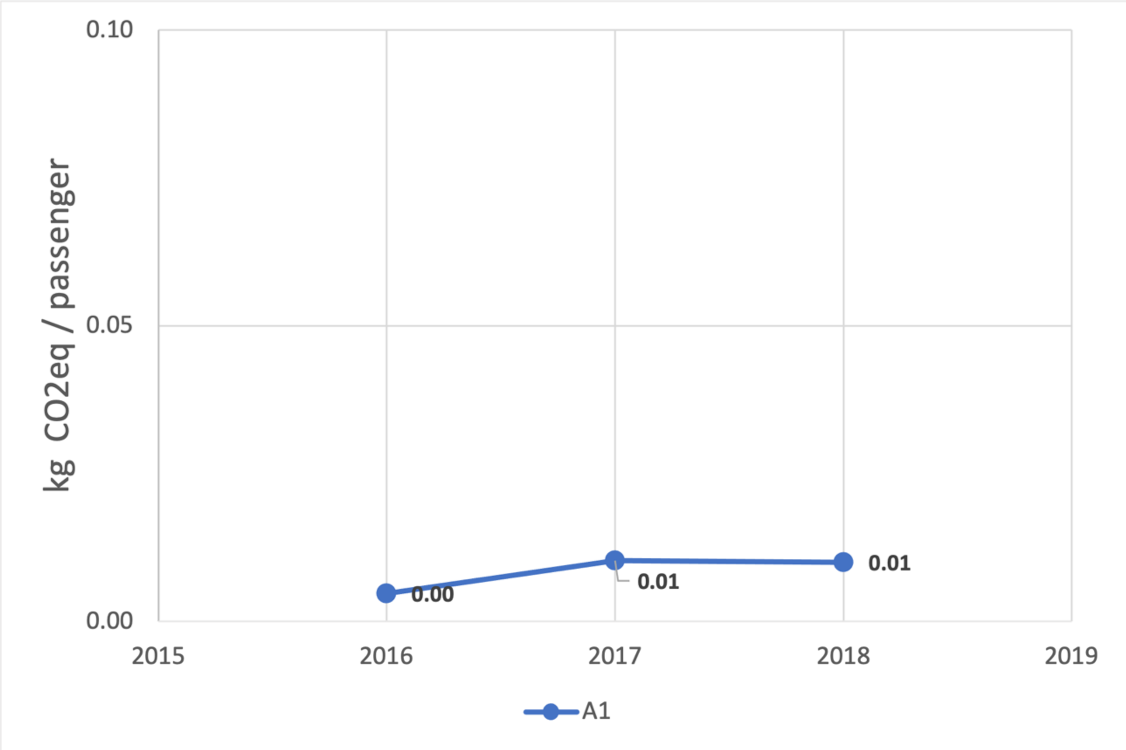


Figure 62 Airports' GHG emissions deriving from company-operated-vehicles electricity consumption per passenger. A1 airport was the only airport using electricity for some company operated vehicles in 2016–2018.

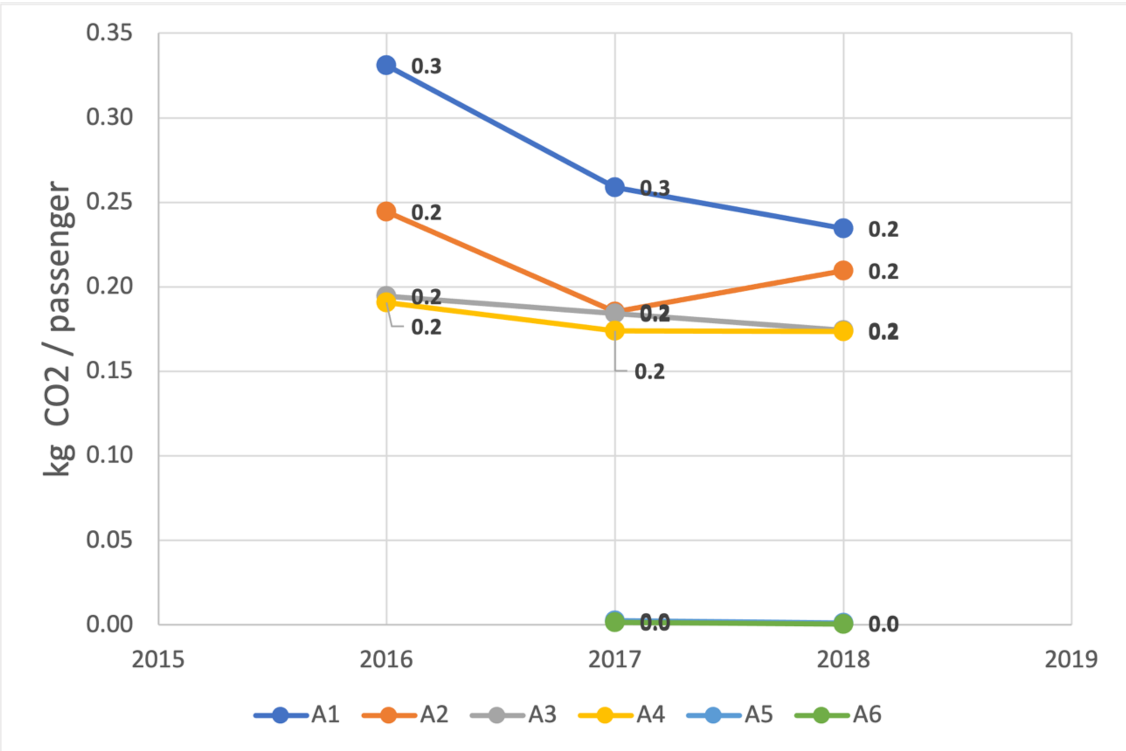


Figure 63 Airports' GHG emissions deriving from company-operated-vehicles electricity and fuel consumption per passenger. A6 and A5 series are close to zero and overlap.

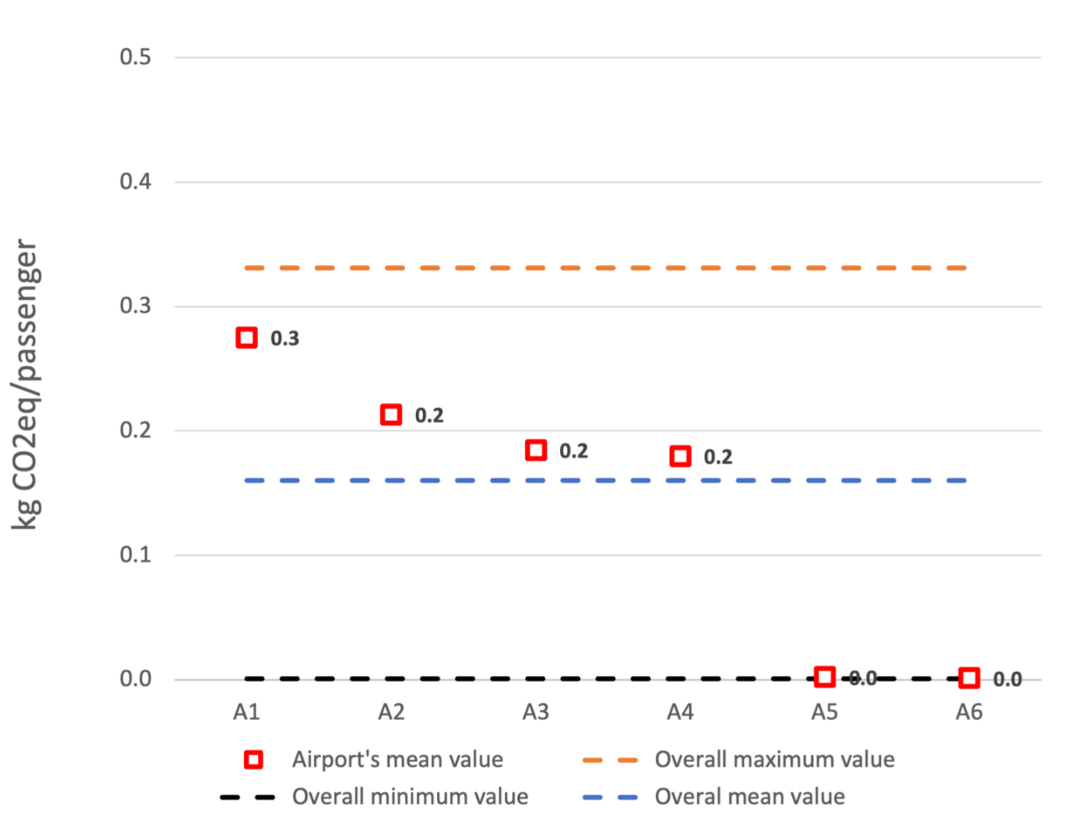


Figure 64 Airports' mean GHG emissions and overall maximum, minimum and mean GHG emission values deriving from (company operated vehicles) electricity and fossil fuel consumption per passenger 2016–2018. A6 and A5 values are close to zero.

