ECOWAVES

Feasibility study for optimization of port waste capacities

<Zadar County Rural Development Agency>

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1. Introduction

The growth of cruise tourism has resulted in an increasing concern for the environmental impact that this type of tourism may cause. Awareness of the marine and environmental pollution caused by cruise ships is a great issue for all Adriatic cities, and it has increased in the last years since the number of cruise calls has drastically increased. Adriatic Sea attracts numerous cruisers in its semi-enclosed area within the Mediterranean and Zadar has in the last years proved to be a very attractive tourist destination especially since the opening of the New Port of Gaženica in 2015 with a temporary terminal building and even more since 2018 when the New Port of Gaženica was in full operation.

In 2019, Zadar was ranked as a third cruising destination in the Republic of Croatia after Dubrovnik and Split and it was chosen as the world's best port at the Sea trade Cruise Awards 2019 with a tendency to increase the traffic in the following years prior to the breakout of the COVID-19 pandemic. Since 2012 to 2019 the number of cruise passengers has increased from 20.958 passengers to 182.682 passengers. The predictions are that the cruise traffic will continue with its increase after the normalization of the situation with the COVID-19 pandemic. Better facilities, new routes and even larger ships support the increase of traffic in the cruise industry which is a benefit also to the economic growth but also a disadvantage to the environmental sustainability as cruise ships are well known marine pollutants.

Dsiplacing the ferry port from the old city core ("Peninsula") to a new location in Gaženica has ensured the sustainability of the destination and better connectivity with the islands in the archipelago in the long run. In the first year of operational operation of the port, the entire ferry traffic was relocated from the city center, which caused a decrease of 500,000 vehicles and approximately 1,700,000 fewer passengers in the city center, and a significant decrease in congestion in the destination. Although the impact of car and truck noise and emissions caused by both vehicles and ferries in the city core/center has been diminished and successfully shifted towards new Port of Gaženica, which has ensured better air, sea and noise quality for the city's inhabitants and protected the city's cultural heritage from the harmful impact of pollution, main issue along proper waste management from croise ships remains real-time monitoring of air, sea and noise quality at the Port of Gaženica especially taking into consideration traffic increase as well as increasing waste management efficiency tackling Ro-Ro traffic by implementing several "Eco islands" providing additional boost to environmental awareness. Therefore, it can be concluded one of the main challenges in the years to come will be developing cruise industry in line with sustainable principles by preserving natural habitat and port cities. This will have to be enhanced in parallel with development and implementation of technological advances in port areas. Therefore, it is necessary to tackle the issue of increasing marine traffic in the port of Zadar which consequently causes an increase in the emissions and potential pollution in the port and port-city area. It is necessary to consider environmentally friendly and sustainable solutions to create a better environment for both tourist and residents.

2. State-of-the-art port waste management systems/solutions

2.1. Legislation

The basic legislative framework for the activities of the Zadar Port Authority is regulated by the provisions of the Maritime Property and Seaports Act and the Maritime Code. Republic of Croatia is a signatory Party to the international Convention of MARPOL 73/78 and its I to V Annexes dealing with the prevention of ship-generated pollution from oil, noxious liquid substances, sewage, and garbage. [7]

The government of Croatia has adopted several regulations and other instruments which deal with the provision of port reception facilities including waste management, as follows:

- Law on Environmental Protection ("Official Gazette", No. 82/94, 128/99);
- Maritime Law ("Official Gazette", No. 17/94 74/94, 43/96);
- Sea Port Law ("Official Gazette" No. 108/95, 6/96, 97/00);
- Law on handling dangerous substances, loading and unloading dangerous substances, bulk cargo, and other cargoes in ports ("Official Gazzette" No. 108/95);
- Law on waste categories ("Official Gazette", No. 27/96).

Discharge at sea of oily water mixtures from the machinery spaces of ships and garbage might be carried out in the jurisdictional, navigable marine waters of the country in compliance with the respective criteria of MARPOL 73/78. Port Authorities are responsible to organize and provide reception facilities for ship-generated wastes. According to Sea Port Law No. 108/95, 6/96, 97/00), basically all ports open for international traffic are required to provide reception facilities and namely those of Rijeka, Zadar, Split and Ploce. Sea Ports Law lays down criteria for classifying the ports of the country, it delineates the activities and the basis that they can be provided in the port area, the obligations of the respective port Authorities, port tariff, issues related with the construction of ports infrastructure and superstructure, etc. [7]

At this moment environmental issues are tackled within the following internal documents:

- Ship Waste Management Plan (2018);
- Ordinance on determining the class and quantity of hazardous substances from ships (2018);
- Ordinance on determining the class and quantity of dangerous substances that may be handled in the port, that is, that may be carried by a ship entering the port area and places in the port of Zadar where these substances will be handled (2015);
- Regulations on the maintenance of order and terms of using the port area under the jurisdiction of the Port of Zadar Authority also lay down safety and security measures.

