Manual on identified solutions and practices

INTERREG V-A Italy-Croatia CBC Programme 2014-2020

Project title GREEN AND INTERMODAL SOLUTIONS FOR ADRIATIC AIRPORTS AND PORTS

Project acronym ADRIGREEN

Project number 10044741

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1. Introduction

Project acronym	ADRIGREEN
Project Title	Green and intermodal solutions for Ports and Airports
Start of the project	01/01/2019
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Related activity:	4.2 – Elaboration of manual on identified solutions and practices
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2. The Aim

Green and intermodal solutions for Adriatic ports and airports - ADRIGREEN is a project approved under the INTERREG V-A Italy Croatia CBC Programme 2014- 2020. The programme is funded by the European Regional Development Fund under the European Territorial Cooperation objective during the programming period 2014- 2020.

The managing body of the Cooperation Program is the Veneto Region, Italy. The national body of the Republic of Croatia coordinating the implementation of the joint programme with other participating countries is the Ministry of Regional Development and European Union funds.

The project has started in January 2019 and it is expected to end by January 2022. The total budget approved for the project amounts to 2.104.217,00 EUR, 85% of which is co-financed through the ERDF fund (European Regional Development Fund). The project is implemented by 10 project partners (PULA AIRPORT Ltd., DUBROVNIK AIRPORT Ltd, AEROPORTI DI PUGLIA S.P.A., AIRIMINUM 2014 S.P.A., Rimini, ABRUZZO AIRPORT MANAGEMENT COMPANY Ltd., DUBROVNIK PORT AUTHORITY, CENTRAL ADRIATIC PORTS AUTHORITY, PULA PORT AUTHORITY SOUTHERN ADRIATIC SEA PORT AUTHORITY, UNIVERSITY POLITECHNIC OF MARCHE), the lead Partner is Pula Airport Ltd.

The main objective of ADRIGREEN project is to improve the integration of Croatian and Italian ports and airports with other modes of transportation in order to enhance the processing of passengers during the summer seasons and to improve environmental performances of the Adriatic maritime and aviation systems. To do that, the project will implement a set of structured activities based on transnational and cooperative approach.

One of the main problems that characterize the Adriatic coastal area is the imbalance in the development of infrastructures and modes of transport, caused by low level of investments and insufficient approach to innovation. In Italy and Croatia there are many maritime cities, which have to deal with a very high number of passengers, especially during the peak season. Even though the road transportation is still predominant, the number of people that are reaching Adriatic cities by ferries and airplanes is significantly increasing year by year. However, most of Adriatic ports and airports are suffering from lack of integration with various modes of transportation, causing serious traffic congestion problems during the summer season.

The main idea is to identify and analyse a few existing operational and technological solutions that can be easily transferred and adapted by involved ports and airports. The partners are not interested in inventing new solutions as there are a plenty successful models and schemes implemented in other parts of the world that can be replicable also in the Programme area. Once the solutions have been identified and analyses, the project partner will test the operational and technological models on their facilities so as to improve intermodal connections and to put in practices new schemes for a sustainable management of ports and airports. The objective of the testing phase will be to demonstrate the feasibility, the effectiveness, and the replicability of the identified solutions. Finally, intention of the project is to disseminate the results of tested solutions so as to explain also to other ports and airports how the operational procedures and technological innovation can be successfully transferred and used.

3. Methodology

In order to record the existing situation and examine replicability and adaptability issues according to the findings of the international investigation a study was designed and implemented in the area of the Adriatic macro region. The manual serves as a consolidated document of all important deliverables within the project, taking into account main results such as international investigations, environmental assessment, joint action plans, pilot actions implemented in the airports and ports od the study area. Further, the Manual contains a overview of other airports and ports in Adriatic regia, based on collected data.

3.1. The Study Area

The study area includes representative airports and ports that are situated along the Adriatic macro region in the following countries:

- Croatia, Pula
  - Pula Airport Ltd
  - Pula Port Authority
- Croatia, Dubrovnik
  - Dubrovnik Airport Ltd.
  - Dubrovnik Port Authority
- Italy, Rimini
  - Rimini Airport
- Italy, Pescara
  - Pescara “Abruzzo” Airport
- Italy, Brindisi
  - Airports of Apulia
- Italy, Ancona
  - Central Adriatic Ports Authority

3.2. Bilateral Meetings

Communication with partners was done by submitting all necessary documentation and comments on the submitted. Through the project, the partners were obligated to deliver a range of deliverables, according to the defined project methodologies. Online meetings with Dubrovnik Airport, the project partner in charge of work package 4, were held on average every two weeks. The meetings were important to monitor the process of creation the manual, the status of the submitted documentation, internal deadlines for the preparation of certain parts of Manual, etc.

3.3. Data Collection

Data collection for this Manual, referred primarily to all deliverables that were to be made as part of the project:

- Environmental performance assessment of Adrigreen airports
- Environmental performance assessment of Adrigreen ports
- Capitalization Report
- Joint actions plans for ports and airports
- Feasibility studies
- Appraisal reports

Also, data on other airports and ports referred to in the manual were collected. Except for basic information about them, research has been made on their goals and visions related to energy efficiency and improving intermodality

4. Results

4.1. International investigation

Activities have been started in June 2019 and finalised as of December 2020.

Replicability research and analysis replicable operational and technological solutions. Partnership has made a general overview of existing solutions for lowering airports/ports environmental impact and for intermodal connection of ports/airports with other means of transportation. Within this activity SWOT analysis of each project partner was performed to assess current situation and fields for improvement. Also, international investigation research was conducted in order to identify and analyse the best solutions already implemented worldwide that can be easily implemented in Adriatic region. One of the main focus areas of international investigation included on-going operational and technical initiatives for making ports/airports environmentally friendly with particular attention to maintenance activities.

Summary of practical sustainable applications to achieve carbon reductions at airport and port infrastructures are as follows:

Solution	Brief description	Port reference case studies	Airport reference case studies
Solar panels	Solar panels installed in different areas of the port/airport (e.g., rooftops of buildings and warehouses) for generating renewable energy.	Rotterdam, Amsterdam, and Gothenburg	Copenhagen, and Helsinki Airport
Geothermal heat pump/ Aquifer thermal energy storage	Renewable thermal energy for large heating and cooling loads. Cooling/heating system employs a water-based thermal energy storage system that stores heat/cold in ground-water reservoirs.	Marseille	Paris-Orly, Nashville, Calgary, Stockholm-Arlanda, and Copenhagen Airport
Energy monitoring system	Monitoring system of the energy consumption of airport/port equipment, buildings and other facilities for supporting decision-making and implementation of measures for improving energy efficiency.	Valencia, Koper, and Jade Weser Port	Copenhagen Airport
Smart grid	Electricity network based on digital technology that can cost-efficiently integrate the behaviour and actions of all generators and consumers that are connected to the grid.	Antwerp	-
Daylighting	A daylighting strategy can reduce	Yokohama	Denver, and

strategy	electricity for lighting and peak electrical demand, cooling energy and peak cooling loads, maintenance costs associated with lamp replacement, and electrical service to the building. Maximize south glazing and minimize east- and west-facing glass		San Francisco Airport
Green roofs	Green roofs are covered with vegetation and a growing medium planted over a waterproofing membrane. When weight restrictions need to be considered, it is possible to utilize substrates that provide an adequate nutrient supply with relatively low specific weight. Main environmental goals: absorbing rainwater, providing insulation, and helping to mitigate the heat island effect in the built environment.	Värtahamnen, and Copenhagen	Frankfurt, Ibiza, Munich Airport, Paris Orly, and Bordeaux–Mérignac Airport
Concrete pavement instead of asphalt	Pavers are lower maintenance and generally have a longer lifespan compared to asphalt.	Värtahamnen	-
LED	Light emitting diode (LED) is a highly energy efficient lighting technology.	Venice, Hamburg, and Los Angeles	Stockholm Arlanda, Copenhagen, Schiphol, and Oslo Airport

4.2. Environmental Assessment

Next step in project implementation comprised of producing Environmental Impact Assessment (EIA) for each project partner based on ad-hoc guidelines produced by technical expert in the project, Polytechnic University of Marche. In order to asses current situation in each partner, evaluation grid for EIA was produced to cover different environmental aspects; environmental impact of local air quality, waste and water management, energy consumption, carbon footprint and noise pollution.

There are different levels of implementation of efficient environmental management within ADRIGREEN airports as can be summarised in table below:

Activity	**Implemented in airports**
Water management	
Education and training of airport staff	4/6
Monitoring of water consumption	3/6
Harvest and reuse rainwater	2/6
Surface water and groundwater quality monitoring	4/6
Runoff water management	5/6

Activity	**Implemented in airports**
Waste management	
Waste handling – more fractions (paper, metal…)	3/6
Aircraft waste advanced handling	1/6
Waste prevention initiatives	1/6
Training on recycling	2/6
Mitigation measures in place	3/6

Activity	**Implemented in airports**
Electricity and fuel consumption	
Photovoltaic systems installed	3/6
LED lighting	6/6
Operational and maintenance procedures in place	5/6
Initiatives to reduce energy consumption	3/6
Energy audit	2/6
GHG emission–high (0,2-0,3 kg CO2eq/pax)	4/6
Switch to electrical or bio-fuel vehicles	4/6
Charging stations	5/6

4.3. Joint Action Plans

Joint action plan definition has been produced by Polytechnic University of Marche with recommendations for improvement for each type of environmental activity.

Therefore, within ADRIGREEN project Joint action plan definition, following measures were underlined regarding decreasing of fuel consumption:

General action	Specific action	Metrics	Airport reference case studies
Decreasing fossil fuel consumption	Purchase of electric vehicles (e.g., electric aircraft tug, electric baggage tractor, etc.)	Electricity consumption (kWh) versus kg or l of fossil fuel; GHG emissions (CO2eq)	Copenhagen Airport (2018).
Decreasing fossil fuel consumption	Provide charging stations for electric vehicles	Electricity consumption (kW); GHG and airborne pollutants emissions	A1 airport (this study); Helsinki Airport (Finavia 2019).
Decreasing fossil fuel consumption	Anti-idling communication campaign	GHG and airborne pollutants emissions	Copenhagen Airport (2018).
Decarbonizing fuel consumption	Use of alternative renewable fuels (diesel from waste and residue) for diesel vehicles	Consumption of renewable fuel vs fossil fuel (l); GHG emissions (CO2eq)	Helsinki Airport, and other Lapland Airports (Finavia 2018).

4.4. Pilot actions for Adrigreen airports and ports (Feasibility studies and Appraisal reports)

Pilot actions are identified according to the following areas:

- implementation of low-cost and smart solutions to better connect airports and ports with the local public transport systems, such as railways and public bus lines;
- implementation of integrated timetabling and information for passengers that shall continue their travel by other means of transport
- adoption of smart solutions to improve waste&water management and to reduce energy consumption in small-medium regional Airports;
- new protocols with public and private transport providers to experiment with new services to speed up the process of passengers from/to touristic destinations which are not well-connected

Airports and ports have performed qualitative risk analysis for different stages of feasibility study (FS) and Action plan implementation as follows:

➢ **Preparation phase** – includes steps that are to be fulfilled prior to developing of FS and Action plan

➢ **Implementation phase** – includes steps that are to be taken for purchase of equipment or software necessary for testing pilot action

➢ **Testing phase** – includes steps that are to be undertaken during the testing phase of the Action plan and producing FS.

Per each phase of the Action plan lifecycle, engaged partners will perform following activities:

➢ **Risk identification** – all types of risks that can occur needs to be identified and addressed,

➢ **Risk assessment** – based on prescribed methodology, each risk shall be measured and assessed based on the probability of occurrence and impact on the project objectives achievement,

➢ **Corrective measures and mitigation measures** – measures prescribed by engaged parties in order to mitigate risk to acceptable level. Acceptable levels of risks are moderate or below, other risk levels should be addressed by appropriate measures.

Implemented process for monitoring and implementation of pilot action consisted of following:

- identifying project team with clear responsibilities of each project team member,
- preparation of project implementation plan including pilot action implementation steps,
- identifying risks that can occur during pilot action implementation process with continuously monitoring and evaluation process,
- conducting timely public procurement processes for purchase of needed equipment,
- implementing purchased equipment in practice and measuring their performance,
- establishing monitoring system for environment analysis and process optimisation analysis for future benefits.

4.4.1. Pilot actions for Adrigreen airports

<u>Brindisi airport</u>

Brindisi Airport is especially interested in improving and integrating communication and transport between units, and in opportunities to implement new innovative technologies according to the latest environmental and sustainable development principles. Consequently, Brindisi Airport pilot action includes purchasing of electric vehicles to be used for aircraft assistance activities, covering the following pilot action field:

- ***adoption of smart solutions to reduce energy consumption in small-medium regional Airports***

The new solutions tested at the Airport will reduce airport air pollution and will better integrate airport systems. Gained experience and benchmark information will provide inputs for future sustainable development of the whole region.

The pilot action of Brindisi Airport was particularly concentrated in the purchase of:

- electric tractors used for aircraft assistance activities (handling).

According to the need's analysis performed, Brindisi Airport has identified following fields for improvement in landside and airside area:

- energy efficiency improvements within airport processes,
- cost effective optimisation of business processes.

The purchase and implementation of electric tractors for handling operations will significantly reduce CO2 emissions and reduce energy consumption in the execution f daily processes at Brindisi airport as the old diesel-powered vehicles will be completely replaced and put out of order. Furthermore, as these vehicles are used in the ground area, it will be visible to stakeholders and the general public who contribute to the airport greenfield policy and zero-emissions strategy adopted within Brindisi airport and presented to the public. Therefore, as part of the ADRIGREEN project, Brindisi airport purchased 1 electric tractors for handling operations, replacing the remaining 1 diesel vehicles. With the use of this new electric tractor, energy consumption and polluting emissions in the air will be reduced.

Within Feasibility Study for Brindisi Airport pilot action initial environmental analysis has been performed which related to basic calculation of CO2 emissions according to technical specifications of equipment purchased compared to the one replaced.