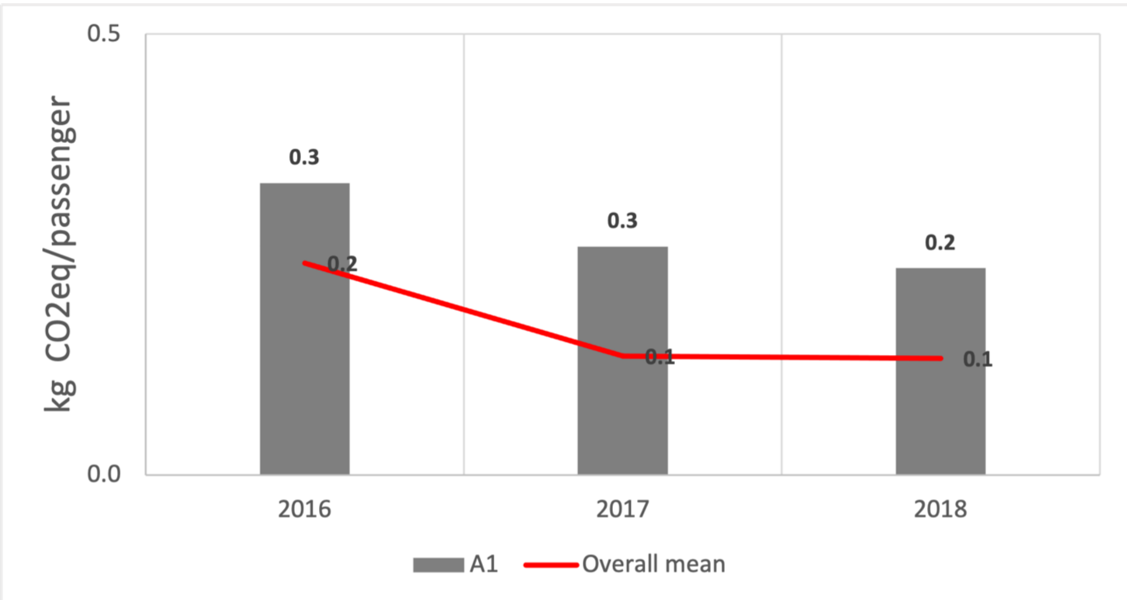


Figure 65 Comparison between overall mean and A1 airport's GHG emissions due to company-operated-vehicles electricity and fuel consumption per passenger.

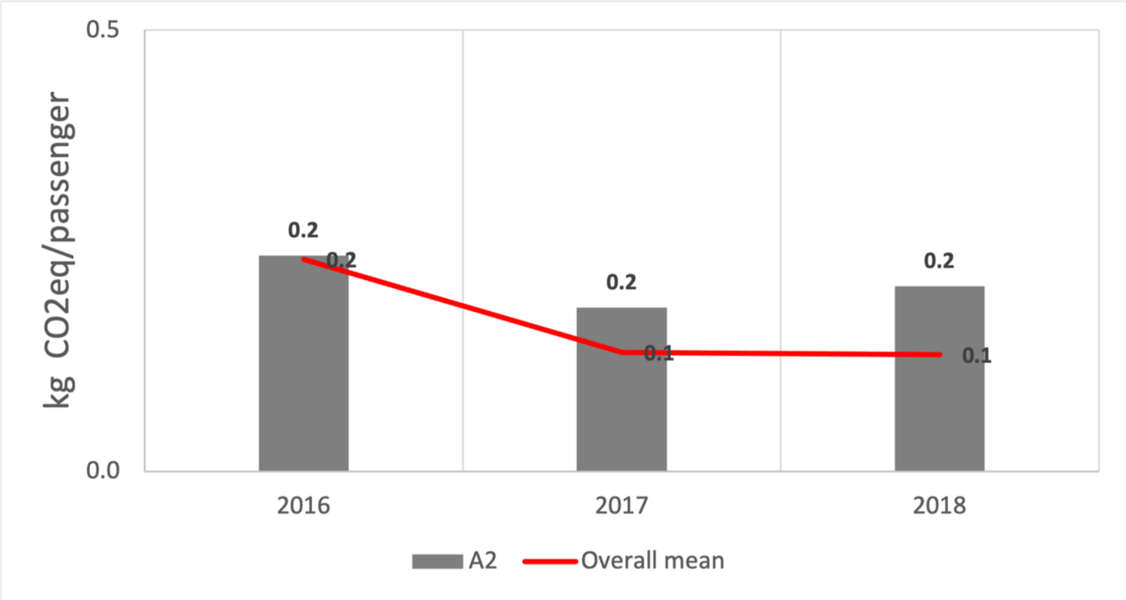


Figure 66 Comparison between overall mean and A2 airport's GHG emissions due to company-operated-vehicles electricity and fuel consumption per passenger.

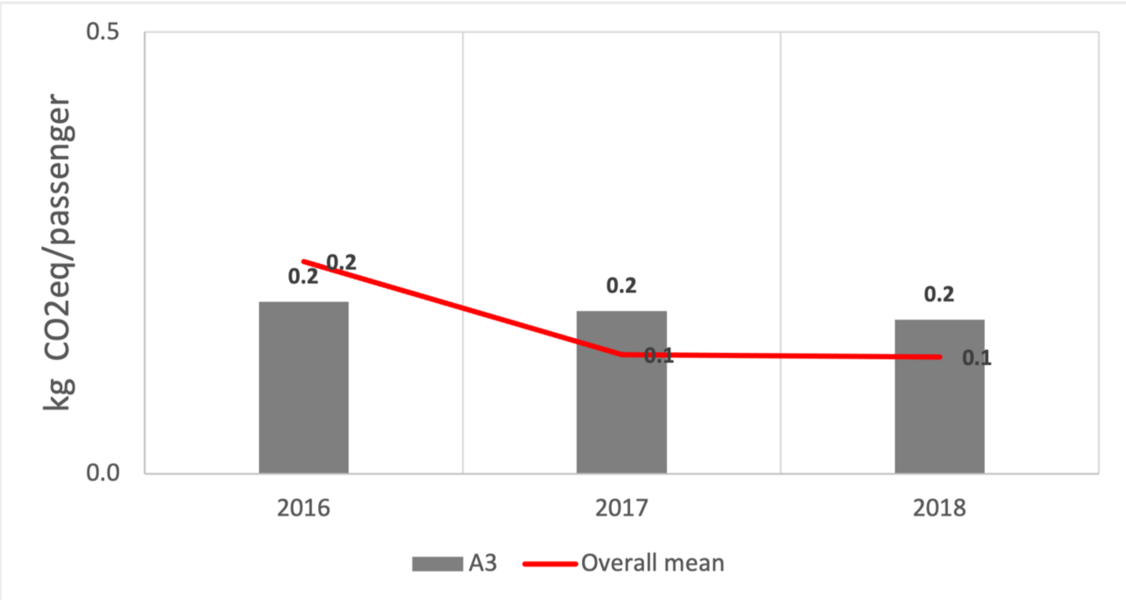


Figure 67 Comparison between overall mean and A3 airport's GHG emissions due to company-operated-vehicles electricity and fuel consumption per passenger.

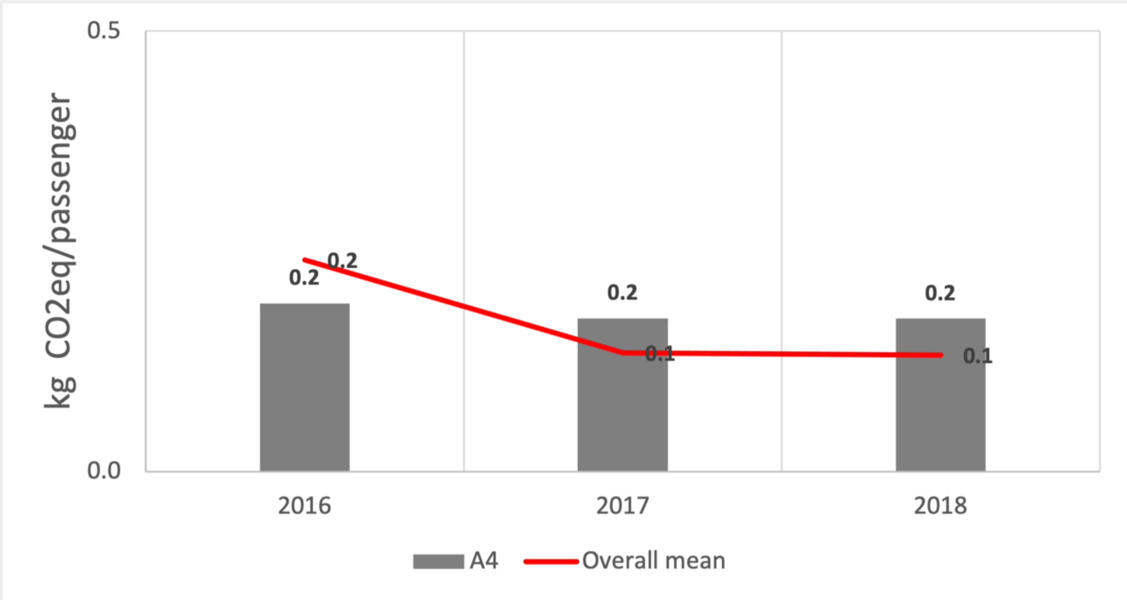


Figure 68 Comparison between overall mean and A4 airport's GHG emissions due to company-operated-vehicles electricity and fuel consumption per passenger.