According to Article (56), (56a) and (58) of Maritime Code (OG 181/04, 76/07, 146/08, 61/11, 56/13, 26/15, 17/19), Article 3 of the Code of 2013. Paragraph 1(7) Regulations on the conditions to be met by ports (OG 110/04), Articles 62(1) and (2). Regulations on the conditions and manner of maintaining order in ports and other parts of inland sea waters and territorial seas of the Republic of Croatia (OG 90/05, 10/08, 155/08, 127/10, 80/12, 56/13,

7/17), Articles 4 and 5 of Directive 2000/59/EC, the guidelines of the IMO of MPEC.1/Circ.834/Rev.1.1 of March 2018, and Article 19(1)(11). The Statute of the Port of Zadar Authority, the Board of Directors of the Port of Zadar Authority, adopts the Waste Management Plan from ships in the port area it manages. The plan is refreshed every three years.

The waste management plan from ships prescribes the reception and handling of ship accumulated waste and ship cargo residues in the area under the management of the Port of Zadar Authority. The plan regulates:

- Management procedures of ship accumulated waste and ship cargo residues from ships entering the port area of the Port Authority,
- Protection of the marine environment from the discharge or dumping of marine litter,
- Protection against pollution of the inland area of the Port of Zadar Authority,
- All entities using the port are obliged to comply with and comply with the provisions of the Maritime Code of the Republic of Croatia (OG 181/04, 76/07, 146/08, 61/11, 56/13, 26/15, 17/19), and the Ordinance on the Order and Conditions of Use of the Port of Port of Zadar Authority.

2.2. Implemented port waste management systems/solutions

In the area of the Zadar Port Authority, it is possible to dispose of various quantities and types of waste from ships such as:

- municipal waste
- various types of oily bilge water
- motor oils
- oily adsorbents
- emulsions
- waste paints and varnishes
- Various types of other hazardous waste.

The objectives of ship waste management are:

- Selective collection and separation of waste for secondary recovery
- Controlled waste disposal
- Prevention of irresponsible waste management
- Education on waste management
- Avoiding unnecessary delays for the ship when picking up waste [2]

Waste from ships in the Zadar Port Authority must be treated in such a way that avoid:

- Danger to human health
- Danger to flora and fauna
- Pollution of water, sea, soil, and air above the prescribed limit values
- Uncontrolled disposal and incineration,

- Explosion or fire,
- Noise and unpleasant odours,
- Emergence and reproduction of harmful animal and plant organisms
- Development of pathogenic microorganisms and
- Disturbance of public order and peace.

In the port area under the jurisdiction of the Port of Zadar Authority, about 120 tons and about 60 m^3 of ship waste are disposed of annually. From permanent waste collection capacities in the port area under the jurisdiction of the Port of Zadar Authority there are containers for municipal waste in the city port of Zadar or the passenger port of Gaženica, as well as a container for the reception of waste oils, oily rags and oil filters in the fishing port of Gaženica. The types and capacities of reception facilities for waste collection are shown on Figure 1.

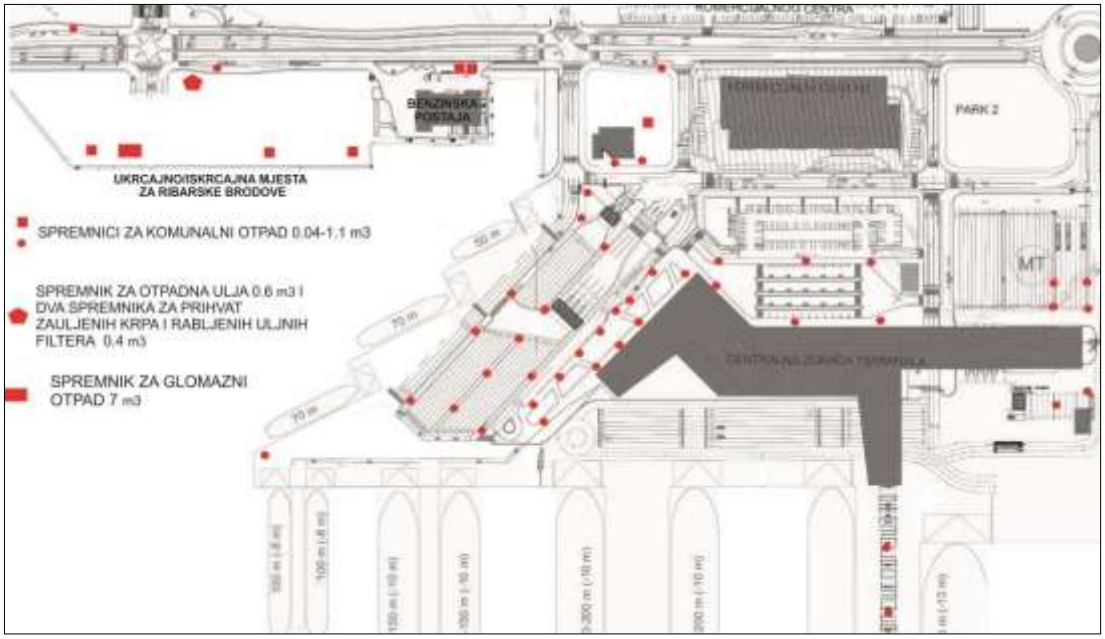

Figure 1: Locations od municipal waste containers in the Port of Gaženica

Waste collection in the area managed by the Zadar Port Authority is handled by specialized companies that have received a concession from the Zadar Port Authority to perform this activity. Concessionaires have different types of environmental protection equipment and means of transport for waste collection. Waste can be collected by land by specialized trucks and tank trucks of various capacities and purposes.