Accordingly, listed below are technical specifications of pilot actions:

- New Diesel Tractor - CO2 emissions are estimated at 532 g / km, on an annual basis, assuming 2.000 km, is 1.064 kg;
- New Electric Tractor Simai TE252 - CO2 emissions are estimated at 172 g / km, on an annual basis, assuming 2.000 km, is 344 kg

Results

Each year, the diesel vehicles emits about 3,8 times the greenhouse gases deriving from the electricity utilised by the electric vehicles (Figure 4-1). End of waste and the life cycle assessment of diesel and electric vehicles were not assessed.

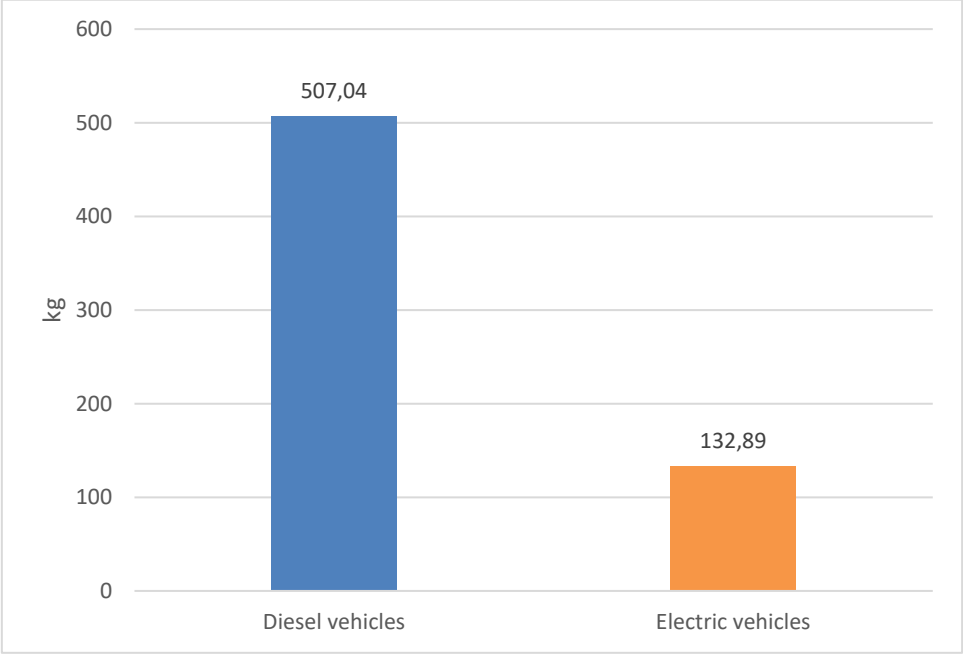

Figure 4-1. – Comparison between greenhouse gases emissions deriving from diesel vehicles (CO2) and electric vehicles (CO2 eq) per year, Brindisi airport

Local emissions of airborne pollutants such as NOx and particulate matter (PM) is assumed to be null for the electric vehicles. However, the emission of airborne pollutants should be considered depending on the location of production and the technology utilised for producing electricity.

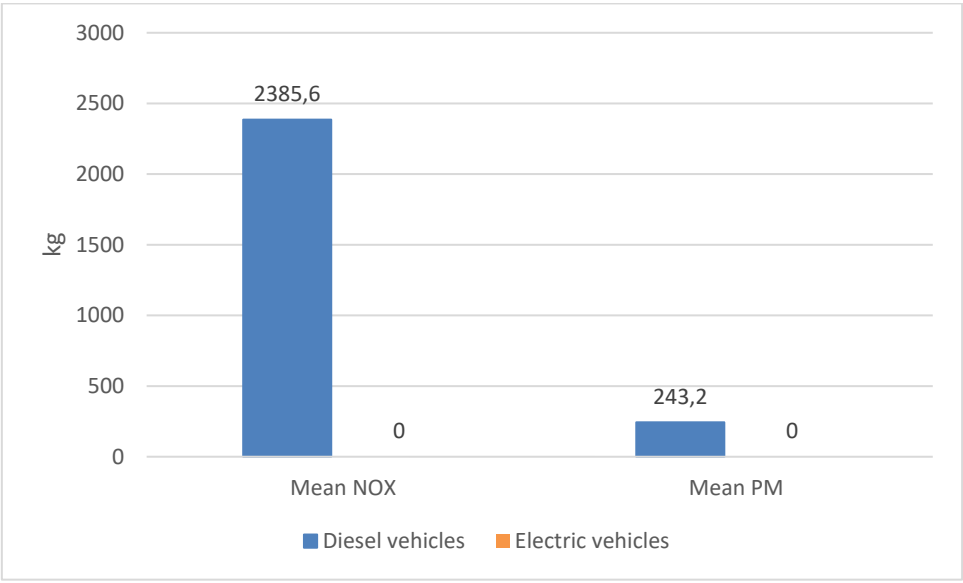

Figure 4-2. Comparison between local emissions of airborne pollutants (i.e., NOx and PM) deriving from diesel vehicles and electric vehicles per year, Brindisi airport

Dubrovnik airport

Dubrovnik Airport pilot action implemented is in compliance to third main pilot action field identified within the project:

- ***adoption of smart solutions to improve waste&water management and to reduce energy consumption in small-medium regional Airports***

and is divided into three main areas / types of vehicles purchased:

- electric vehicle for waste management process,
- electric vehicle for ICT department, for field work within Dubrovnik Airport premises,
- electric scooters and bicycles to be used by airport staff for airside and landside processes optimisation.

According the need's analysis performed, Dubrovnik Airport has identified following fields for improvement in landside and airside area:

- energy efficiency improvements within airport processes,
- cost effective optimisation of business processes.

Purchase and implementation of the electric vehicle for waste management process and electric vehicle for ICT department will significantly lower CO2 emission and it will reduce energy consumption in performing daily processes within Dubrovnik Airport premises since old fuel vehicles are fully replaced and put out of the function. Also, since these vehicles are used on the landside area, it will be visible to the stakeholders and general public contributing to the airport green field policy and zero emission strategy adopted within Dubrovnik Airport and presented to the public.

Additionally, daily operative activities performed by Dubrovnik Airport staff in landside and airside area were supported mainly by several vehicles on diesel fuel and some bicycles, where bottlenecks occurred due to the limited space in the landside and airside area for vehicle usage. These bottlenecks have influenced optimisation of Dubrovnik Airport landside and airside processes, resulting in non-cost-effective processes.

Accordingly, listed below are technical specifications of pilot actions:

- Waste management vehicle – old diesel vehicle CO2 emission is 162 g / km, on a yearly basis, 30.000 km, it is 4.860.00 g. Electric vehicles emission factor was 234,81 g CO2 eq/kWh in Croatia in 2017;
- Vehicle for ICT department – old diesel vehicle CO2 emission is 162 g / km, on a yearly basis, 15.000 km, it is 2.430.00 g. Electric vehicles emission factor was 234,81 g CO2 eq/kWh in Croatia in 2017
- Two old vehicles –CO2 emission is 162 g / km, on a yearly basis, 12.000 km, it is 2.430.00 g per vehicle. Electric vehicles emission factor was 234,81 g CO2 eq/kWh in Croatia in 2017

Each year, the diesel vehicles emits about 7.8 times the greenhouse gases deriving from the electricity utilised by the electric vehicles (Figure 4-3). End of waste and the life cycle assessment of diesel and electric vehicles were not assessed.

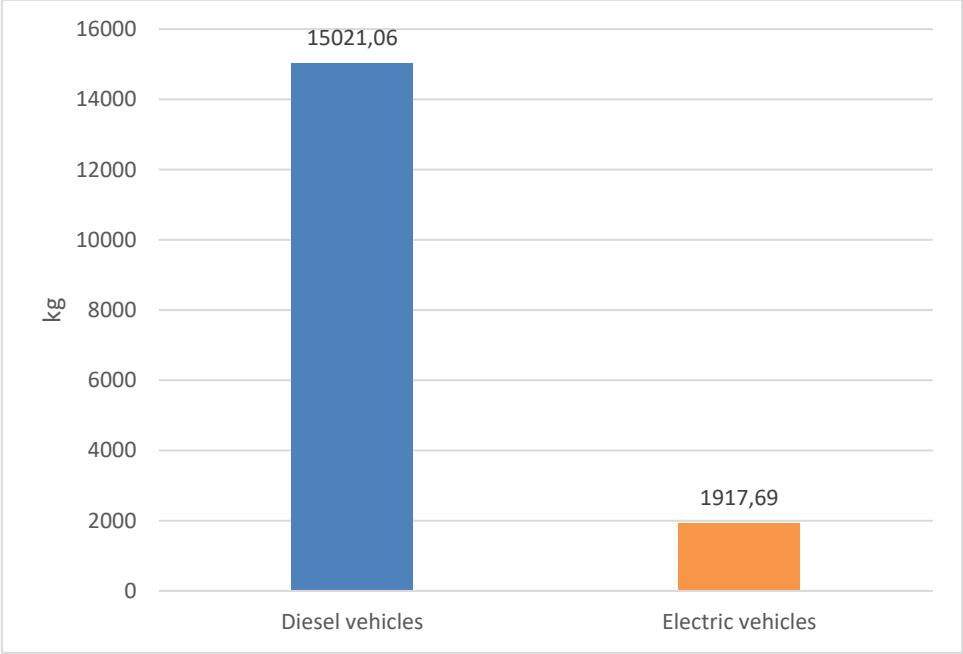

Figure 4-3. Comparison between greenhouse gases emissions deriving from diesel vehicles (CO2) and electric vehicles (CO2 eq) per year, Dubrovnik airport

Local emissions of airborne pollutants such as NOx and particulate matter (PM) is assumed to be null for the electric vehicles. However, the emission of airborne pollutants should be considered depending on the location of production and the technology utilised for producing electricity.

On the contrary, utilising the diesel vehicles would result in local emissions of NOx and PM (Figure 4-4).

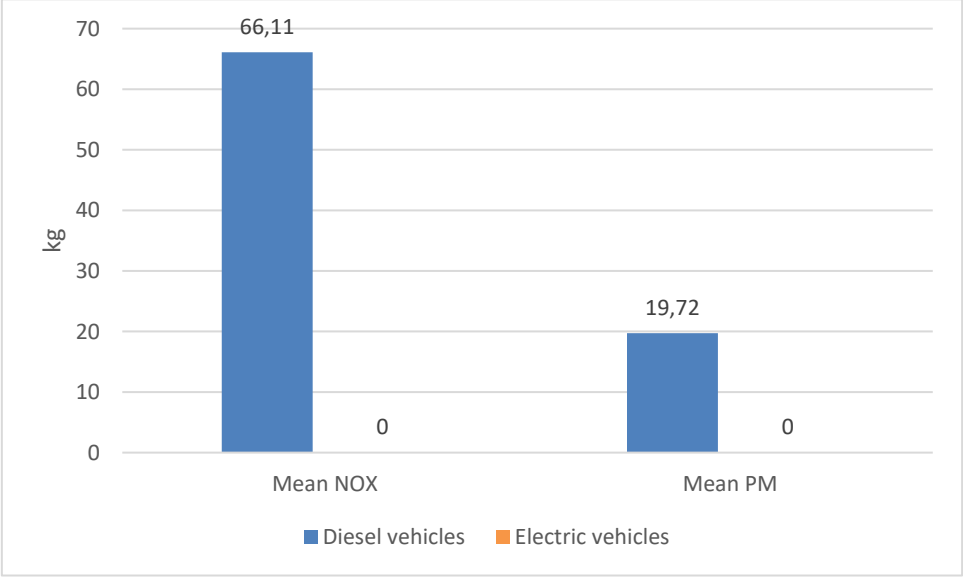

Figure 4-4. Comparison between local emissions of airborne pollutants (i.e., NOx and PM) deriving from diesel vehicles and electric vehicles per year, Dubrovnik airport

Pescara airport

Pescara Airport pilot action implemented is in compliance to third main pilot action field identified within the project:

- ***adoption of smart solutions to improve waste & water management and to reduce energy consumption in small-medium regional Airports***

The focus of the Pescara airport is to reduce energy carbon emissions, the proposed intervention is:

- Replacement of diesel GPU (Ground Power Unit) with a new full electric version used for grounded aircraft activities (handling).
- The Electrical Ground Power Unit (E-GPU) is small engine which produce power for the aircraft when it is on the ground, able to save tonnes of CO2 per year. The estimated costs is 140.000

According to the need's analysis performed, Pescara Airport has identified following fields for improvement in airside area:

• energy efficiency improvements within airport processes,

• cost effective optimisation of business processes.

• reduction of CO2 emissions.

Purchase and implementation of the electric equipment for handling process will significantly lower CO2 emission and it will reduce energy consumption in performing daily processes within Pescara Airport premises since old diesel vehicle is replaced and put out of the function.

Also, since this vehicle is used on the airside area, it will be visible to the Airlines and general public contributing to the airport green field policy and zero emission strategy adopted within Pescara Airport and presented to the public

The Pescara airport, from the project aims to obtain a greener footprint of an airport under development that is important for the region. This can be considered as the first step towards a sustainable development for the environment, without neglecting the important economic developments that green solutions can propose.

Pula airport

Pula Airport pilot action implemented complies with third main pilot action field identified within the project:

- **adoption of smart solutions to improve waste & water management and to reduce energy consumption in small-medium regional Airports**

and is defined by the purchased equipment:

- electric chargers for vehicles on the airport landside,
- electric vehicle for airport handling operations.

According to the need's analysis performed, Pula Airport has identified the following fields for improvement in the landside and airside area:

- energy efficiency improvements within airport processes,
- cost-effective optimisation of business processes.

Purchase and implementation of the electric vehicle for aircrafts handling process and chargers for electrical vehicles will significantly lower CO2 emission and it will reduce energy consumption in performing daily processes within Pula Airport premises since old fuel vehicles are fully replaced and put out of the function. Also, since these vehicles and equipment are used on both the landside and airside areas, it will be visible to the stakeholders and general public contributing to the airport greenfield policy and zero-emission strategy adopted within Pula Airport and presented to the public.