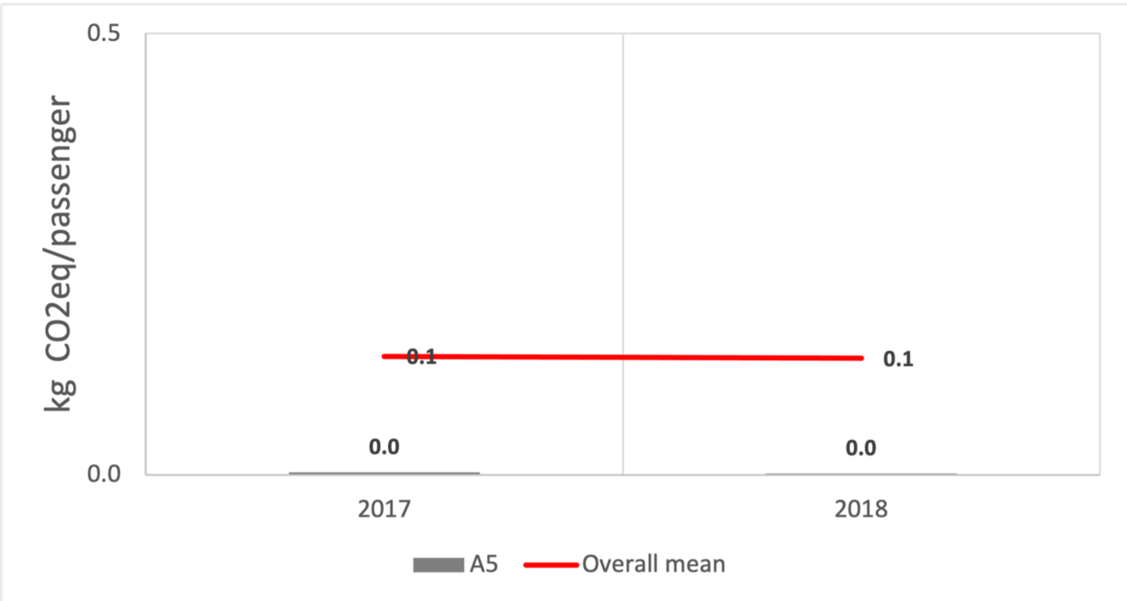


Figure 69 Comparison between overall mean and A5 airport's GHG emissions due to company-operated-vehicles electricity and fuel consumption per passenger.

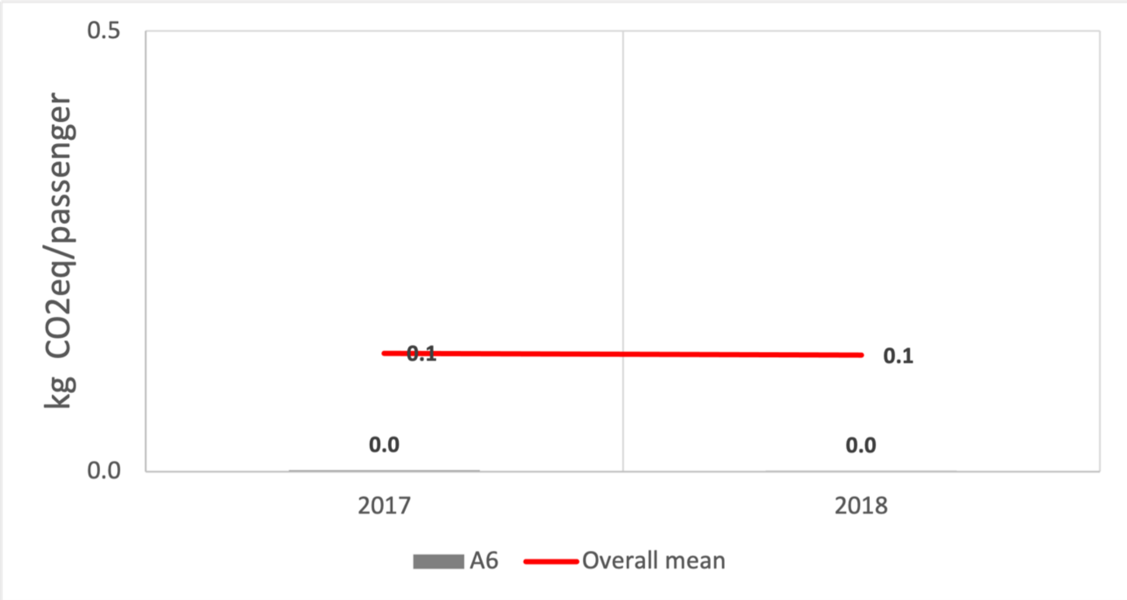


Figure 70 Comparison between overall mean and A6 airport's GHG emissions due to company-operated-vehicles electricity and fuel consumption per passenger.

Analysis of greenhouse gas emissions deriving from fuel and electricity consumption at Adrigreen airports

Figures 71–76 show the contributions in percentage to the GHG emissions of the airports deriving from fuel for heating buildings, electricity consumption, and company operated vehicles' consumption of electricity and fuel from 2016 to 2018. Electricity consumption was the highest contributor to GHG emissions at A1 airport (up to 49.9%), A2 airport (up to 65.4%), A3 airport (up to 55.8%), and A4 airport (up to 54.6%). At A5 and A6 airports, electricity consumption gave a negative contribute to the GHG emissions in 2018 (Figs 75 and 76).

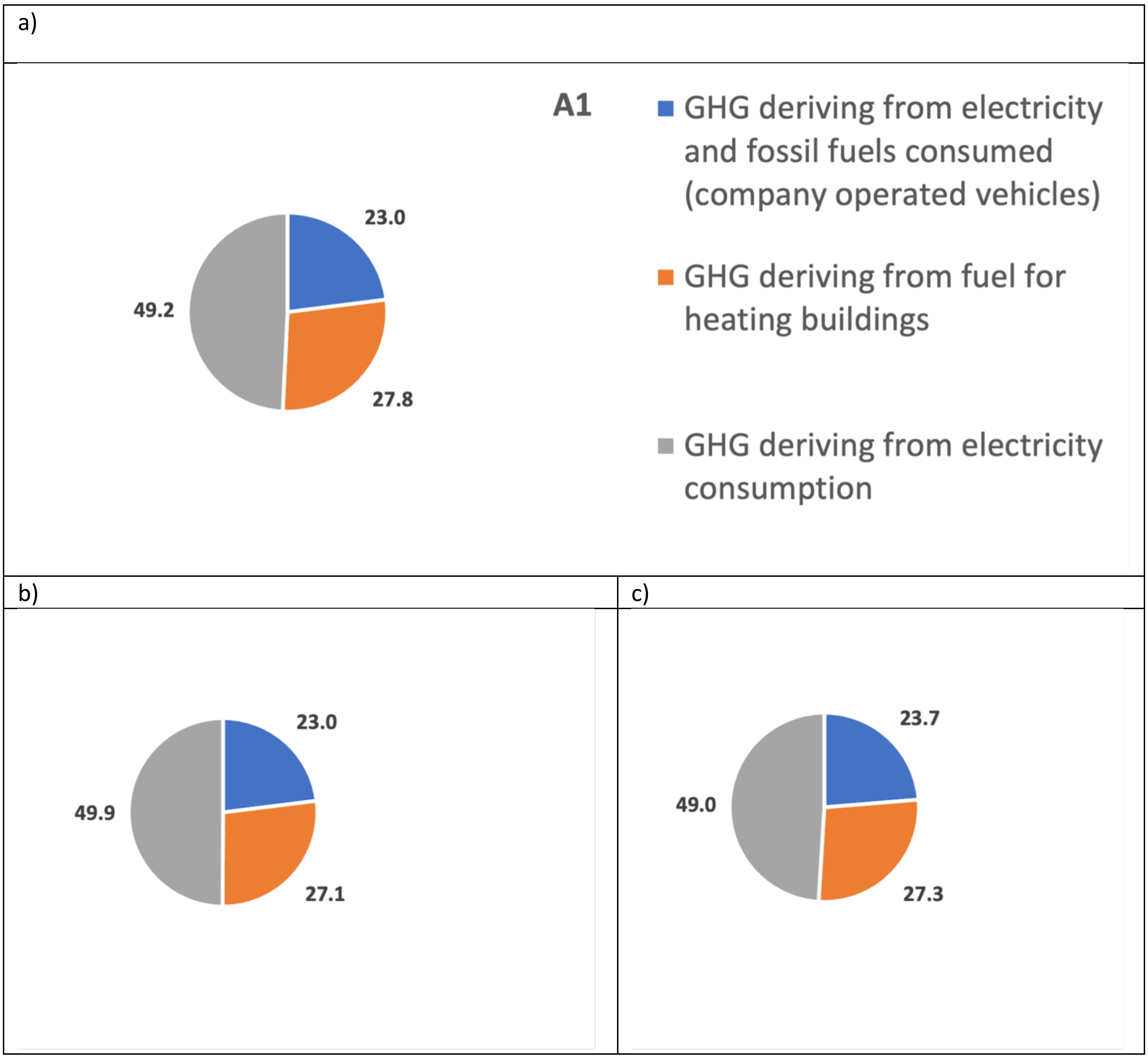


Figure 71 Contribution in percentage to the greenhouse gas emissions of A1 airport due to heating fuel, electricity consumption, and ccompany-operated-vehicles electricity and fuel consumption in 2016 (a), 2017 (b), and 2018 (c).

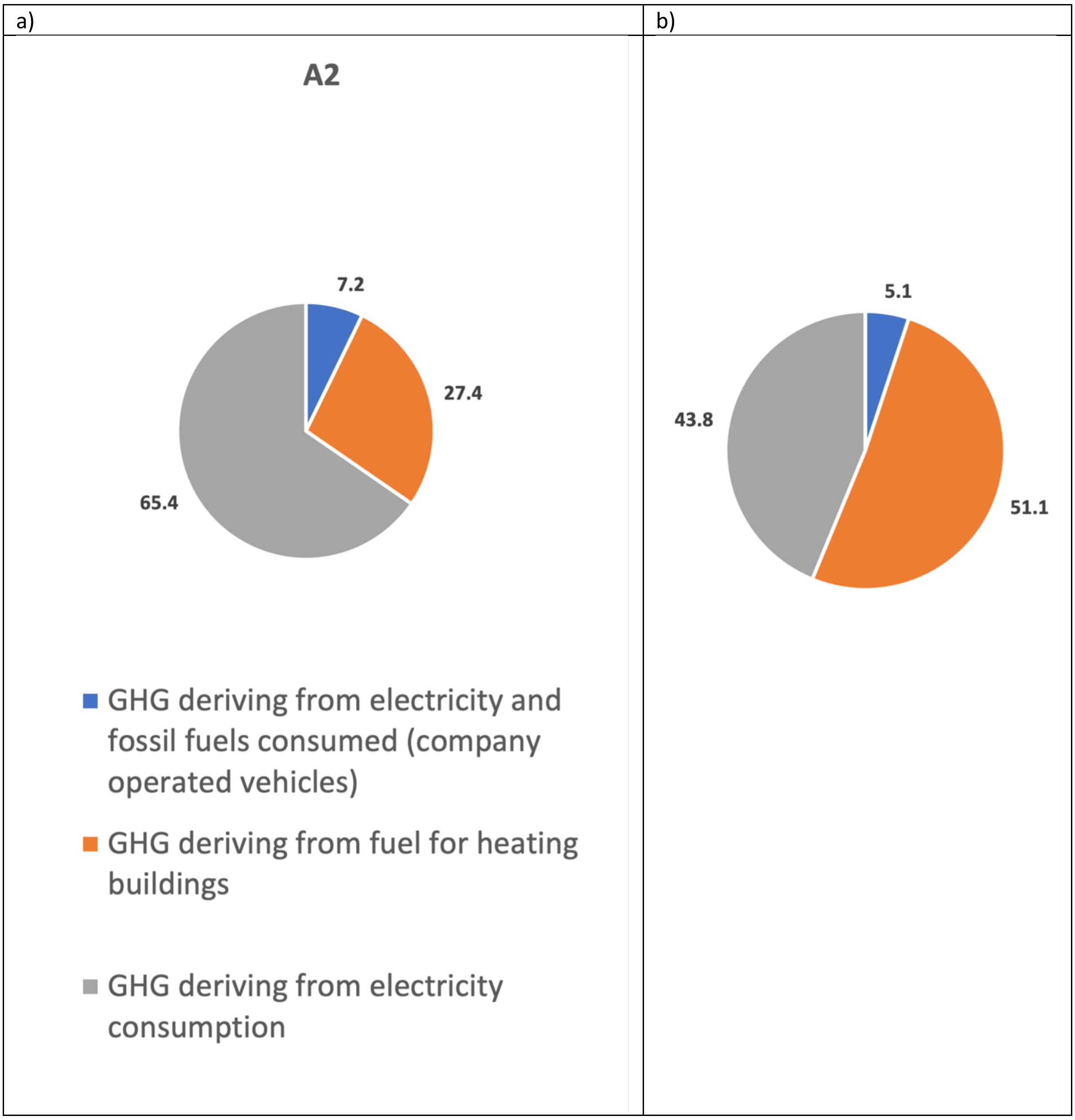


Figure 72 Contribution in percentage to the greenhouse gas emissions of A2 airport due to heating fuel, electricity consumption, and ccompany-operated-vehicles electricity and fuel consumption in 2017 (a), and 2018 (b).

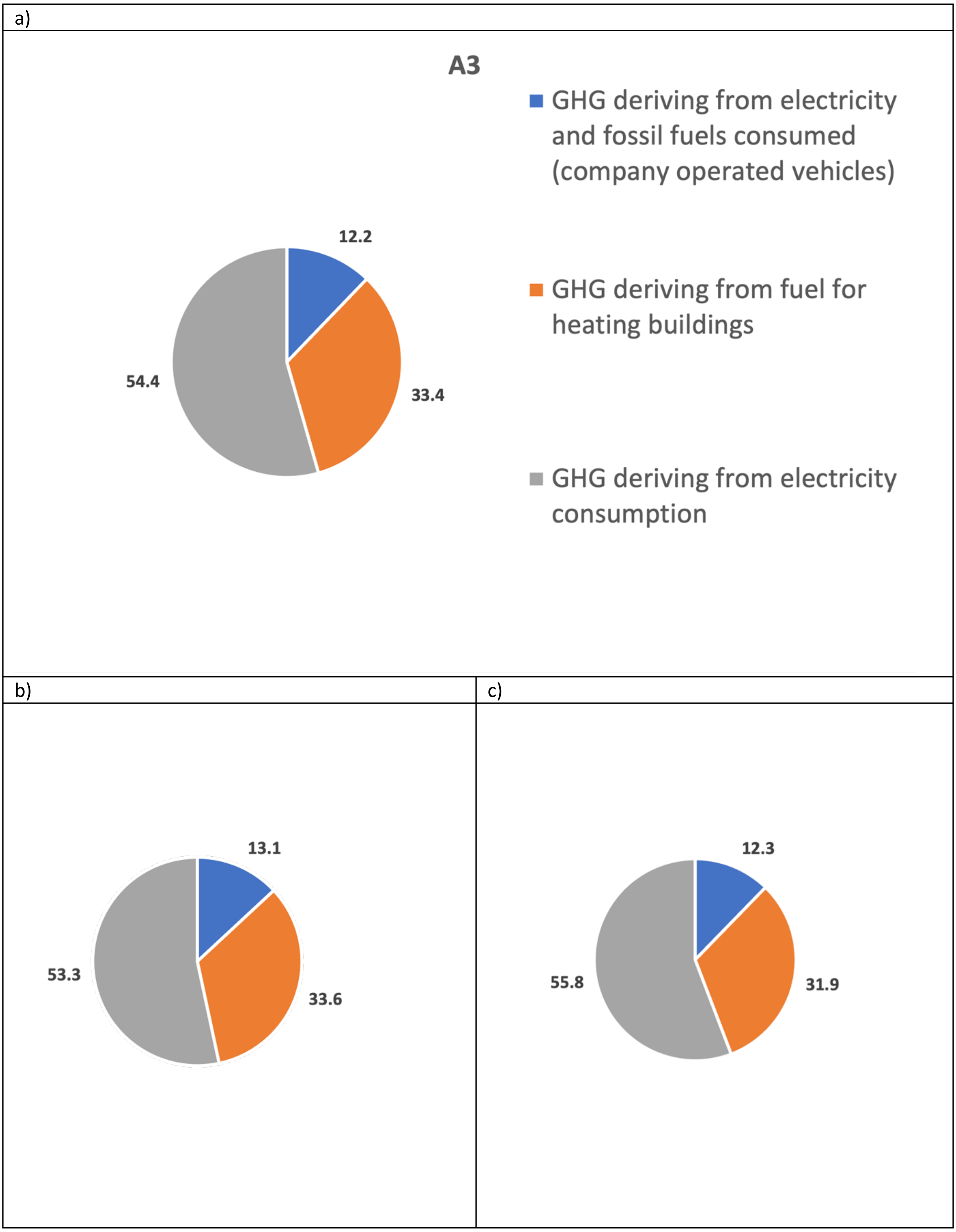


Figure 73 Contribution in percentage to the greenhouse gas emissions of A3 airport due to heating fuel, electricity consumption, and ccompany-operated-vehicles electricity and fuel consumption in 2016 (a), 2017 (b), and 2018 (c).