Pula Airport has performed a financial analysis of equipment purchased and used. In conducting financial analysis following assumptions were taken into the consideration:

- purchase price of new chargers for electrical vehicles,
- purchase price of new vehicle and old (replaced vehicle),
- additional yearly maintenance expenses for electrical vehicles,
- additional yearly maintenance expenses for electrical chargers,
- the economic life usage period of chargers (15 years),
- the economic life usage period of electrical vehicles (8 years).

Other information:

- chargers Terra 54 for electric vehicles was purchased and put in use in June 2020.
- electric vehicle VET-17kN for aircraft handling process was purchased and put in use in June 2021.

Accordingly, listed below are technical specifications of pilot actions:

- old diesel vehicle CO2 emission is 162 g / km, on a yearly basis, 10.000 km, it is 1.620.00 g. Electric vehicles emission factor was 234,81 g CO2 eq/kWh in Croatia in 2017,
- numbers of electrical vehicles that are or will be charged in a certain period of time can't be estimated because it is a factor not relevant to the airport itself but to the number of electric vehicles used in the region both during the season and the rest of the year. Fossil fuel vehicle CO2 emission is 162 g / km, on a yearly basis, 30.000 km, it is 4.860.00 g. Electric vehicles emission factor was 234,81 g CO2 eq/kWh in Croatia in 2017.

Rimini airport

Rimini Airport pilot action implemented is in compliance to third main pilot action field identified within the project:

- ***adoption of smart solutions to improve waste & water management and to reduce energy consumption in small-medium regional Airports***

The focus of the Rimini airport is to reduce energy consumption and carbon emissions, the proposed intervention is

- Replacement of diesel tractors with new electric tractors used for aircraft assistance activities (handling)

According to the need's analysis performed, Rimini Airport has identified following fields for improvement in landside and airside area:

- energy efficiency improvements within airport processes,
- cost effective optimisation of business processes.
- CO2 emission reduced.

Purchase and implementation of the electric vehicle for handling process will significantly lower CO2 emission and it will reduce energy consumption in performing daily processes within Rimini Airport premises since old diesel vehicles are fully replaced and put out of the function.

Also, since these vehicles are used on the airside area, it will be visible to the Airlines and general public contributing to the airport green field policy and zero emission strategy adopted within Rimini Airport and presented to the public.

Other information:

- electric vehicles are purchase and will put in use in February 2021

Consequently, the annual CO2 production is estimated below, considering that:

- Electric tractor - CO2 emissions are estimated at 172 g / km, on an annual basis, I assume 5,000 km, that's 860 kg.
- New Diesel Tractor - CO2 emissions are estimated at 532 g / km, on an annual basis, 5,000 km, is 2,660 kg.

Each year, the utilization of 3 diesel tractors would result in emitting about 3.6 times the greenhouse gases deriving from the electricity related to the use of 3 electric tractors (Figure 4-5). End of waste and the life cycle assessment of diesel and electric tractors were not assessed.

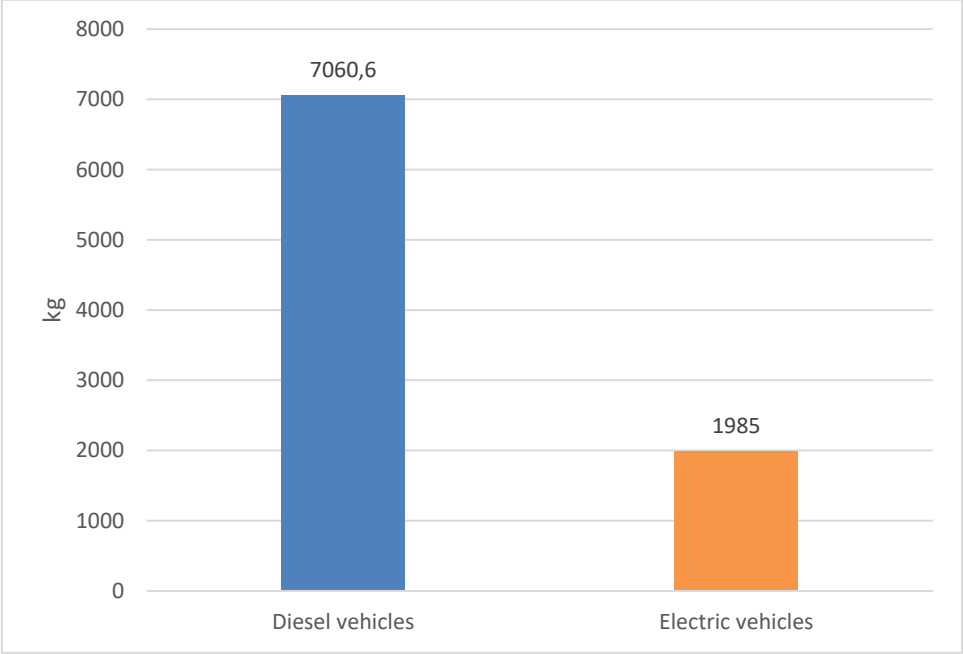

Figure 4-5. Comparison between greenhouse gases emissions deriving from diesel vehicles (CO2) and electric vehicles (CO2 eq) per year, Rimini airport

Local emissions of airborne pollutants such as NOx and particulate matter with a diameter equal or less than 10 µm (i.e., PM10) is assumed to be null for the electric vehicles. However, the emission of airborne pollutants should be considered depending on the location of production and the technology utilised for producing electricity.

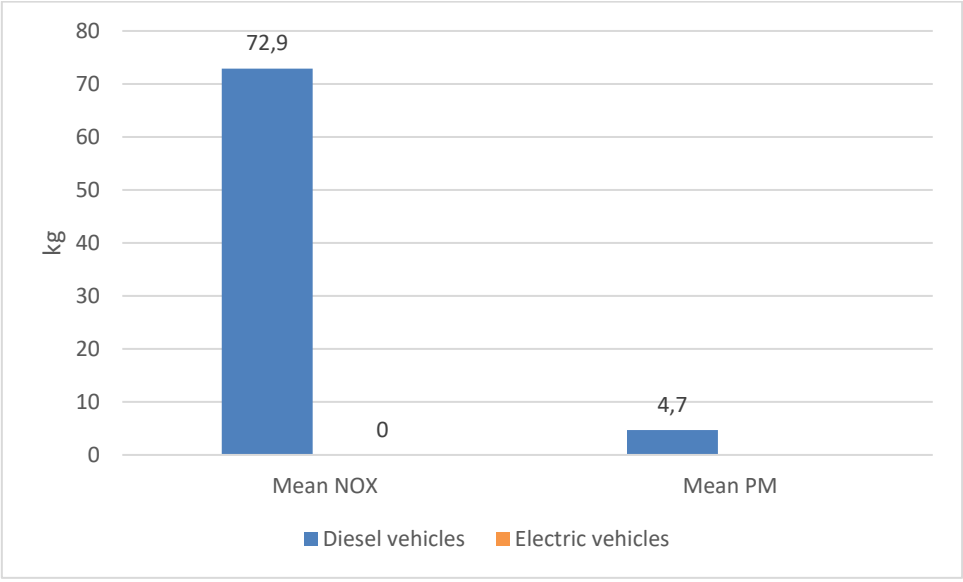

Figure 4-6. Comparison between local emissions of airborne pollutants (i.e., NOx and PM) deriving from diesel vehicles and electric vehicles per year, Rimini airport

On the contrary, utilising the diesel tractors would result in local emissions of NOx and PM. (Figure 4-6).

Abruzzo airport

Abruzzo airport pilot action implemented is in compliance to third main pilot action field identified within the project:

- ***adoption of smart solutions to improve waste & water management and to reduce energy consumption in small-medium regional Airports***

The focus of the Abruzzo airport is to reduce energy consumption and carbon emissions, the proposed intervention is

- Replacement of old diesel-fuelled ground power unit (GPU) with new electric ground power unit (GPU) for aircraft handling operations

According to the need's analysis performed, Abruzzo airport has identified the following fields for improvement in airside area:

- energy efficiency improvements within airport processes,
- cost effective optimisation of business processes,
- reduction of airborne pollutants and greenhouse gas emissions.

Purchase and implementation of the new electric ground power unit (GPU) will reduce energy consumption in performing daily processes within Abruzzo Airport airside area. Therefore, significantly lower airborne pollutant and greenhouse gas emissions are expected for the aircraft handling operations at Abruzzo airport. Moreover, this new electric equipment will be visible to the airline companies and travelers improving the dissemination of the green and sustainable policy implemented at Abruzzo Airport.

Other information:

- Electric ground power unit (GPU) was purchased in October 2021 and will be put in use in December 2021.

Results:

Replacing the use of a diesel-fuelled ground power unit with an electric ground power unit represents a solution for reducing the CO2 footprint and local airborne pollutants emissions (PM10, and NOx) during turnaround operations. Therefore, the implementation of the pilot action is expected to bring benefits to the Abruzzo Airport employees, passengers, and the local community because of reduction of local emissions of PM10, NOx and noise. Moreover, the reduction in greenhouse gas emissions (i.e., CO2) will benefit the global environment.

Each year, the utilization of the diesel-fuelled ground power unit would result in emitting about 2.8 times the greenhouse gases deriving from the electricity related to the use of the electric ground power unit at Abruzzo Airport (Figure 1).

Local emissions of airborne pollutants such as NOx and PM10 are assumed to be null for the electric ground power unit. However, the emission of airborne pollutants should be considered depending on the location of production and the technology utlised for producing electricity.

On the contrary, utilising the diesel-fuelled ground power unit would result in local emissions of NOx and PM10 (Figure 2).

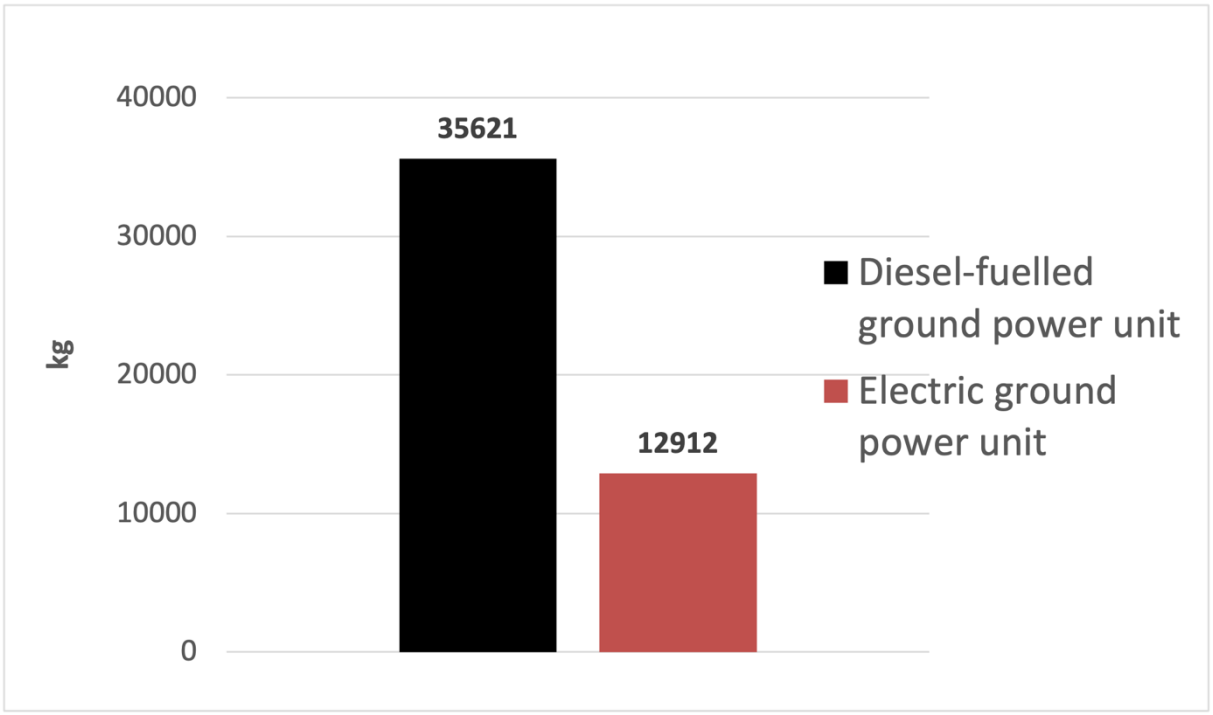

Figure 7. Comparison between greenhouse gases (CO2) emissions deriving from diesel-fuelled and electric ground power units per year.

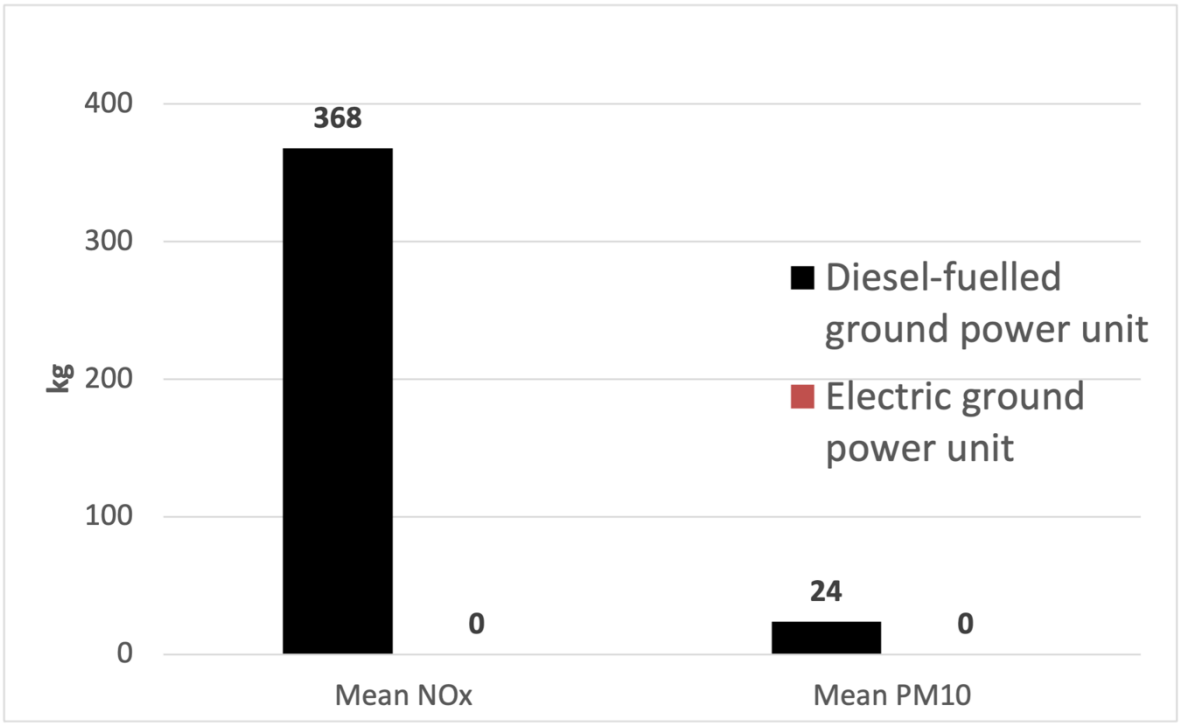

Figure 8. Comparison between local emissions of airborne pollutants (i.e., NOx and PM10) deriving from diesel-fuelled and electric ground power units per year.

4.4.2. Pilot actions for Adrigreen ports (Feasibility studies and Appraisal reports)

Ancona port

The Central Adriatic Ports Authority will implement several solutions to speed up the passengers flows from/to the port of Ancona. In particular, it complies with the second pilot action field identified by Adrigreen project :

- ***implementation of integrated timetabling and information for passengers that must continue their travel by other means of transport***

According to the needs analysis performed, the pilot action will address ferries' passengers, acting on two different levels:

- Improved connection between the ticket office "Ancona Ferries Terminal" and the ferry quays, as well as port connection with the local public transport system and railway station;
- Installation of a multimedia outdoor totem to provide passengers on-time information on the ferries and trains transiting, respectively, in Ancona port and Ancona railway station.

According to the environmental analysis realised within the technical framework provided by Marche Polytechnic University, technical partner within Adrigreen project, the pilot action implementation has

reduced the environmental impact of ports activities, optimising passengers' flows and creating benefits also for the local community.

Furthermore, Adrigreen pilot action wants to improve the accessibility and the connection between land and sea, providing dedicated signage to smooth passengers' flow and ease the interconnection between the port, the public transport system and the railway station. Installation of variable message panels The Central Adriatic Ports Authority intends to install variable message panels in a strategic area, to catch passengers embarking or disembarking in the port of Ancona. The panel is conceived to give updated on-time information on:

- The number of quays, the dedicated ferry line and the time scheduled for departure;
- The local public transport to reach the railway station;
- The trains in Ancona railway station. The panel is equipped with software able to guarantee an efficient and on-time information flow between three different sources of information (ferry related information as well as local public transport and railway ones).

Thus, ADRIGREEN pilot action will act on those passengers, increasing the use of local public transport by 10% and 20%, thus reaching between 60% and 70% on the total share. Therefore, the environmental analysis was based on two scenarios, assuming a different share of utilization of two means of transport (i.e., public transport versus local cars).

Scenarios	Before the pilot action	After the pilot action
Scenario A	50% use local public transport 50% use local cars	60% use public transport 40% use local cars
Scenario B	50% use local public transport 50% use local cars	70% use public transport 30% use local cars

The implementation of the pilot action is expected to increase the use of local public transport by travellers that embark/disembark in the port of Ancona with no vehicle, decreasing the use of local cars to reach the intermodal hubs. The avoided mileage of local cars, according to the different scenarios, can reduce CO2 emissions up to nearly 1221 kg per year (Figure 4-7).

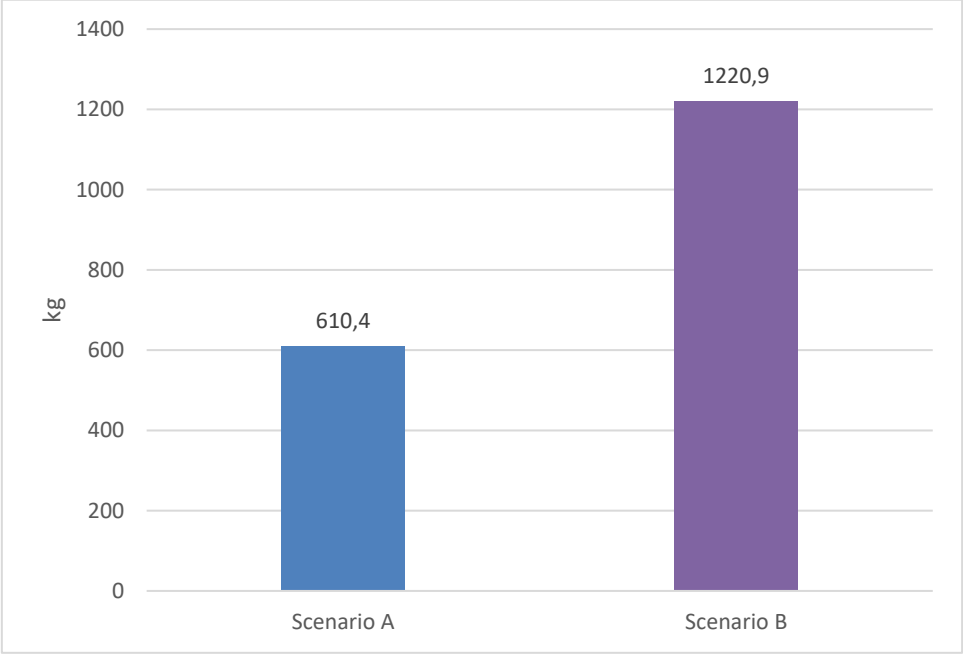

Figure 4-9. Avoided greenhouse gases emissions deriving from increasing the utilization of public transport at expenses of local cars according to the different scenarios, Ancona port

Moreover, local emissions of airborne pollutants such as NOx and particulate matter (PM) may be avoided up to about 4.2 kg NOx and 0.2 kg PM per year (Figure 4-8).

In addition, the pilot action will contribute to the reduction of traffic jams in the rush hours, thus providing further environmental benefits such as the reduction of noise pollution and a further decrease of airborne pollutants and greenhouse gases emissions.

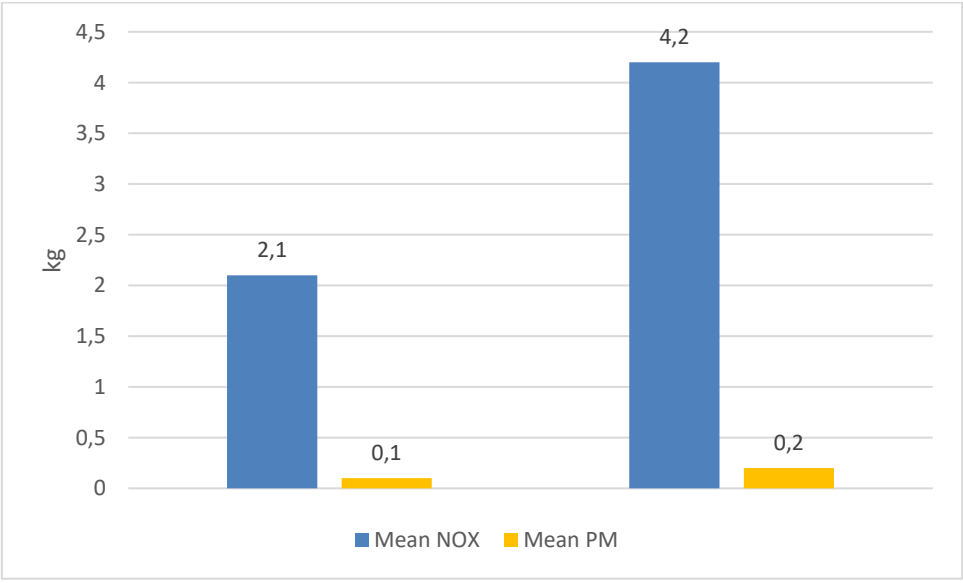

Figure 4-10. Avoided local emissions of airborne pollutants deriving from increasing the utilization of public transport at expenses of passenger cars according to the different scenarios, Ancona port

Dubrovnik port

Dubrovnik Port Authority pilot action implemented is in compliance to pilot action field identified within the project:

- **adoption of smart solutions to reduce energy consumption**

It is divided into two main areas / types of vehicles purchased:

➢ electric car (smart EQ forfour)

➢ electric moped (SUNRA- Hawk)

According to the need's analysis performed, Dubrovnik Port Authority has identified following fields for improvement in landside and airside area:

➢ energy efficiency improvements within ports processes,

➢ cost effective optimisation of business processes.

Purchase and implementation of the electric vehicle will significantly lower CO2 emission and it will reduce energy consumption in performing daily processes within Dubrovnik Port Authority. Also, since these vehicles is used on the landside area, it will be visible to the stakeholders and general public contributing to the ports green field policy and zero emission strategy.

The Dubrovnik Port Authority intends to install variable message panels to give updated on-time information. The panel will be equipped with software able to guarantee an efficient and on-time information flow between different sources of information (ferry related information as well as local public transport).

Other information:

➢ electric vehicle was purchased and put in use in August 2019.

➢ electric moped was purchased and put in use in June 2019.

➢ three electric bicycles were purchased and put in use in May 2021.

Each year, the fossil fuel vehicles emits about 10.3 times the greenhouse gases deriving from the electricity utilised by the electric vehicles (Figure 4-9). End of waste and the life cycle assement of diesel and electric vehicles were not assessed.

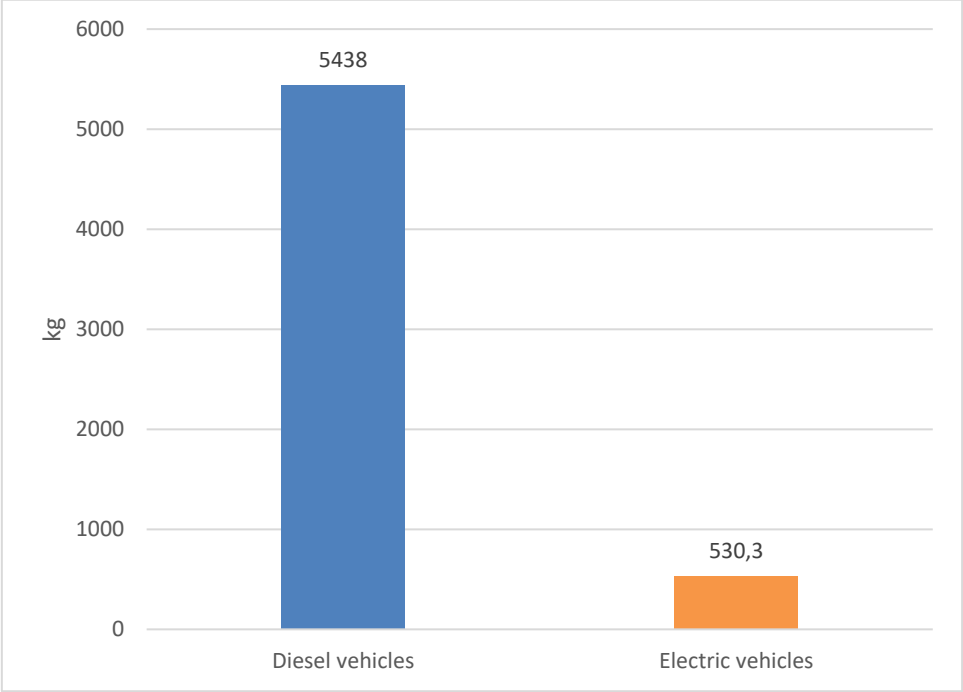

Figure 4-11. Comparison between greenhouse gases emissions deriving from diesel vehicles (CO2) and electric vehicles (CO2 eq) per year, Dubrovnik port

Local emissions of airborne pollutants such as NOx and particulate matter (PM) is assumed to be null for the electic vehicles. However, the emission of airborne pollutants should be considered depending on the location of production and the technology utlised for producing electicity.

On the contrary, utilising the fossil fuel vehicles would result in local emissions of NOx and PM (Figure 4-10).

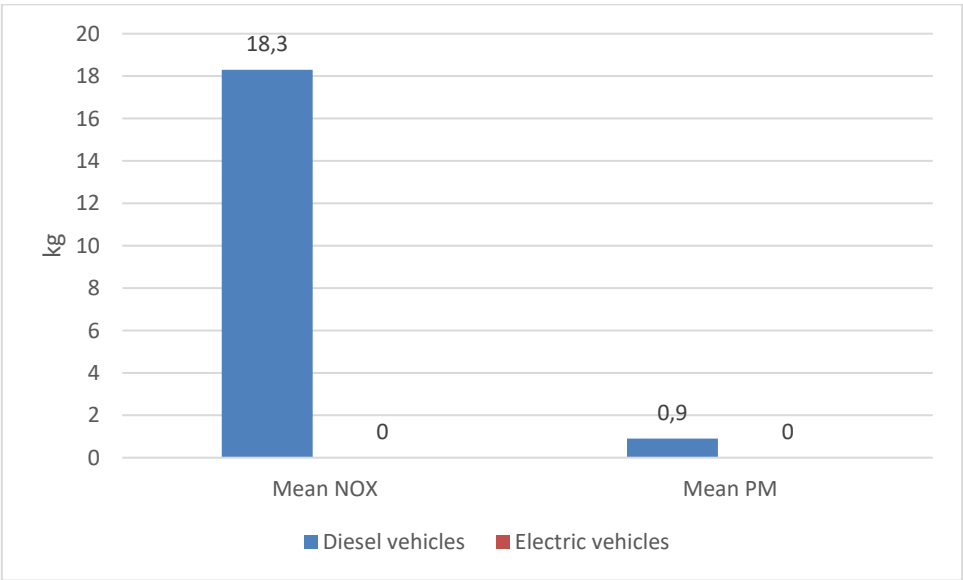

Figure 4-12. Comparison between local emissions of airborne pollutants (i.e., NOx and PM) deriving from diesel vehicles and electric vehicles per year, Dubrovnik port

Pula Port

Pula port Authority pilot action implemented is in compliance to third main pilot action field identified within the project:

- ***adoption of smart solutions to improve waste&water management and to reduce energy consumption in small ports***

It is divided into different types of vehicles purchased:

- electric cleaning machine
- electric scooters and bicycles to be used by port staff for faster and cleaner service offering

According to the need's analysis performed, Pula port Authority has identified following fields for improvement in landside and airside area:

- energy efficiency improvements within port processes,
- cost effective optimisation of business processes.