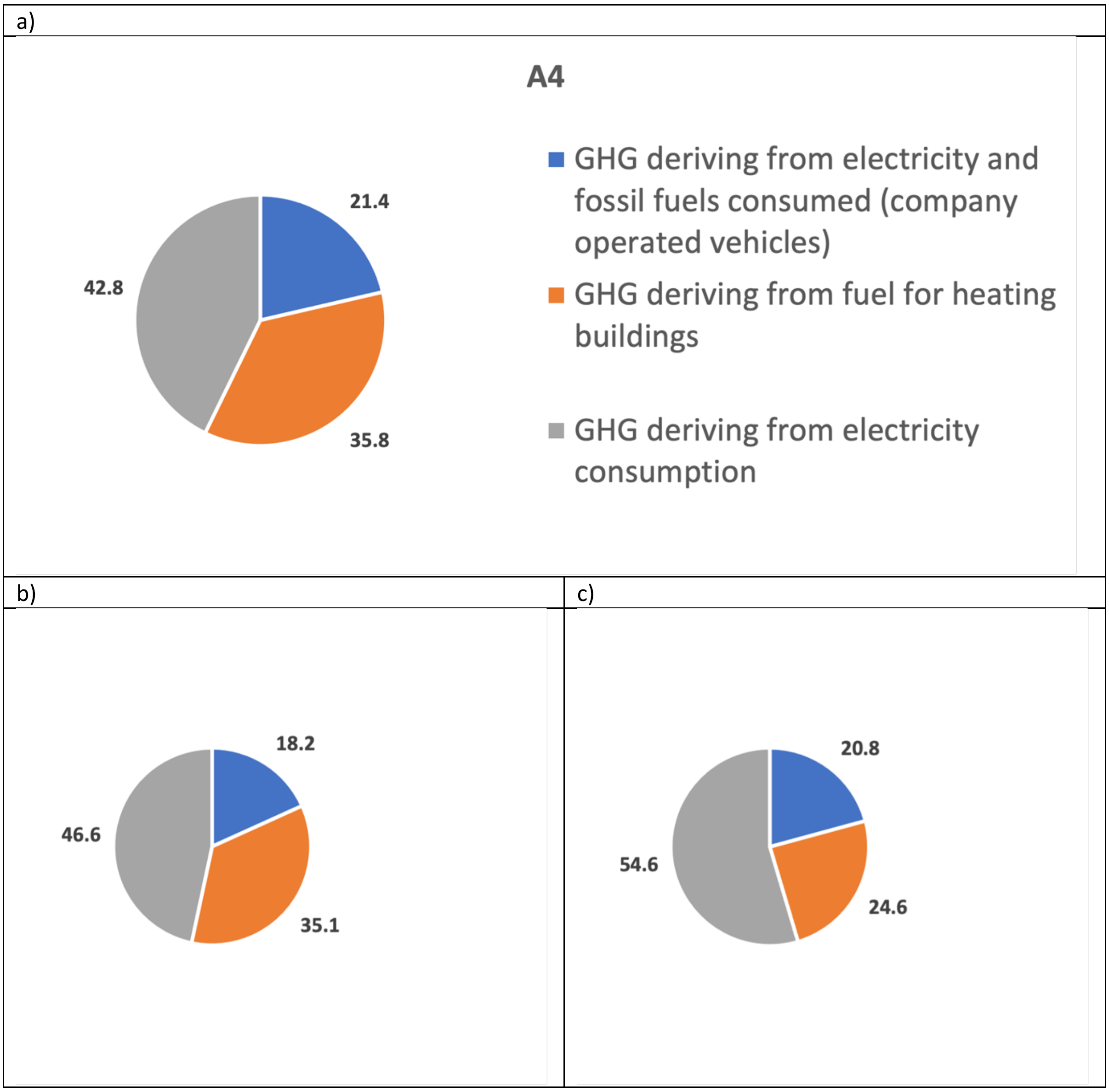
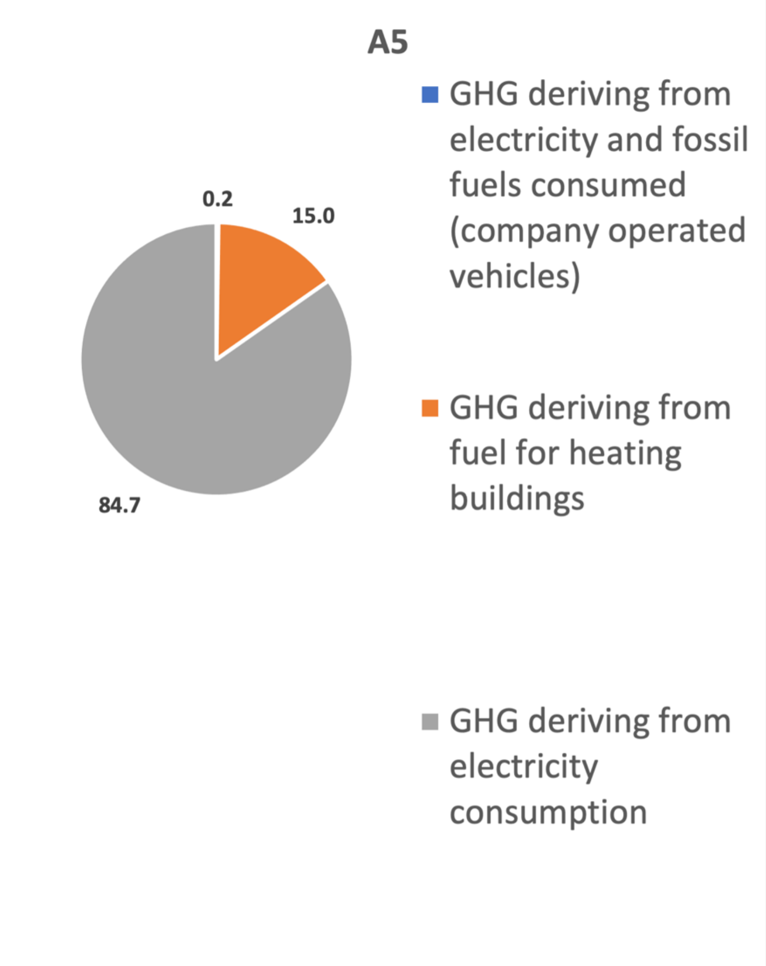


Figure 74 Contribution in percentage to the greenhouse gas emissions of A4 airport due to heating fuel, electricity consumption, and ccompany-operated-vehicles electricity and fuel consumption in 2016 (a), 2017 (b), and 2018 (c).

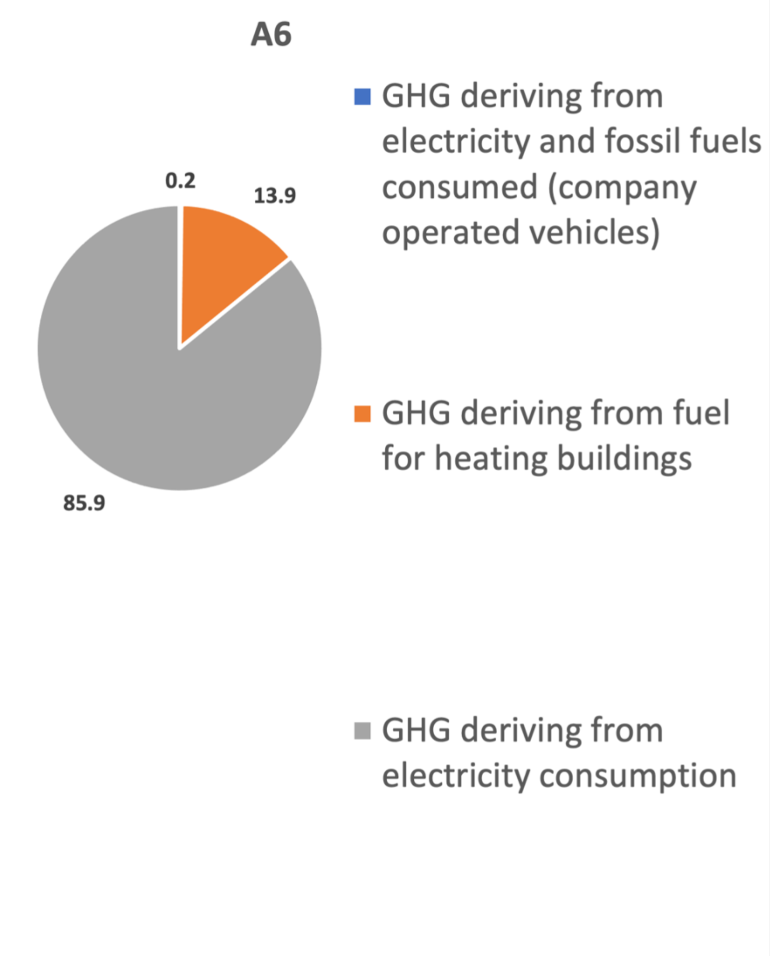
a)



b)

	%
GHG due to electricity and fuels consumed by company operated vehicles	0.5
GHG due to heating fuel	112.1
GHG due to electricity consumption	-12.6

Figure 75 Contribution in percentage to the greenhouse gas emissions of A5 airport due to heating fuel, electricity consumption, and ccompany-operated-vehicles electricity and fuel consumption in 2017 (a), and 2018 (b).



	%
GHG due to electricity and fuels consumed by company operated vehicles	1.2
GHG due to heating fuel	268.4
GHG due to electricity consumption	-169.6

Figure 76 Contribution in percentage to the greenhouse gas emissions of A6 airport due to heating fuel, electricity consumption, and ccompany-operated-vehicles electricity and fuel consumption in 2017 (a), and 2018 (b).

Multimodality

Some 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 pilot action consisted in establishing a direct connection between a Croatian airport and the nearby port in 2019. This allowed the passengers to reach the port and airport through a direct bus line every 30 minutes.

Table 10 shows the main findings reported by University of Ioannina (2018) regarding intermodal solutions that could be adapted in the Adriatic Area.