The purchase and application of an electric vehicle for cleaning the stone part of the coastal wall and pier, and the purchase of electric bicycles and scooters will reduce CO2 emissions and will reduce fuel consumption and regular maintenance costs that have been outsourced so far area. The cleaning machine, electric bicycles and scooters will be visible to stakeholders and the general public and will contribute to sustainable environmental policy, awareness and reduction of greenhouse gas emissions.

Pula port Authority has performed financial analysis of equipment purchased and used. In conducting financial analysis following assumptions were taken into the consideration:

- purchase price of new cleaning machine and costs of maintenance,
- The current cost of maintaining and cleaning the coast

Other information:

- electric machine was purchased and put in use 16.07.2020.
- electric scooters and bicycles were purchased and put in use:

Other information:

- electric machine was purchased and put in use 16.07.2020.
- electric scooters and bicycles were purchased and put in use:

E CITY APOLO - 1.04.2021.

2 * MS ENERGY E-BIKE - 30.04.2021.

2 * MS ENERGY E20 - 26.03.2021.

Each year, the diesel vehicles (passenger cars, and street sweeper) emit about 16.8 times the greenhouse gases deriving from the electricity utilised by the electric vehicles (e-street sweeper, e-bicycles and e-scooters) (Figure 4-11).

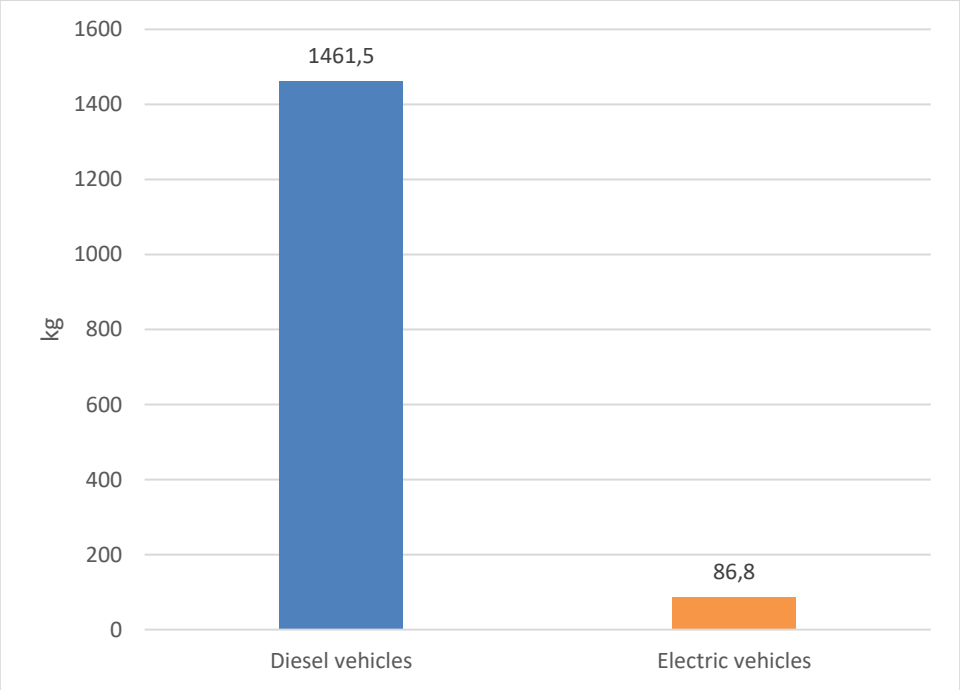

Figure 4-13. Comparison between greenhouse gases emissions deriving from the usage of diesel vehicles (i.e., cars and street sweeper) (CO2) and electric vehicles (e-street sweeper,e-bicycles and e-scooters) (CO2 eq) per year, Pula port

Moreover, local emissions of airborne pollutants such as NOx and particulate matter (PM) may be avoided up to about 4.2 kg NOx and 0.2 kg PM per year (Figure 4-12).

In addition, the pilot action will contribute to the reduction of traffic jams in the rush hours, thus providing further environmental benefits such as the reduction of noise pollution and a further decrease of airborne pollutants and greenhouse gases emissions.

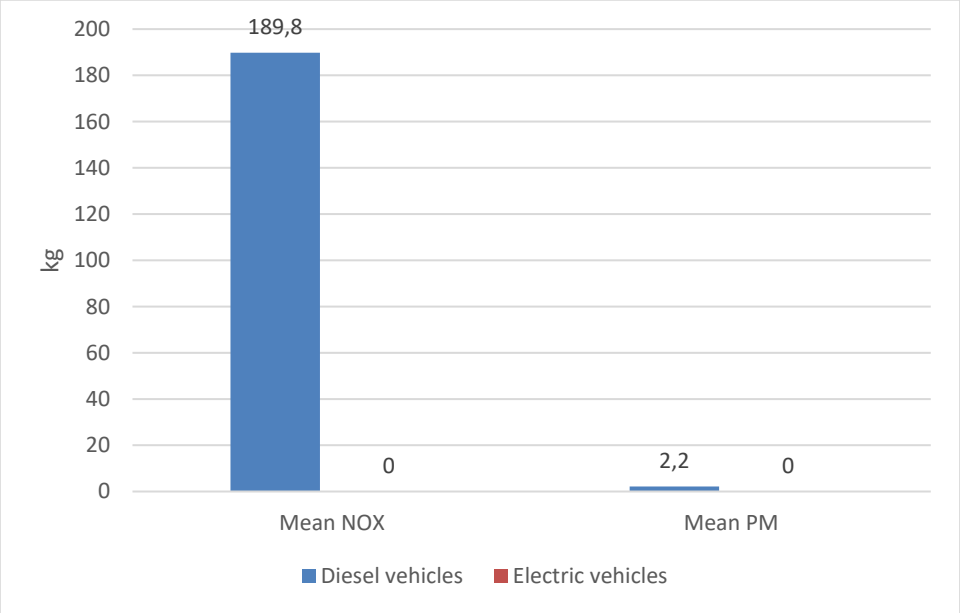

Figure 4-14. Avoided local emissions of airborne pollutants deriving from increasing the utilization of public transport at expenses of passenger cars according to the different scenarios

4.5. Optimization of Multimodal Transportation Approaches and related changes in airborne pollutants and greenhouse gases emissions: news scenarios deriving from SARS- Covid-2 pandemic and possible effects within Adrigreen project for ports and airports

5. Scenarios

5.1. The case of Pula Airport

Pula is the largest city in Istria County, Croatia and the eighth largest city in Croatia, situated at the southern tip of the Istria peninsula.

The Region of Istria has many completive advantages as a location. In fact, Pula is a cruise port that has a very good road connection to the railway station; not to mention that the airport is situated in a close proximity. The creation of new infrastructures with a view on cruise tourism growth, is an issue of great interest nowadays in Pula. Nevertheless, intermodality is in need of organization, expansion and further development, since there is no taxi or bus station near the port. Thus, the total lack of public/ private transportation solutions is making it difficult for passengers to move from port to airport and to other destinations as well. There is a need for the creation and development for certain solutions such as taxi station in the area, or the introduction of public transportation of a bus/coach, which in turn could also enhance the opportunities for employment supporting the local economy.

5.2. The case of Pula Port Authority

Pula port Authority is located in Istria County. The main transport branch is road transport, which has developed a lot in the last 20 years. The existence of the Airport contributes the most to passenger traffic. Istria County is currently a car destination, but in recent years (before the COVID-19 pandemic) air traffic has become more prevalent.

The Port is situated near the city center and there is equipped gate, logistic and hospitality but the weakness is that the port is regional, non-governmental. The port is protected of weather inconvenience and is very close to the national park “Brijuni Islands”. Port and Airport are in short distance (6 km). However, there is a small budget that is inadequate for rapid development and expansion of the port. There is a very good road connection of the port which is also near to the railway station. Rail traffic is very poorly represented.

The port of Pula is not adapted to ferries or large cruisers, and the share of passenger traffic by ships is low. Sea traffic is represented in the summer months when small boats, yachts, sailboats, tourist and excursion boats sail.

The opportunities are the development of cruise terminal close to the City of Pula with the implementation of Cruise and Fly system. New part of the port is almost constructed with the possibility to develop ferry transport with the ability of very big incoming tourism potential (tour operator cooperation) outside the High season

In the last 10 years, the Port of Pula Authority has built approximately 500 m of coastal wall intended for the needs of the users it currently serves. It has developed the possibility of uninterrupted traffic of passenger ships, fishing boats, cargo ships, tourist ships, small yachts, etc. The forthcoming development of the Port Authority brings the construction of passenger terminals, cruisers and ferries. As only the initial soil testing was performed in order to design and plan the construction of the future terminal, there are all the prerequisites for it to be operated according to ecological principles and to receive ships that are adapted to it. Sustainability is one of the basic provisions that the Port of Pula

Authority has focused on. In addition to environmental development and port planning, the local community needs to adapt in smart waste management and the promotion and increased representation of electric vehicle traffic. With these intentions, it could be the first such terminal in the eastern part of Europe.

There are other emerging environmental challenges that were identified in recent years. Such new challenges are mostly due to the increase of traffic and the introduction of new infrastructure. The additional manoeuvring areas, buildings and facilities need to be integrated in existing systems and exploited in efficient way with lesser possible negative environmental effects.

5.3. The case of Rimini Airport

The Rimini Airport experienced continuous growth in last years. In the last four years (2015 – 2019) Rimini Airport recorded a constant increase of yearly passenger turnover with average growth of 13% per year. Rimini and San Marino International Airport "Federico Fellini" is totally privately managed by AIRiminum 2014 S.p.A., since April 1, 2015. The 30 year-concession has been declared by Italian Government decree, signed on January, 2018. The concession lasts until 2048. The City of Rimini is located on the Adriatic Sea in the Emilia-Romagna region of northern Italy. It is in the centre of a more than 50 km long coast section with sandy beaches which stretches between the cities of Ravenna and Cattolica. Rimini has nearly 150,000 inhabitants (225,000 in the greater urban area) and is one of the major seaside resorts and holiday destinations in Europe. With more than 1000 hotels the population of the city can rise above 1,000,000 during the main holiday season during summer. Besides tourism, which is the main driver for the local economy, Rimini has an important trade fair and conference centre attracting 60,000 – 80,000 visitors per year and the region is the home of several industries especially from the clothing and automobile sector. Rimini is also very close to the independent Republic of San Marino with its important banking and tourism sector (22 km distance). Rimini is directly connected via the A 14 (E 45) motorway to the cities of Bologna, Milan, Verona and Venice in the north as well as Ancona, Pescara and Bari in the south. Rimini is also a major junction of the national and regional railway network and it is one of the main stations of the Adriatic railway. Rimini Station also is a junction of the railroad lines Bologna-Ancona and Ferrara-Ravenna-Rimini, and trains of all categories stop there. The station has long-distance connections to Rome and Milan and there are ongoing activities to upgrade the railway line to Bologna to a top-speed of 250 km/h, which would considerably shorten the travel times to Bologna and Milan. The region's economy is mostly based on tourism. Therefore, the traffic in Rimini airport is mostly international traffic, including various destinations worldwide, especially during the summer season. As pointed out, the Rimini Airport had rapid traffic growth in last years that has introduced airport to new environmental challenges, such as increase of air pollutions and integration of environmental protective measures. Such challenges are mostly elaborated and mitigated through airport major infrastructure projects such as DAD. Also, Airport highly invest in partnership with the port and other stakeholders in order 9 to coordinate and collaborate on environmental issues, which result from the increase of traffic and tourist demand, and to mitigate negative effects of increasing airport traffic. There are other emerging environmental challenges that were identified in recent years. The future evolution of airport will introduce new challenges, mostly due to the increase of traffic and the implementation of new airport infrastructure. Buildings and facilities need to be project in efficient way, with lesser negative environmental effects. In order to cope with new environmental challenges, Rimini Airport has planned to increase the level of environmental

performance at the airport through number of dedicated projects, as photovoltaic solutions, electrical vehicles and led panels, to decrease carbon footprint of airport.

5.4. The case of Pescara "Abruzzo" Airport

SAGA, an acronym for the Abruzzo Airport Management Company, was commissioned in 1981 with the task of managing the Abruzzo airport 99.99% of the shareholder structure is made up of public bodies. The participation of the Abruzzo Region in the share capital of Thesaga is almost totalitarian, only a symbolic share is held by the company consulting S.R.L.S.The Ministry of Transport, in concert with the Ministry of Economy and Finance, on June 14, 2007 entrusted the company with the thirty year concession, according to the terms indicated in the Convention stipulated with ENAC, for the planning, the development, the realization, the adjustment, management, maintenance and use of the systems and airport infrastructure. The presence in the territory of a properly sized and interconnected airport is able to produce a significant benefit in terms of development of the Abruzzo Brand, growth of added value and employment in the Region. In fact, the presence of efficient air connections allow a greater integration of Abruzzo businesses with the main international trade markets and promote the development of tourism demand. The policy indicates the priority objectives for the development of international traffic and in particular the incoming segment also through the leverage of charter carriers and criteria for the evaluation of offers by the carriers. Abruzzo Airport's main objective is to stimulate the development of air traffic by encouraging carriers to operate new routes and upgrade existing ones, in order to implement a continuous development of the airport and to promote economic growth of the Region of Abruzzo. Abruzzo is located in central Italy and stretches from the heart of the Apennines to the Adriatic Sea, on a mostly mountainous and wild terrain. In the mountains, tourist resorts and well-equipped facilities for skiing and winter sports rise among unpolluted peaks and rocky walls: among them are Pescasseroli, Rivisondoli and Roccaraso. The natural landscape of the high and steep peaks of the Gran Sasso, Laga Mountains, and Mount Majella slopes down to a wide range of hills, until it finally reaches the Adriatic coast. The route that spans from the Gran Sasso down to the sea crosses territories that are rich in history, traditions and art that never cease to surprise visitors. Narrow valleys and impressive, natural paths thrust their way into the mountains and hills, as does the amazing and fascinating Aterno Valley, crawling with ancient villages. Natural reserves, like the National Park of Abruzzo, the Park of Gran Sasso and the Laga Mountains, or that of Mount Majella, protect the typical vegetable and animal species of the area, including the golden eagle, the wolf and the Marsican brown bear. The Adriatic coast is characterized by long and sandy beaches to the north and pebbly beaches to the south. Also, the small villages of the hinterland, as well as the monasteries and castles of the region, are very charming and part of many touristic routes in this the "greenest region" in Italy. The provinces of the region are: L'Aquila (regional capital), Pescara, Teramo and Chieti. The main benefit for Abruzzo Airport will be to identify a set of innovative solutions for lowering airport environmental impact and for better connection of the airport with city centre of Pescara and with rail station and the port terminal. The testing action will improve the current situation and lay the ground for further investments and activities coherent with Airport multiannual strategy. The project will also strengthen the collaboration with local private and public companies and stakeholders such us public transportation companies, tourist operators and private transportation companies. In addition, the training activities will significantly improve the knowledge of employees in relations to technological solutions and procedures for more sustainable management of the airport facility The Airport of Abruzzo is not using any electrical devises and this is causing considerable air pollution. It has been proved that Electrical Ground Power

Unit could considerably improve the environmental performances of the airport. This is just the first step for Pescara Airport to increase the level of environmental performance at the airport through number of dedicated projects, as photovoltaic solutions, electrical vehicles and led panels, to decrease carbon footprint of airport. The Adrigreen Project represents a unique opportunity for Pescara Airport to continue its development toward an environmentally friendly airport.

The Pescara airport, from the project aims to obtain a greener footprint of an airport under development that is important for the region. This can be considered as the first step towards a sustainable development for the environment, without neglecting the important economic developments that green solutions can propose.

5.5. The case of Airport of Apulia

Brindisi Airport had rapid traffic growth in last years that has introduced airport to new environmental challenges, such as increase of air pollutions and integration of environmental protective measures. These challenges will mostly be worked out and mitigated through large infrastructure projects connecting with the airport. One of the various projects has a total cost of 112 million euros with resources of 60 million euros borne by the Development and Cohesion Fund; the completion of the financial coverage is envisaged as part of the Recovery Plan. A project was presented for the construction of a single track line between Brindisi Station and the Airport, with 2 bridges, one towards Taranto / Bari, the other towards Brindisi / Lecce in order to potentially allow rail services from all the main Apulian towns. The construction of a new airport service station with 2 tracks is planned. Once the final design has been completed, the authorization process is starting. The new link is expected to be completed by 2025.

To cope with the new environmental challenges, Brindisi airport therefore plans to increase the level of multimodality / intermodality and the environmental performance of the airport through a series of dedicated projects.

Brindisi Airport is especially interested in improving and integrating communication and transport between units, and in opportunities to implement new innovative technologies according to the latest environmental and sustainable development principles.

5.6. The case of Dubrovnik Airport

Dubrovnik Airport had rapid traffic growth in last years that has introduced airport to new environmental challenges, such as increase of air pollutions and integration of environmental protective measures. Such challenges are mostly elaborated and mitigated through airport major infrastructure projects such as Dubrovnik Airport Development project (DAD). Also, Airport highly invest in partnership with the Dubrovnik Port and other stakeholders in order to coordinate and collaborate on environmental issues, which result from the increase of traffic and tourist demand, and to mitigate negative effects of increasing airport traffic.

In order to cope with new environmental challenges, Dubrovnik Airport has planned to increase the level of multimodality/intermodality and environmental performance at the airport through number of dedicated projects. With the completion of DAD project in Spring 2020, the airport is facing significant challenge how to effectively integrate new infrastructure in existing systems. The introduction of new facilities has dislocated number of airport organizational units due to safety and performance needs.

Now the internal communication and transport between those units is representing organizational and environmental challenges. Such needs should be met with environmental-friendly solutions taking into the account specifics of airport technology and operations.

5.7. The case of Dubrovnik Port Authority

The Port of Dubrovnik is categorized as a passenger port open to public traffic, it is one of the six ports of international economic interest for the Republic of Croatia. The management of this port is directly the responsibility of the Ministry of the Sea, Transport and Infrastructure, the Maritime Transport Administration, the Maritime Property and the Port. Due to the presence of certain types of traffic, the port of Dubrovnik stands out among the ports in the Croatian part of the Adriatic with its orientation to cruiser traffic. In the last decade Dubrovnik has become a significant cruise ship destination in Adriatic Sea, namely the second one after Venice. The connectivity between Airport and Port is of major interest from environmental and industrial point of view. Also, it is important to highlight that there is only one route (a national road) between the Airport and the Port. This represents a significant infrastructural challenge to overcome, especially during tourist season. Dubrovnik Airport is in close relation with Dubrovnik Port, to monitor and organize transfers between the airport and port, and the are also collaborating on a number of projects. Such projects range from dedicated business projects such as Home Port for cruise ships, to more public ones such as projects supported by EU founding.

There are other emerging environmental challenges that were identified in recent years. Such new challenges are mostly due to the increase of traffic and the introduction of new port infrastructure. The additional manoeuvring areas, buildings and facilities need to be integrated in existing systems and exploited in efficient way with lesser possible negative environmental effects. In order to cope with new environmental challenges, Dubrovnik Port Authority has planned to increase the level of multimodality/ intermodality and environmental performance at the airport through number of dedicated projects.

5.8. The case of Central Adriatic Ports Authority

The Central Adriatic Ports Authority is one of the 16 Italian Ports Authority established by the Italian law 84/1994, as updated by the Italian Legislative Decree 169/2016 and subsequent amendments and additions, which identifies the competence of the Central Adriatic Ports Authority on the ports of Pesaro, Falconara Marittima, Ancona, San Benedetto del Tronto, Pescara e Ortona, located in Marche and Abruzzo regions.

The port of Ancona is the main port of the Central Adriatic Network and core port of the SCAN-MED and Baltic-Adriatic Corridors, a crucial north-south axis for the European economy within the TEN-T network.

In addition to significant freight traffic, the port of Ancona is as a strategic reference point in the Adriatic for all passengers who intend to reach the Balkans and the South-Eastern Mediterranean, in line with the historic vocation of the port as a " Gateway to the East".

Thanks also to its privileged geographical position and competitive transit time to Balkan countries and Greece, the port of Ancona holds nearly 19% on the international ferry passengers flows of the Italian ports. Due to recent road infrastructure improvements, the catchment area of the port of Ancona has increased, as well as its connections to the Italian Western coast.

Indeed, the Doric port is connected during the whole year with Croatia, Albania and Greece, thanks to regular ferry services allowing the transport of goods and passengers.

Some data are provided below:

- Daily departures for Greece (Igoumenitsa-Patras): three companies operating two services (1-2 departures/day)
- Main Italian port on the Italy-Croatia ferry traffic (Split and Zadar in the summer season. Two companies in the summer season operating two services on the Ancona-Split line);
- Regular line to Durres (Albania).

The Adriatic shores are an increasingly popular destination for tourists, also due to the significant historical and cultural heritage surrounding their ports. However, the trend of the tourist flow is not homogeneous during the year, but has peaks during the summer season, creating congestions on city traffic and the infrastructures involved. Thus, the Central Adriatic Ports Authority decided to focus on new services for passengers transiting to the port of Ancona.
In particular, the Central Adriatic Ports Authority decided to create and test an integrated system containing timetables and information for passengers who must continue their journey with other means of transport.

6. Discussion

The utilization of ICT technologies in efficient intermodal planning has proven to be one of the major steps towards a successful intermodal model (Hong et al., 2018). Indeed, along with the cooperation on a multilevel basis have shown beyond doubt that these two factors can contribute in decreasing transport costs and time and improving the quality of passengers' experience. The combination of setting an observatory consortium including monitoring and operating the whole system with the support of new technologically advanced methods in transportation management systems constitute the two main axes for defining the strategies, methods, patterns and action plans of the manual of ADRIGREEN project. The major indications of this study have showed that environmental motivation plays a crucial role in adopting efficient intermodal transportations for ports and airports in several cases. Additionally, intermediate and preliminary intermodal concepts do exist in some of the organizations and are set in function mainly when there is an urgent need to assist the passengers and meet their several needs; a matter which underlines that the existing network struggles to achieve intramodality patterns as a reflex, when certain problems occur connected with increased numbers of passengers. Whereas, if successful planning is the goal then institutional, managerial and operational improvements are to be implemented based on synergies and strong cooperation. Not to mention that the engagement of the public services is definitely classified under the key factors of successful planning. In fact there is a need to combine transportation needs with the provided public means of transport in all of the cases examined, as the use of individual cars for airport-port routes undoubtedly aggravates the traffic problems accompanied with all the negative effects of bottlenecks, traffic jams, which in turn lead to time and money consuming situations, increasing the passengers' stress and leading to a bad travel experience. In a future study, it is recommended that the visitors' views and attitudes should be examined so as to acquire a better view of their needs and effectively plan the possible collaboration and synergies in tailor made intermodal patterns connecting the participating ports and airports of Croatia and Italy.

7. Overview of airports and ports in Adriatic Regia (Venice, Trieste, Rijeka, Zara, Split)

7.1. Venice

7.1.1. Venice Port

The North Adriatic Sea port system, constituted by Venice and Chioggia, boasts a strategic position at the top of the Adriatic Sea, crossed by 2 European Transport Corridors - the Mediterranean and the Baltic-Adriatic – besides being the MoS terminal of the East Mediterranean Sea connecting Central Europe to Africa and Middle East and representing the river pipe crossing the Po valley allowing sea-river intermodality and balanced transport of cargo on barges.

The Veneto port system counts on its natural multipurpose vocation, as an aspect which is particularly strong and extremely relevant in the Port of Venice; indeed, no branch prevails as a preponderant one in a multifunctional port: on the contrary, different supply chains and sectors are equally balanced.

The Port of Venice in particular operates and relates with different supply chains (agribusiness, steel products, chemical industry, energy) besides commercial and tourism branches encompassing not only the regional but the whole North of Italy area. In addition, the fishing supply chain is also part of the port system, thanks to well-known role played by the Port of Chioggia.

In terms of flows and relations, the Port System impacts on the regional entrepreneurial fabric and in general terms on the entire North East area.

7.1.2. Venice airport

Venice International Airport, also called Venice Marco Polo Airport, carries the international codes of VCE (IATA) and LIPZ (ICAO). The airport is located at Viale Galileo Galilei 30, 30173 Venezia VE and lies at an elevated position of 2 meters above sea level. VCE is located on the mainland, ca 8 km or 4.9 miles from the city of Venice. In 2018 Venice Airport handled 11,184,608 passengers, which made it Italy's fourth busiest airport. Venice Airport serves as a hub for EasyJet and Volotea budget airlines. From Venice Airport passengers can travel to Amsterdam and Brussels, Dublin and Dubai, Moscow and Montreal, Paris, Munich and Vienna and many more.

Passengers can get to and from Venice International Airport by rail and road. Venice Mestre station is linked to the airport, and also to the bus terminal at Piazzale Roma. Scheduled buses travel to the bus terminal and there is also a water shuttle, the Alilaguna water shuttle, which offers various destinations in Venice through its Red, Blue and Orange lines. Busitalia Sita Nord also provides bus services from the airport into central Venice.

7.2. Trieste

7.2. 1. Port of Trieste

Located in the heart of Europe, at the intersection between shipping routes and the Baltic-Adriatic and Mediterranean TEN-T core network corridors, the Port of Trieste is an international hub for overland and sea trade with the dynamic market of Central and Eastern Europe.

The intensification of trade and maritime traffic between the Far East and Europe and the eastward enlargement of the European Union have revived the importance of the Upper Adriatic, opening up new

growth and development opportunities for Trieste. In this context, Trieste plays a decisive role in two separate supply chains: long-distance intercontinental maritime transportation and short/medium-distance intra-Mediterranean trade. The convergence of the TEN-T strategic axes of the "East Mediterranean Motorways of the Sea" with the Baltic-Adriatic and Mediterranean Corridors is resulting in the growth of intermodal services and the development of innovative solutions in the field of logistics and transportation.

Trieste is the terminus of regular direct ocean transportation services provided by the world's main shipping lines to China, the Far East, Singapore and Malaysia, with stops in several other ports in the Mediterranean Basin (Albania, Slovenia, Croatia, Greece, Turkey, Egypt, Lebanon, Israel, etc.).

More than 400 trains a month link Trieste to the manufacturing and industrial areas of North-East Italy and Central Europe, with different destinations, such as Germany, Austria, Czech Republic, Hungary, Switzerland and Luxembourg, to serve a developing and highly organised economic hinterland. To reach the target markets in Central and Eastern Europe, highly specialised intermodal services have been developed, using direct trains organised by the company Alpe Adria S.p.A., a multi-client operator, which offers all-inclusive packages with guaranteed delivery and frequency.

The Port of Trieste has an internal rail network (70 km of track) that connects with the national and international network and allows all the docks to be served by rail with the possibility of shunting and/or assembling freight trains directly in the various terminals; a direct junction and a flyover (within the Port) connect to the outside road system, which leads directly to the motorway network, ensuring ease of access to the national road network built with the Best of Machinery.