Table 10 Main findings regarding intermodal solutions that could be adapted in the Adriatic Area. (University of Ioannina, 2018).

	Current situation	Plans on expanding/strengthening intermodality issues
Dubrovnik and Pula airports	Most of the passengers use taxis and rental cars to get to their destination.	New plans to establish intermodal systems.
Dubrovnik and Pula ports	Both port representatives have mentioned the use of intermediate or preliminary intermodal concepts, such as more available taxis in rush hour and traffic police. Athough in some cases there are more frequent public transportation yet there are in line with the port operations and timetables and scheduled arrivals/departures.	Both ports do not have a department for intermodalism. Pula port reported not to use any intermodal transportation concept. Dubrovnik port has already made some initial steps towards intermodal patterns, with plans on expanding/strengthening intermodality.

As an index of the connections provided by local public transport service, the total number of bus runs in a year was divided by the number of passengers at each airport.

In 2018, the number of bus runs per passenger ranked as A2>A3>A1>A4 (Fig.77).

Notably, there is a railway station in the premises of the terminal of A5 airport and the airport is well served by regional trains.

There is a train stop in the premises of A2 airport (about 15 minutes walking distance). However, the train calls are sparse. There is a rubber-tired metro stop at about 15 minutes walking distance from A2 airport.

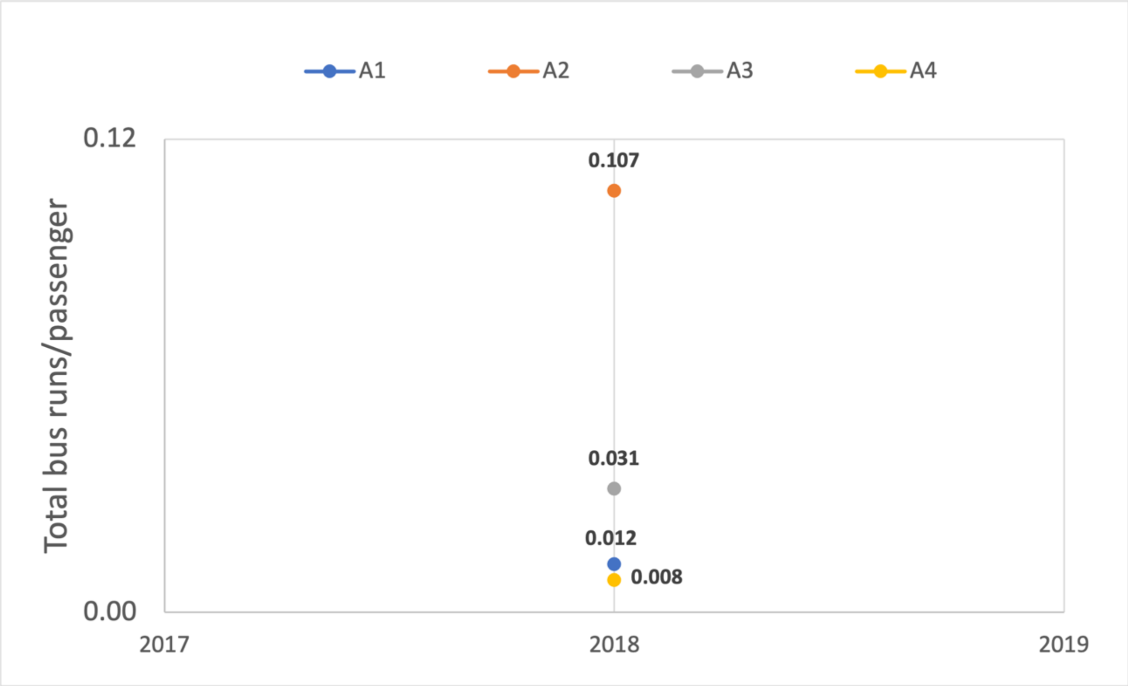


Figure 77 Number of bus runs per passenger at the airports.

Noise pollution

Noise pollution is not among the main environmental concerns of the airports.

Four airports do not consider noise a potential risk factor for the airport development (e.g., in relation to properties nearby), whereas noise may be a potential risk factor for A2 and A3 airports depending on acoustic zoning study. Both A2 and A3 airports have noise abatement requirements set by the authorities.

None of the airports has night flying restrictions or night curfew. Five airports have no constrain about landing and take-off (LTO) paths, whereas one airport has constrained LTO paths.

Only one airport reported operation restrictions because of noise nuisance. These restrictions concern engines tests (e.g., engine run ups), the use of the runway for the aircrafts during the landing phase, and the use of APU on the apron.

None of the airports imposes noise-related charges such as high fees against flight noise or discount to low-noise flight. None of the airports has higher noise charge in case of night flight.

Five airports declared to monitor and control the acoustic emissions from the infrastructure, or to plan to do so in the future.

Three airports (i.e., A4, A5, and A6) have monitoring stations (e.g., sound level meters) placed according to the potential receptors.

A1 airport reported to comply with the requirements regarding noise monitoring and control. These requirements are relatively less stringent because of the limited number of aircraft movements per year at A1 airport.

Two airports (namely A5 and A6) reported the implementation of the following operational solutions to mitigate noise nuisance:

- Engagement and involvement of the personnel in applying more silent cargo handling methods (e.g., slow driving);
- Low noise machinery and vehicle fleet;
- Low speed limits within the airport area.

Regarding the technical solutions for mitigating noise nuisance from aircrafts, hills were set as noise barriers to reduce noise impact on the urban areas close to A4 and A5 airports.

A3 airport is planning to build noise barriers; A2 airport has plans for implementing noise abatement measures in the future.

Four airports have cooperation with other airport authorities regarding noise pollution.

For example, A5 and A6 declared to collaborate with the national air navigation service provider and the national civil aviation authority.

Four airports have collaboration and communication strategies with the stakeholders involved in the noise problem.

For example, A4 has a yearly publication with information about noise pollution. Both A5 and A6 airports provide information about noise pollution on their respective websites. Moreover, A5 and A6 airports communicate with local authorities about noise pollution.

Conclusions

WATER

Between 2016 and 2018, water consumption ranged from 12.3 to 34.4 l/passenger at Adrigreen airports. A1, A2, A3, and A4 airports showed similar mean water consumptions per passenger in the time period 2016–2018, with values in the range 26.3–27.5 l/passenger (Table 11). A5 and A6 airports' mean value of water consumption per passenger were below the overall mean value (23.8 l/passenger) by 5.1 and 11.3 l/passenger, respectively.

Table 11 Ranking of airports' mean water consumption per passenger in the time period 2016–2018.

	Unit	Ranking	Time period
Mean water consumption per passenger	l/passenger	A1≅A2>A3>A4>A5>A6	2016–2018

Generally, higher values of water consumption per passenger were estimated for the airports located in a relatively short distance from the nearby city and with a lower number of passengers per year. According to Adrigreen partners, water consumption per passenger may be affected by the amount of water consumed:

- due to basic activities (e.g., cleaning) and the personnel working at the airports with a relatively smaller number of passengers per year;
- by the groups of relatives or friends that tend to escort the true passengers from/to the airports that are close to the nearby cities.

Four airports organize training and education of airport staff related to water protection, namely A1, A4, A5, and A6 airports.

Monitoring of water consumption is done at A1, A3, and A4 airports.

A5 and A6 airports harvest and reuse rainwater. A2, A3, and A4 airports reported to have in place or plan to implement initiatives aiming at reducing water consumption.

Surface water and groundwater quality monitoring is done at four airports, namely at A1, A4, A5, and A6 airports. These airports have put in place initiatives to prevent groundwater pollution.

Runoff water management is done at A1, A3, A4, A5, and A6 airports.

WASTE

Regarding waste handling at the airports, A4, A5, A6 are the airports that recycle more waste fractions (e.g., paper and cardboard, metal, plastic, glass, organic fraction, and hazardous waste), whereas the only waste fractions that are recycled at A1, A2, and A3 airports are paper, cardboard, and metal. Between 2016 and 2018, none of the airports had in place any economic incentives for recycling more and generating less waste such as the pay-as-you-throw program.

Regarding aircraft waste advanced handling, at A1 airport the preparation for recycling of waste from aircraft is aimed at separating cardboard waste.

Regarding the waste prevention initiatives in place at the airports, disposable cutlery and beverages were replaced with easily degradable materials at A1 airport; training of employees on recycling is held at A5 and A6 airports.

Regarding waste mitigation measures in place at the airports, instructions for waste separation are displayed inside the passenger terminal of A1, A5, and A6 airports.

A4 airport has plans for installing more recycling bins and for improving the handling of waste food and green waste.

A5 airport has a top separation and recycling scheme implemented within all airport areas. It should be considered as a possible example of BAT implementation.

ELECTRICITY

In the time period 2016–2018, airports' electricity consumption per passenger was between 1.86 and 5.27 kWh/passenger almost all the airports scoring about 2 kWh/passenger but A2 whose consumption is much higher. In fact, between 2016 and 2018 the mean electricity consumption per passenger was high at A2 airport, followed by other airports with mean values in the range 2.08–2.85 kWh/passenger (Table 12).

Table 12 Ranking of airports’ mean electricity consumption per passenger in the time period 2016–2018.