Deep water up to 18 metres, great ease of access for shipping, excellent road and rail links and proximity to markets, make the Port of Trieste an efficient and competitive destination. Trieste, a natural crossroads between East and West, intends to be Europe's preferred point of access to the markets of the Far East. In fact, the Port of Trieste can offer a saving of five days sailing on routes between Europe and East Asia, compared with North European ports. For a fleet of 6,000 TEU container vessels this translates into a saving of over USD 25 million a year in freight and fuel costs.

7.2.2. Airport of Trieste

Trieste – Friuli Venezia Giulia is an international airport located 0.3 NM (0.56 km; 0.35 mi) west of Ronchi dei Legionari (Province of Gorizia),[near Trieste in Venezia Giulia, north-eastern Italy. The airport has a catchment area of approximately 5 million people, stretching beyond Friuli-Venezia Giulia into Slovenia, Austria and Croatia. The airport is connected to the national railway and highway networks thanks to the Intermodal Transit Hub completed in March 2018, serving as an air-road-rail interchange. In recent years the airport has witnessed growth in low-cost and cargo traffic.

7.1. Rijeka

7.1.1. Port of Rijeka

Most of the port area is intended for freight traffic, while a smaller part is within the Rijeka basin and Sušak intended for passenger traffic. The passenger terminal (Figure 4) is located in front of the city center on the very root of the Rijeka breakwater. Larger passenger and ro-ro can be moored at the

passenger terminal passenger ships at depths of 7.0 meters. Part of the passenger terminal is also intended for mooring very fast passenger ships (HSC ships).

Since 2012, Rijeka has started to develop cruising tourism more intensively, which is a new challenge in organization of all activities related to the flow of passengers / goods related to cruising. There is no adequate terminal with supporting infrastructure intended for cruiser docking, however mooring cruisers are enabled at two locations, both with certain restrictions. One location is located in passenger part of the Rijeka basin on the inside of the Rijeka breakwater, while the other is located in the pool Sušak at the Brajdica container terminal.

The Brajdica container terminal is intended for reloading and storage of containers, ro-ro trailers and other vehicles and handling heavy parcels and stone blocks. The total length of the coast is 628 m, with a maximum depth of 13.5 m and the possibility of simultaneously accepting the two largest container vessels367 meters long. The land area is 110,000 m2. The Brajdica container terminal is also used for reception cruise ships in case their draft is greater than 7 meters. The container terminal can accept cruisers of all sizes.

7.1.2. Airport of Rijeka

Rijeka airport is located on important location in the heart of Europe:

- 3 million people within only 120 min drive from the airport

- 60 min drive to Pula and Trieste

- 90 min drive to Zagreb and Ljubljana

- 120 min drive to Venice and Zadar

- 180 min drive to Graz and Split

The general objectives of the Rijeka Airport are:

- Increase of aircraft, passengers and cargo traffic
- Quality of service
- Development of infrastructure
- Safety and security of air traffic
- Employee education
- Environmental protection

The specific objectives of the Rijeka Airport operations in the forthcoming period are:

- Transformation of Rijeka Airport into the airport available to all air transport users H24 throughout the whole year, with constant connectivity with other types of transport and network of airports in the world.
- Integration into the international air traffic system, respecting all restrictions given the specific international border crossing.
- Integration into the domestic air traffic system through a PSO model with a volume of at least 700 flights a year.

- Integrating as one of the development drivers in the County traffic direction.
- Securing the position for development of the Rijeka Airport through integration into spatial plans and strategic programs at the local, county and state levels.
- Ensuring the continuous maintenance and development of infrastructure, equipment and knowledge in order to ensure rigorous minimum quality of functioning of the same in front of the Croatian Civil Aviation Agency and the European Aviation Safety Agency.
- Ensuring continuous growth of traffic (increasing number of air carriers, increasing number of destinations, increasing number of rotations) and sustainable development of the Airport while respecting the environmental impact.
- Conducting a company's business with the care of a good businessman for safe, efficient and regular customer service.
- Rationalization of the Company's operations through personnel reorganization and retraining, additional education and training for work in multiple jobs of the same complexity of the business.

7.2. Zara

7.2.1. Zara port

The port of Zadar is at a distance of approx. 3.5 km from the historical nucleus of the City of Zadar in southeastern direction. A fast road connects the port directly to highway A1 and the nearby airport as well as state road D8 connection with the City of Zadar and its city traffic network. There is also a railway track between the port and the city (there is no infrastructure for passenger reception in the port). It was closed to traffic in mid-2014 and it is foreseen for the route to be arranged as a new cycling trail tower the inner-city center. It is possible to reach the city on foot from the port following the attractive walkway by the sea or the sidewalk that follows the state road. There is a taxi and PT station the port area. The most frequent means of transport of cruising tourists . With the construction of Zadar passenger port Gaženica with all the inner roads, terminal buildings and car lots conditions have been acquired for passenger and car embarking and disembarking according to the following capacities:

- 7 ferryboats on local lines length 50-150 meters in length;
- 2 ships of international navigation 150-200 meters in length;
- 3 ships on cruising trips 200-350 meters in length as well as the possibility of accommodating RO-RO ships on the same moles.

The port of Zadar is connected with the inner-city centre by the following modalities: public bus transport –PT, taxi, shuttle buses, pedestrian zone, while the introduction of bicycles is in process. Considering the specific and international character of cruising tourists (reception in the limited traffic zone), the most frequent form of their transport between the terminal and their destination is represented by shuttle buses managed by concessionaires (concession granted by the Zadar Port Authority). In leaving the international terminal, it has been made possible for cruising tourists to use all modalities but it is necessary to emphasize that the city public transport timetable is not adapted to the arrival /departure of cruiser ships but completely subject to the timetable of local

ferry lines connecting the nearby islands with Zadar. Due to this, shuttle buses represent the primary means of cruising tourist transport to the inner-city center. Taxi transport(located outside of the international terminal) is mostly used by the crew members due to the speed and easy accessibility to most destinations. The main vision is to focus on establishing a sustainable transport system for the future between the Port and the City of Zadar based on synergic effects of three objectives: state-of-the-art analysis, decreasing shuttle bus/PT vehicle emissions, altogether making a plausible reduction of inner city traffic congestions, especially during the summer/tourist season

7.4.2. Zara airport

Zara airport is the largest aviation center in Croatia. Due to its two runways (in vertical relationships) it is able to accept aircraft regardless of weather conditions. Specializes in the reception and maintenance of firefighting aircraft (Canadaira and Air tractors) which is also the home port. At the same time, the base of the Croatian Air Force is authorized for the education and training of professional pilots. It is equipped with the following equipment: Mi-8, Mi-17, OH-58D, AT-802, CL-415, PC-9, Zlin 242, Bell-206B-3. Lufthansa's InterCockpit flight school also operates within Zadar Airport.

Zadar Airport is an important factor in connecting northern Dalmatia and Lika with other parts of Croatia and the world, and an important factor for the Croatian Air Force.

Due to the establishment of new airlines at the beginning of 2007, the passenger terminal building was additionally expanded, which enabled Zadar Airport to accommodate a much larger number of passengers. Since 2008, it has owned a VIP terminal, making it a favourite airport for wealthy guests who visit Croatia anonymously on private jets.

7.5. Split

7.5.1. Split port

The port of Split is located in the central Adriatic and is the largest port in Dalmatia. Due to the deep indentation into the island area, access to the port is provided by coastal or inland access waterways through the Drvenički, Šoltanski, and Brački channel and the Split Gate.

As of 2017, the port ranks as the largest passenger port in Croatia, the largest passenger port in the Adriatic, and the 11th largest port in the Mediterranean, with annual passenger volume of approximately 5 million. By 2010, the Port of Split recorded 18,000 ship arrivals each year. The port is managed by the Port of Split Authority . In the late 2000s, the PSA and the port operators, Ferry Port Split ltd. and Luka Split ltd, started to implement an investment plan aimed at increasing both passenger and cargo traffic volume, scheduled to be completed by 2015, which would allow the port to handle up to 7 million passengers per year.

The Port of Split - handles yachts, fishing vessels, passenger ships, navigation safety craft, sailing ships, tugboats, seaplanes and ferries; contains a passenger terminal and a rail link, 28 berths and accommodates vessels up to 250 meters (820 feet) long with draught up to 7.9 meters (26 feet)

In recent times, the city port has been expanding, new specialized freight terminals have been built, and passenger traffic has been separated from freight traffic. Thus, the southern part of the port of

Split along the city center is used for passenger traffic, while freight traffic is redirected to the industrial zone, the northern part of the Port - Vranjičko-Solinski basin and Kaštela basins.

7.5.2. Split airport

Split Airport, known as Resnik Airport, was founded in 1966 and is one of nine airports in Croatia. It is 25 km away from the second largest city in Croatia, Split, in the area of Resnik.

Despite the fact that this airport is not the largest in Croatia, it boasts the highest traffic. According to official data, the number of passengers passing through this airport is growing every year, and by the end of 2019, Split Airport has reached 3.3 million passengers.

Due to the constant growth in the number of tourists in the area of Split and the Split-Dalmatia County, a new passenger terminal was opened in July 2019, which makes this airport the most modern in Croatia. With this project, the airport's capacity has been expanded to 4 million passengers a year. At the same time, during July 2019, the largest passenger traffic was recorded - over 700,000 passengers, which is also the largest number of passengers recorded in one month in the last seven years.

7.6. Geographical area features

Airports and ports of Venice, Trieste, Rijeka, Zadar and Split are like the airpots and ports of this project, are in the Adriatic coastal which is dealing with a very high number of passengers during the summer months, in the peak season. Most of the people are reaching tih area by car, but also there is noticable increase in transport ferries and airplanes. Although there is a network of roads, railways and shipping lines they are not co-ordinated at an enviable level, which leads to traffic congestion problems during the peak season.

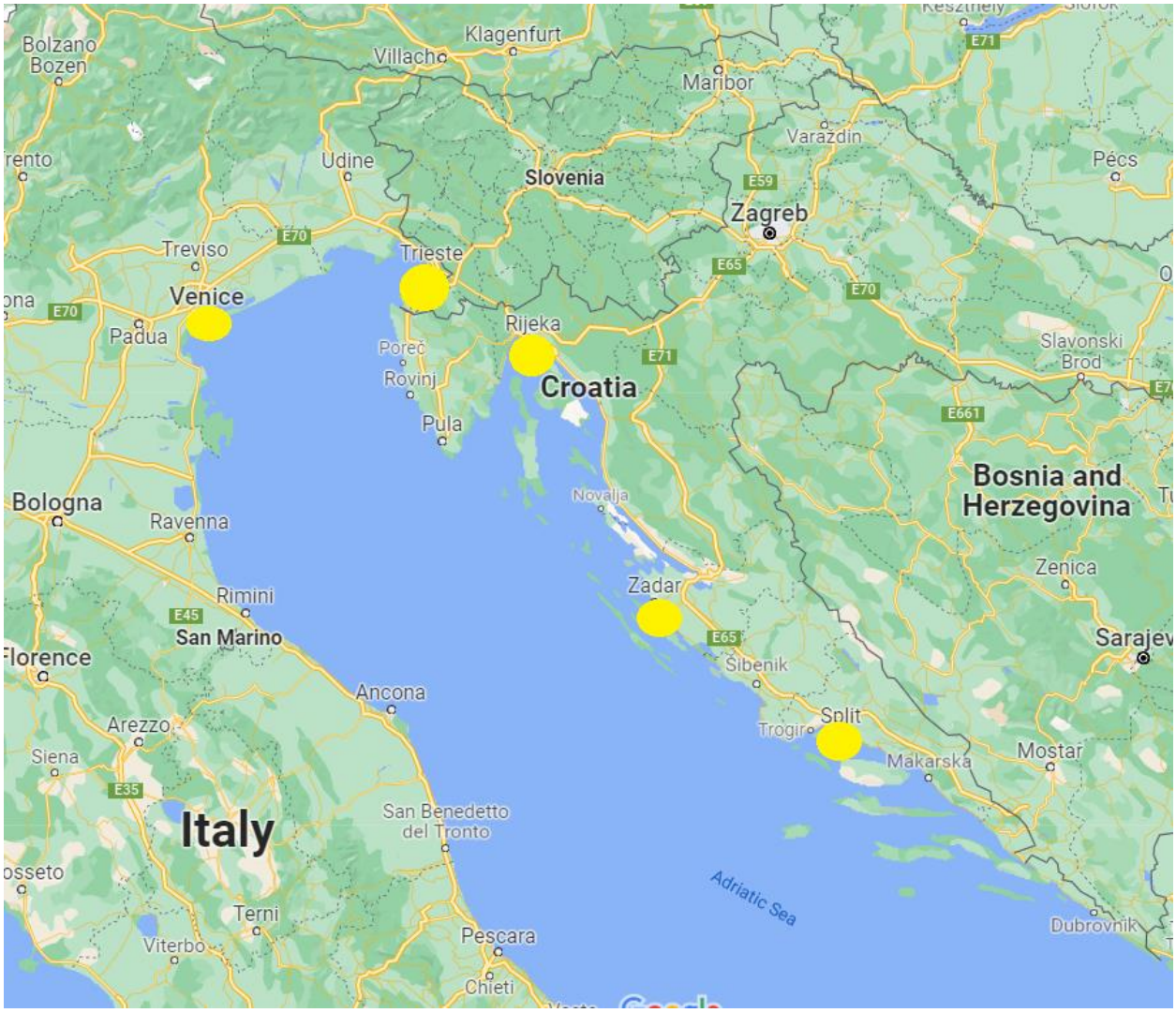

Figure 7-1. Venice, Triste, Rijeka, Zadar and Split (https://www.google.com/maps/)

7.7. Problems and obstacles

Future development process in all airports and ports should recognises the importance of all pillars of the sustainability of business management (environmental, economic, social). Consequently, there are number of EU-funded projects dealing with a range of related topics, which are airports and ports part of. Improving airport and port competencies in joint planning of environmental sustainability and energy efficiency, smart intermodal solutions will ensure the basis for long-term change.