	Unit	Ranking	Time period
Mean electricity consumption per passenger	kWh /passenger	A2>A1>A5>A3>A6>A4	2016–2018

Photovoltaic systems are in use at A4, A5 and A6 airports; a photovoltaic system will be operating at A3 airport; A1 airport has plans for producing/consuming energy from renewable sources. All the Adrigreen airports installed LED lighting to improve the energy efficiency.

GREENHOUSE GASES DERIVING FROM ELECTRICITY AND FUEL CONSUMPTION

At A1, A2, A3, and A4 airports, from 2016 to 2018 electricity consumption was the highest contributor to GHG emissions (43.8–65.4%), followed by fuel for heating buildings (21.7–51.1%), and electricity and fuel consumed by company operated vehicles (5.1–23.7%).

Notably, in 2018 electricity consumption gave a negative contribute to the GHG emissions deriving from A5 and A6 airports' activities because of the production/consumption of photovoltaic electricity combined with the purchase of electricity produced by renewable energy sources.

Airports' GHG emissions deriving from electricity consumption per passenger were between -0.1 and 1.8 kg CO2eq/passenger in the time period 2016–2018.

Between 2016 and 2018 the mean GHG emissions deriving from electricity consumption per passenger was highest at A2 airport with 1.7kg CO2eq/passenger, followed by the other airports with mean values in the range 0.2–0.8 kg CO2eq/passenger (Table 13).

Airports' GHG emissions deriving from electricity consumption per volume of air-conditioned spaces were between -1.6 and 10.5 kg CO2eq/m3 in the time period 2016–2018.

Between 2016 and 2018 the mean GHG emissions deriving from electricity consumption per volume of air-conditioned spaces was highest at A3 airport with 10.1 kg CO2eq/m3, followed by the other airports with mean values in the range 2.7–6.5 kg CO2eq/m3 (Table 13).

Table 13 Ranking of airports' mean greenhouse gases (GHG) emissions deriving from electricity consumption in the time period 2016–2018.

	Unit	Ranking	Time period
Mean GHG emissions deriving from electricity consumption per passenger	kg CO2eq /passenger	A2>A3>A1>A4≅A5>A6	2016-2018
Mean GHG emissions deriving from electricity consumption per volume of air-conditioned spaces	kg CO2eq /m3	A3>A1>A4>A2>A6>A5	2016-2018

Airports' GHG emissions deriving from the fuel used for heating buildings per passenger were between 0.1 and 2.1 kg CO2eq/passenger in the time period 2016–2018.

Between 2016 and 2018 the mean GHG emissions deriving from fuel used for heating per passenger was highest at A2 airport with 1.4 kg CO2eq/passenger, followed by the other airports with mean values in the range 0.1–0.5 kg CO2eq/passenger (Table 14).

Airports' GHG emissions deriving from the fuel used for heating buildings per volume of the buildings were between 1 and 6 kg CO2eq/m3.

Between 2016 and 2018 the mean GHG emissions deriving from fuel used for heating per heated spaces was highest at A3 airport with 6.1 kg CO2eq/m3, and lowest at A5 and A6 airports with mean values of 1.4 and 2 kg CO2eq/m3, respectively (Table 14).

Table 14 Ranking of airports' mean greenhouse gases (GHG) emissions deriving from the fuel used for heating buildings in the time period 2016–2018.

	Unit	Ranking	Time period
Mean GHG emissions deriving from the fuel used for heating buildings per passenger	kg CO2eq /passenger	A2>A3>A1≅A4>A5>A6	2016-2018
Mean GHG emissions deriving from the fuel used for heating buildings per heated spaces	kg CO2eq /m3	A3>A2>A1≅A4>A6>A5	2016-2018

At A1, A3, A4, A5, and A6 airports, new operational and maintenance procedures are in use to improve and optimize energy efficiency and improvements in heating, ventilation, and air conditioning. In the near future, A2 airport considers a combined cooling heat and power plant as an interesting option.

Regarding the initiatives to reduce energy consumption, 3 airports have implemented actions to improve management systems and energy facilities such as:

- installing new meters and a building management system in the gates area (A3 airport);
- rebuilding the terminal and purchasing new equipment (A4 airport);
- installing a cogeneration plant and improving the energy efficiency of the passenger terminal and runways (A5 airport).

A5 and A6 airports carry out an energy audit every 4 years according to the national legislation in line with the EU Energy Efficiency Directive.

In the time period 2016–2018, airports' mean GHG emissions deriving from company-operated-vehicles electricity and fossil fuel consumption per passenger were high at A1, A2, A3, A4 airports with values in the range 0.2– 0.3 kg CO2eq/passenger, whereas the mean values per passenger were less than 0.01 kg CO2eq/passenger at A5 and A6 airports (Tab. 15).

A5 and A6 airports have dealt with the improvement of efficiency of cargo transport. A3 airport reported to have plans for the improvement of efficiency of cargo transport.

A1, A4, A5, and A6 airports are switching from carriers, hybrid vehicles, trailers, tractors, forklift trucks and cranes burning diesel fuels to vehicles burning bio-fuels or powered by electricity generated from renewable sources. For example, A4 airport purchased electric tractors for towing of baggage carts, and electric bicycles and scooters for the staff; A3 airport has planned to replace some of the machineries that use diesel fuels with machineries powered by electricity.

Table 15 Ranking of airports' mean greenhouse gases (GHG) emissions deriving from (company operated vehicles) electricity and fossil fuel consumption per passenger in the time period 2016–2018.

	Unit	Ranking	Time period
Mean GHG emissions deriving from (company operated vehicles) electricity and fossil fuel consumption per passenger	kg CO2eq /passenger	A1>A2>A3≅A4>A5≅A6	2016-2018

Charging stations for electric vehicles are available at A1, A3, A4, A5, and A6 airports. For example, there are 7 charging stations for electric vehicles at A1 airport; A3 airport has 2 charging stations for battery powered tow tugs.

A2, A3, A4, A5, and A6 airports have plans for installing charging stations for electric vehicles.

NOISE

Apparently, noise pollution is not among the main environmental concerns of the airports.

MULTIMODALITY.

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 Airports is very diverse and will require ad-hoc interventions for such assorted conditions.

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Annex

Datasheet explanations

1. Airport general info.

This datasheet contains: a brief description of the airport area airport characteristics, typology of companies located at the airport, incoming and out-coming traffic, general information about quality and environmental management.

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

Data will be used to have a picture of the airport infrastructure, the hosted activities, and general quality and environmental information.

- Table 1.1. Reference data of the airport.
  - Managing Authority
  - Site
  - Country/EU Member State
  - Region/ City
  - Geographical coordinates (Lat, Lon)
  - IATA code

- Table 1.2. Airport characteristics.
  - Size of the airport area
  - Size of the area under the competence of the airport authority
  - Size of airside area
  - Size of land side area
  - Heated spaces
  - Air-conditioned spaces

- Table 1.3. Employees.
  - Full-time employees
  - Seasonal employees
  - Other - Please specify - Add further lines

- Table 1.4. Activities.
    - Activities related to storage, loading, and unloading of cargo plane
    - Activities related to the storage, loading, and unloading of cargo plane and bulk (liquid and solid)
    - Cargo flights
    - Passenger flights
    - Domestic flights
    - International flights
    - Other - Please specify - Add further lines

- Table 1.5. Companies located at the airport.
    - Tourism
    - Security
    - Airport operator
    - Air navigation operator
    - Shopping
    - Rent- a- car
    - Services
    - Government agencies
    - Fuel storage and distribution
    - Restaurant and coffee bars
    - General aviation
    - Commercial aviation
    - Other - Please specify - Add further lines

- Table 1.6. Other departments.
    - Managing authority/function
    - Military
    - Airline companies
    - Governmental Authority
    - Associations
    - Hotels
    - Restaurants
    - Medical service
    - Bank office
    - Transport
    - Post office
    - Tourism office
    - Other - Please specify - Add further lines

- Table 1.7. Open air spaces
    - Number of runways
    - Number of taxiways
    - Number of passenger terminals
    - Number of cargo terminals
    - Total length of runaway (m)
    - Total length of taxiway (m)
    - The maximum authorized aircraft ICAO category
    - Maximum authorized length of an airplane (m)
    - Maximum authorized breadth of an airplane (m)
    - Maximum authorized wingspan of an airplane (m)
    - Location of the airport (i.e. near city, near airport etc..)
    - Catchment area served by the airport (km2, or other such as regions, counties, etc.)