Problem and obstacles in domain of sustainable management in current situations are mainly in:

- condition of electricity and other infrastructure and the need for certain modifications, upgrades and renovations
- possible questionable availability of space for necessary modifications / upgrades, etc.
- a significant number of concessionaires and other stakeholders

- lack of a comprehensive, long-standing system for monitoring energy consumption
- possible insufficient general capacity to implement complex port sustainability development
- environmental pollution
- slowness of administrative processes required during the implementation of projects / measures
- possible conflicts with other users or contenders for the same space and / or resources and / or infrastructure, etc.
- general crises of various origins, especially those that may have an impact on the development of demand in the transport sector

Exchange of experiences and analysis of best practices is important part of this process.

8. Solutions and practises

The model of sustainable mobility is becoming more important than ever and requires an integrated approach designed to optimize the efficiency of the transport system, transport organization and safety, and reduce energy consumption and environmental consequences.

Almost a quarter of all greenhouse gas (GHG) emissions in the EU come from the transport sector, making it the sector with the second highest greenhouse gas emissions, behind the energy sector. Moreover, transport is the only sector in the EU whose emissions have risen since 1990 - a total of 22%. After 2008, emissions fell slightly, but the long-term trend remains on the rise.

For this reason, the 2011 White Paper on Transport recommends a 20% reduction in transport emissions (including emissions from international aviation, but excluding international maritime transport) by 2008-2030 and a reduction of at least 60% in the period from 1990 and 2050. It also recommends a 40% reduction in emissions from international maritime transport between 2005 and 2050.

The White Paper calls for the use of sustainable low-carbon fuels and proposes the use of 40% in aviation by 2050 and a reduction in the share of vehicles using traditional fuels in urban transport by 50% by 2030 or even 100% by 2050. years.

Capitalisation report was developed as part of the project, which proposes the solutions to improve the environmental performance of ports and airports are presented as follows:

- Objectives;
- Case studies;
- Solutions;
- Possible improvements;
- SWOT strategies;
- Solution indicators

Objectives

Environmental goals that can be achieved implementing the solution.

Case studies

Examples of infrastructures implementing the solution.

Solution

Brief description of the solution with information regarding case studies.

Possible improvements

Weaknesses	Improvement
Main weaknesses according to the SWOT analysis of the infrastructures considered in the present study	How the solution is expected to positively act on the weakness of the infrastructure

Improvements are defined according to a qualitative scale ranging from no expected effect on the weakness, to an expected very high positive effect on the weakness.

Degree of improvement deriving from implementing the solution

Very high	There is high expectation of success in implementing the solution with respect to the weakness of the infrastructure.
High	The solution is expected to act efficiently on the weakness of the infrastructure.
Medium	Some effects are expected on the weakness of the infrastructure
Low	Weak effects are expected on the weakness of the infrastructure
Very low	Very weak effects are expected on the weakness of the infrastructure
None	No direct effect is expected on the weakness of the infrastructure

SWOT strategies

SWOT strategies are used to identify strategic directions, scenarios, and best practices related to environmental externalities deriving from operations at airport and port infrastructures

Converting W into S	Best practices aiming at turning Weaknesses into Strengths.
Converting S into W	Wrong approaches may convert Strengths into Weaknesses.
Converting T into O	Strategic directions that may convert Threats into Opportunities. Scenarios turning Threats into Opportunities.
Converting O into T	Inadequate planning may convert Opportunities into Threats Scenarios turning Opportunities into Threats
Matching O to S	Scenarios that match Opportunities with Strengths. Best practices aiming at matching Opportunities with Strengths.
Avoid T and W	Scenarios that may match Threats and Weaknesses.

	Best practices aiming at minimizing Threats and Weaknesses.

Solution indicators

Each solution was assessed considering the following indicators.

Design complexity

The expected complexity for the design of the solution was evaluated according to the following indexes.

Very low	No planning is needed.
Low	Little planning is needed. The solution does not require planning permissions.
Medium	The solution requires a standard design.
High	The solution requires a design. The solution requires authorizations.
Very high	Highly specialized design is needed. The solution requires authorizations

Implementation complexity

The expected complexity of implementing the solution was evaluated according to the following qualitative indicators:

Very low	Very easy to implement solution. Quick-delivery solution. No specific expertise and skills are required.
Low	Easy to implement solution. Some deliverables can be achieved in a short period of time. Some specific expertise and skills may be required.
Medium	Project duration may be long. Some stakeholders may be involved. Specific expertise and skills may be required.
High	Project duration is long. Some stakeholders are involved. There is a need for monitoring and controlling. Specific expertise and skills are required.
Very high	Expected project duration is long. Many stakeholders are involved. High level of monitoring and controlling. Teams with a wide range of expertise and skills are required.

Implementation cost

Expected costs involved in the implementation of the solution were evaluated according to the following qualitative indicators

Very low	No need for investing in infrastructures. No need for investing in human capital. Example: campaign about green habits delivering flyers and gadgets to customers
Low	No need for investing in infrastructures. Low-level investments in human capital. Examples: purchase of new machinery; workshops and training courses to engage the employees on sustainability.
Medium	Low-level investments in infrastructure. Low-level investments in human capital. Only basic changes in technology with no need for mutual adaptation of technology to the parties involved in the transport system.
High	Need for investing in infrastructures. Need for investing in human capital. Changes in technology impose mutual adaptation of technology only to minor parties involved in the transport system.
Very high	High need for investing in infrastructure. High need for investing in human capital. Changes in technology may impose mutual adaptation of technology to the parties involved in the transport system.

Local impact

The impact of the solution on the quality of local environment was evaluated considering the following:

Very negative	The solution impairs the quality of local environment. The solution is expected to increase the negative impact of the infrastructure on protected biota. The solution is expected to increase emissions of pollutants in air, soil or water.
Negative	The solution likely has a negative impact on the quality of local environment. The solution likely increases the negative impact of the infrastructure on protected biota. The solution likely increases emissions of pollutants in air, soil or water
Neutral	The solution may have an impact on the quality of local environment but no negative impacts are to be ascribed to the solution.
Positive	The solution likely has a positive impact on the quality of local environment.

	The solution likely reduces the impact of the infrastructure on protected biota. The solution likely reduces emissions of pollutants in air, soil or water.
Very positive	The solution restores the quality of local environment. The solution is expected to minimize the impact of the infrastructure on protected biota. The solution is expected to minimize emissions of pollutants in air, soil or water

Global impact

The impact of the solution on the quality of global environment (the greenhouse effect) was evaluated considering the following

Very negative	The implementation of the solution impairs the environment at the global level. For example, the solution directly increases the carbon footprint of the infrastructure
Negative	The implementation of the solution likely contributes to the impairment of the environment at the global level. For example, the solution likely contributes to increase the carbon footprint of the infrastructure
Neutral	The implementation of the solution is not expected to have a positive or negative impact on the quality of the environment at the global level. No changes in the carbon footprint of the infrastructure are expected due to the implementation of the solution
Positive	The implementation of the solution likely contributes to improve the environment at the global level. For example, the solution likely contributes to decrease the carbon footprint of the infrastructure
Very positive	The implementation of the solution directly contributes to improve the environment at the global level. For example, the solution minimizes the carbon footprint of the infrastructure

Based on the proposed criteria, possible solutions to improve the environmental performance of airports and ports are presented below.

Airports

	Realization complexity	Implementation complexity	Implementation cost	Local impact	Global impact
Continuous descent approach, (continuous descent operations)	high	medium	low	positive	very positive
Airport collaborative decision making	high	high	low	very positive	very positive
Noise mitigation measures	very low	very low	very low	neutral	neutral
Fixed electrical ground power and pre-conditioned air system	low	high	medium	very positive	very positive
Deployment of sustainable low-carbon fuels (e.g. bio jet fuels)	medium	low	low	neutral	neutral
Electrically powered buses	high	medium	high	very positive	very positive

Charging stations for electric hybrid cars	low	medium	medium	positive	very positive
Renewable fuel (diesel from waste and residue) for diesel vehicles	low	very low	low	neutral	positive
Improvement in energy efficiency/reduction in energy consumption	medium	high	medium	positive	very positive
Water-smart strategies aiming at preserving freshwater	low	very low	medium	positive	very positive
Waste management aiming at zero waste to landfill	high	high	low	positive	positive
Use of environmentally friendly asphalt (warm-mix asphalt) for repaving runways	low	medium	low	very positive	very positive

Anti-idling campaign: idling gets you nowhere!	very low	low	very low	very positive	very positive
Intermodal passenger transport (mixed mode commuting)	high	high	very high	very positive	very positive
Air-rail intermodality: from train to plain	low	medium	medium	very positive	very positive

Ports

	Realization complexity	Implementation complexity	Implementation cost	Local impact	Global impact
Onshore power supply for seagoing vessels	high	medium	high	very positive	positive
Redesigning the ferry terminal (Buffer zone)	high	high	high	positive	positive
Tir trucks under control with the new smart road	medium	medium	low	positive	neutral
Container exchange by rail (PortShuttle)	high	medium	high	very positive	positive
Venice Offshore Onshore Port System	very high	very high	very high	very positive	positive
Logistics application (OnTrack)	low	low	low	neutral	neutral
Solar concentrator farm	medium	high	medium	very positive	very positive

Water turbine	high	very high	high	very positive	positive
Solution indicators	low	low	low	neutral	neutral
Port call optimization	low	low	low	neutral	neutral
Incentives for LNG ships and ships with waste recovery on board	very low	low	low	positive	positive
Light emitting diode (LED) technology system	low	low	low	positive	very positive
Water Management	high	very high	high	very positive	neutral
Noise Control	low	low	low	positive	positive

8.1. Operating procedures

Sustainable mobility and intermodal transport should be based on more efficient use of energy resources and reducing the harmful environmental impact of increased transport. Operating procedures are contributing to better organization of transport, relief of road infrastructure, energy savings, easier fulfilment of environmental goals, reduction of traffic congestion, opening space for more environmentally friendly solutions.

8.2. Technological innovations

Environmental sustainability domain and overall energy efficiency are very important themes for different business and other actors, including airport and ports. In order to achieve these objectives, an efficient environmental management system is important, including the so-called carbon management, since a range of activities, products and services has a certain environmental impact and generates greenhouse gas emissions, which should be avoided or at least minimised. In the context of sustainability and energy efficiency, the analysis of available literature, guidelines, good practices and the scope of the relevant regulatory framework makes it clear that the highest focus is on the air quality and climate change, but also waste and noise domain. Literature sources and examples of good practice indicate a set of possible measures to reduce emissions in airports and ports without one single set of measures applicable to all ports as such. In the decision-making process on further sustainable development, and therefore on an appropriate set of measures, it is necessary to recognise the diversity of individual airport and port areas in terms of location characteristics, existing infrastructure, organisational arrangements with respective authorities, services/products/activities carried out, national/regional/local regulatory framework, etc., as well as to needs and objectives and financial opportunities. Cooperation from all stakeholders is important for successful implementation of measures.

9. Conclusions

One of the main problems that characterize the Adriatic coastal area is the imbalance in the development of infrastructures and modes of transport, caused by low level of investments and insufficient approach to innovation. In Italy and Croatia there are many maritime cities, which have to deal with a very high number of passengers, especially during the peak season. Even though the road transportation is still predominant, the number of people that are reaching Adriatic cities by ferries and airplanes is significantly increasing year by year. However, most of Adriatic ports and airports are suffering from lack of integration with various modes of transportation, causing serious traffic congestion problems during the summer season.

The main objective of ADRIGREEN project is to improve the integration of Croatian and Italian ports and airports with other modes of transportation in order to enhance the processing of passengers during the summer seasons and to improve environmental performances of the Adriatic maritime and aviation systems.

The project was implemented by 10 project partners (Pula airport ltd., Dubrovnik airport ltd, Aeroporti di Puglia s.p.a., Airiminum 2014 s.p.a., Rimini, Abruzzo Airport Management Company ltd., Dubrovnik Port Authority, Central Adriatic Ports Authority, Pula Port Authority, Southern Adriatic Sea Port Authority, University Politechnic of Marche), the lead partner was Pula Airport ltd.

The main idea was to identify and analyse a few existing operational and technological solutions that can be easily transferred and adapted by involved ports and airports

Pilot actions are identified according to the following areas:

- implementation of low-cost and smart solutions to better connect airports and ports with the local public transport systems, such as railways and public bus lines;
- implementation of integrated timetabling and information for passengers that shall continue their travel by other means of transport
- adoption of smart solutions to improve waste& water management and to reduce energy consumption in small-medium regional Airports;
- new protocols with public and private transport providers to experiment with new services to speed up the process of passengers from/to touristic destinations which are not well-connected

Through the project, a number of useful studies have been prepared, which previous the pilot activities therefore, such as:

- International Investigation
- Environmental Assessment
- Joint Action Plans
- Feasibility Studies
- Appraisal Reports
- Optimization of Multimodal Transportation Approaches and related changes in airborne pollutants and greenhouse gases emissions

- Capitalization Report

There is no need in inventing new solutions as there are a plenty successful models and schemes implemented in other parts of the world that can be replicable also in the Programme area. Identified and analysed solutions for the operational and technological models, can be tested to improve intermodal connections and to put in practices new schemes for a sustainable management of ports and airports.

Problem and obstacles in domain of sustainable management in analysed situations are mainly in: condition of electricity and other infrastructure and the need for certain modifications, upgrades and renovations , possible questionable availability of space for necessary modifications / upgrades, etc., a significant number of concessionaires and other stakeholders, lack of a comprehensive, long-standing system for monitoring energy consumption, possible insufficient general capacity to implement complex port sustainability development, environmental pollution, slowness of administrative processes required during the implementation of projects / measures, possible conflicts with other users or contenders for the same space and / or resources and / or infrastructure, etc., general crises of various origins, especially those that may have an impact on the development of demand in the transport sector.

The model of sustainable mobility is becoming more important than ever and requires an integrated approach designed to optimize the efficiency of the transport system, transport organization and safety, and reduce energy consumption and environmental consequences.

The manual provides an overview of the Capitalization report in which they are listed solutions to improve the environmental performance of ports and airports, which are presented as objectives, case studies, solutions, possible improvements, SWOT strategies, solution indicators.

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