- Table 1.8a. Airport Traffic (Latest statistics about airport traffic - 2016 and/or 2017 and/or 2018)
    - Revenues (euro)
    - Total cargo (in tons or specify)
    - Other goods
    - International passengers
    - Domestic passengers
    - Cars (served by airport parking lots)
    - Commercial vehicles (suppliers)
    - Other revenues
    - Other - Please specify - Add further lines

- Table 1.8b. Incoming road traffic (2016 or 2017 or 2018) (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 1.8c. Incoming road traffic (2016 or 2017 or 2018) (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 1.9. Quality and environmental general information.
  - Quality Management System (QMS) or Environmental Management System (EMS) implemented or under development
  - Certifications (e.g. ISO14001, EMAS)
  - Impact assessment and monitoring of the airport activities on nearest ecosystem.
  - Are there any institutionalised forms of cooperation to avoid any potential conflicts between the urban development and the airport development?
  - Presence of environmental policies at the local level fostering environmental remediation measures of airport and airport related activities
  - Presence of environmental policies at the regional or national level fostering remediation measures of airport and airport related activities
  - Presence of an inventory of relevant environmental legislation
  - Presence of an inventory of significant environmental aspects for the airport area
  - Presence of environmental training programme for airport employees
  - Does the airport have an environmental policy?
  - Does the policy aim at improving environmental standards?
  - Was the local community involved in developing the environmental policy of the airport?
  - Is the environmental policy available to the public?
  - Presence of an environmental monitoring programme
  - Does the airport have designated personnel for environmental management?
  - Publication of a publicly available environmental report

- Table 1.10. Infrastructure maintenance.
  - Does the airport 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 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 airport 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-Water basin nearby
    - 4- Cultural heritage sites nearby
    - 5-Contaminated site of national or regional interest?
  - Other Remarks

2. Airport schedule.

This datasheet contains schedules of international and domestic flights. The datasheet is divided in two sections: winter season, and summer season (e.g. last Sunday in March —last Saturday in October).

The suggested year of reference is 2018.

If comprehensive data are missing for this time period, it is possible to enter data referring to the year 2016 or 2017. Only data collected in a time span (e.g., 1 month) that is representative of a type of season must be considered.

The datasheet is divided in two sections:

- winter season;
- summer season.

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. Fuel sold in winter season
  - Domestic aviation
  - International aviation
  - Total/winter season
  - Specify year

- Table 2.2. Airport schedule winter season domestic and/or international aviation:
    - ICAO code
    - Destination
    - Manufacturer
    - Aircraft Type
    - Number of engines
    - Engine type
    - Frequencies per week
    - Total number per winter season
    - Landing take-off (LTO) cycles, (number/season) Auxiliary engine use during manoeuvring [%]

- Table 2.3. Fuel sold in summer season
    - Domestic aviation
    - International aviation
    - Total/summer season
    - Specify year

- Table 2.4. Airport schedule winter season domestic and/or international aviation:
    - ICAO code
    - Destination
    - Manufacturer
    - Aircraft Type
    - Number of engines
    - Engine type
    - Frequencies per week
    - Total number per winter season
    - Landing Take-off (LTO) cycles, (number/season) Auxiliary engine use during manoeuvring [%]

3. Other vehicles

This datasheet contains a description of airport equipment and ground support vehicles utilised at the airport.

Data must refer to the same year of the airport schedule datasheet.

We recommend collecting such info at fleet managers/fleet operators, and technical branches (motor characteristics etc.) or maintenance and operations departments of the airport managing authority.

Data will be used to evaluate the emissions of airborne pollutants deriving from the activities supporting the airport operations and the related and carbon footprint.

- Table 3.1. Description of other types of vehicles in use at the airport (e.g., passenger bus, aircraft tug)
    - Type of vehicle
    - Manufacturer
    - Year of production
    - Utilization (km/year)
    - Utilization (hour/year)
    - Operational remarks
    - Fuel/Energy consumption [g/hour] or [kWh]
    - Engine, power/displacement, fuel, emission standard
    - Airborne emissions (specify type and quantity)

4. Energy

This datasheet reports any relevant information for computing total energy use. The datasheet contains quantitative information about energy consumption and qualitative (yes/no) information about the planned/implemented initiatives to reduce energy consumption, improve energy efficiency and increase the share of renewable energy.

We recommend collecting such info at the commercial office (e.g., electricity bills) and other management offices (e.g., the infrastructure development department, airport operations department) of the airport managing authority.

Data will be used to evaluate the energy performance of the airport infrastructure including the related emissions of airborne pollutants and carbon footprint.

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

- Table 4.2. Electricity. This table reports data about: consumption and cost for the electricity consumed within the airport 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)
    - Other (specify and add lines)

- 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
    - 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 biofuels 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 airport (specify and add lines)

5. Water

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.

We recommend collecting such info at the commercial office (e.g., water bills) and other offices of the airport managing authority such as the rescue and fire-fighting department under the operational division or other authorities in charge of water supply and the water cycle management.

Data will be used to evaluate the water footprint of the airport infrastructure.

- 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
    - Own treatment system
        - Sanitary waste waters
        - Process waters
    - 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 aircrafts and vehicles
    - Any fertilisers to maintain open air spaces
    - Any herbicides, insecticides, pesticides to maintain open air spaces
    - Others (please specify)

- Table 5.4. Seasonal contamination. Information about seasonal events that are potential sources of water contamination:
    - De-icing of aircrafts and runways
    - Type and quantity of materials for aircraft de-icing
    - Quantity of material utilized for de-icing of runways
    - Others (please specify)

- Table 5.5. 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
    - Firefighting (specify materials: add rows)

- Table 5.6. Initiatives to reduce the impact on hydrosphere. Information about planned/implemented initiatives relevant to improve the water footprint of the airport and airport activities:
    - Reduction in water consumption
    - Wastewater reuse following treatment (wastewater and sewage treatment plants) (e.g. for irrigation, flushing of toilets, vehicle washing, etc.)
    - Using rainwater (e.g., see above)
    - Protection of groundwater from pollution
    - Monitoring of water consumption
    - Monitoring the quality of surface water and groundwater
    - Revising the operations of cooling towers
    - Training and education of airport staff

6. Waste

This datasheet contains information about waste production and management, the planned/implemented initiatives to improve waste management at the airport.

The datasheet reports any relevant information for computing the fractions of waste produced at the airport, 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 airport, and waste mitigation/waste prevention strategies.

We recommend collecting such info at the commercial office (e.g., waste bills) and other management offices (e.g. airport operations department, facility maintenance department) of the airport managing authority or other waste management authorities.

Data will be used to evaluate the waste management performance of the airport.

- 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 and add lines)
    - 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 and add lines)

- 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. Aircraft waste advanced handling
  - Preparation for reuse of waste from the aircrafts
  - Preparation for recycling of waste from aircrafts
  - Other (please specify and add lines)

- 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 aircraft movements had on the volume of waste generated at the airport?
  2 - What type of waste management system (centralized, de-centralized, a combination of both) has been implemented at the airport?
  3 - What systems are used to mitigate the impact of waste on the environment at the airport?
  4 - Are any waste prevention initiatives in place at the airport?
  5 - Are any waste mitigation measures in place at the airport?

7. Noise

This datasheet contains qualitative (yes/no) information about noise management (e.g., restrictions, technical and operational solutions planned or implemented) and quantitative information about any airport operation restrictions.

We recommend collecting such info at management offices (e.g., the infrastructure development department, airport operations department) of the airport managing authority or at other local/regional authorities involved in noise nuisance management.

Data will be used to evaluate the noise management at the airport infrastructure.

- 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 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 airport development (e.g. in relation to properties nearby)
- Are the noise policy and requirements in the airport 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 airport?
- Is there a noise map of the airport area?
- Are there any plans for noise abatement measures?
- Is there any cooperation with other airport 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 airport operation restrictions addressing noise nuisances should be reported
    - Are there any airport operation restrictions because of noise nuisance?
    - Are there any night flying restrictions for limiting the ground-perceived exposure to aircraft noise?
    - Are there any constrained LTO paths?
    - Are any noise-related charges imposed? (high fees against flight noise or discount to low-noise flight).
    - In case of night flight, are the noise charge higher?

- Table 7.3. Airport operation restrictions

- Table 7.4. Technical and operational solutions. A list of potential technical and operational solutions is reported
    - Engagement and involvement of the personnel in applying more silent cargo handling methods (e.g., lower driving speed).
    - Low noise machinery and vehicle fleet.
    - Lower speed limits within the airport area.

- Traffic arrangements to reduce the noise impact of the airport (e.g., diverting the traffic to the airport area in less sensitive area, installing physical obstacles forcing to lower speeds, silent asphalts).
- Airport layout such as noise walls and barriers, topographical formations (e.g., hills as noise barriers).

8. Air quality — GHG

This datasheet contains qualitative (yes/no) information and open questions about air quality and greenhouse gases emission management at the airport.

We recommend collecting such info at management offices (e.g. airport operations department) of the airport managing authority or at other local/regional authorities involved in air quality management.

Data will be used to evaluate the emissions of airborne pollutants and greenhouse gases deriving from airport 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 airport 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?
    - Are environmental charges implemented by regional or local authorities?
    - Are there incentive-based environmental regulation in form of charges or taxes.
    - Are part of the landing and take-off (LTO) fees based on the emission certified values during LTO cycles.
    - 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 open questions about multimodality and integration of the airport with the local/regional transport networks and quantitative information about any types of transport from/to the airport.

We recommend collecting such info at management offices (e.g. the infrastructure development department, airport operations department) of the airport managing authority or at other authorities involved in supplying transport service and managing the transport network (e.g. public transport operators, transport enterprises, fleet managers/fleet operator, etc.).

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

- Table 9.1. Transport ''From… — To airport''. 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 airport 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 airport — from….’’ Quantitative and descriptive information about any types of transportation (e.g., bus, tram, railways, electric car, private car) connecting the airport 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 airport 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 airport area.
    3. Description of any transport infrastructures reachable from the airport area.