The methodology, quantity and transport of waste from ships that normally call Port of Zadar depends on the category of waste, the required dynamics and the location of the waste collection. Depending on the type and quantity of waste, the remains of the cargo are disposed of in a convenient manner by prior agreement with the selected concessionaire. The concessionaire is obliged to hold a valid concession authorisation for the collection of a certain type of waste and is obliged to inform the Port Authority of any change related to the authorisation.

Authorised concessionaires, after prior notice, collect other types of waste:

- Oily liquid and solid waste,
- Hazardous waste,
- Fecal waters,
- Plastic,
- Food residues,
- Ship's municipal waste,
- Kitchen oils,
- Incinerator's ash,
- Work waste,
- Non-human animal by-products,
- Fishing gear,
- Electronic waste,
- Ship's cargo residues.

Oily liquid and solid waste

The reception of oily waste from ships is carried out by authorized concessionaires with prior notice in accordance with Rule 38. Annexes and MARPOL conventions. Ship's discharge pumps for covered waste shall support transhipment capacity not less than 6 m^3/h. When pumping, the washed waste liquids must be heated to a temperature of not less than 60 °C. Solid peeled waste must be conveniently packed in marked bags or in non-refundable containers/containers. Waste water is collected by specialized autocysters after carrying out chemical-physical analysis. Fishing vessels in the area of embarkation/unloading points for fishing boats in the port of Gaženica, may dispose of small quantities of waste oils (up to 100 liters) in waste oil reception tanks and marine municipal waste in municipal waste reception tanks. Smaller vessels, and yachts of up to 12 crew members, docking in the city port can, only by prior notice, dispose of waste oils (up to 100 litres), while the ship's municipal waste may be disposed of in municipal waste reception containers.

Hazardpous waste

The disposal of various types of hazardous waste is possible, with the prior consent of the Port Authority, and with the agreement with the selected concessionaire. Hazardous waste is taken for treatment by authorised processors of this type of waste.

Fecal waters (Annex IV of the MARPOL Convention)

Fecal waters are collected by autocysters by an authorized concessionaire, after which the concessionaires take them to the central city purifier.

Plastics (Annex V of the MARPOL Convention - Category A)

Upon arrival of the ship, the reception of plastics from the ship is obliged to be carried out separately by authorized concessionaires and taken away in specialized plastic containers, and taken to recycling separately from other categories of waste.

Food residues (Annex V of the MARPOL Convention - Category B)

The ship may not dispose of such waste in municipal waste, but separately hand it over for disposal and innocuous removal to an authorised concessionaire.

Marine municipal waste (Annex V of the MARPOL Convention - Category C)

The reception of municipal waste from the ship is carried out by an authorized concessionaire

by prior notice. This category of waste is taken by specialized metal containers (7m^3).

Kitchen oils (Annex V of the MARPOL Convention - Category D)

his category of waste is collected by selected concessionaire(s) and taken for final waste treatment.

Incinerator's ash (Annex V of the MARPOL Convention - Category E)

This category of waste is collected by ADR vehicles for final waste treatment.

Working waste (Annex V of the MARPOL Convention - Category F)

Working waste must be adequately packaged in marked bags or in non-refundable containers/containers, and reception by the concessionaire shall be carried out by specialised containers separately from other categories of waste.

Non-human animal by-products (Annex V of the MARPOL Convention - Category G)

Upon arrival of the ship in international traffic, the reception of animal by-products from the ship is performed by concessionaire with specialized containers. The waste is disposed of in containers with a lid marked "for removal only" and taken from the port to the collection point and stored inside the registered facility. The incineration of the such waste is subsequently organised.

Fising fear (Annex V of the MARPOL Convention - Category H)

This category of waste is collected by concessionaire for final waste treatment.

Electronic waste (Annex V of the MARPOL Convention - Category I)

This category of waste is collected by concessionaire for final waste treatment.

Ship's cargo residues (Annex V of the MARPOL Convention - Category J and K)

This category of waste is collected by concessionaire with specialized vehicles for final waste treatment.

Depending on the type and quantity of waste, the remains of the cargo are disposed of in a convenient way by prior agreement with the selected concessionaire. The obligation of the cargo recipient is to dispose of the remains of cargo from ships at his own expense. The costs of accepting cargo residues from the ship shall be reimbursed by the user of the reception devices for the disposal of a certain category of waste. Exceptionally, the ship may forward to the next port without delivering the remains of the cargo if it is possible, based on the data provided, that there is sufficient space on board to accommodate the remains of the cargo on board to the port where the rest of the cargo will be handed over to the reception devices.

Also, the harbourmaster may order the ship to unload the remains of the cargo before leaving the port if it is evident that the port of destination does not have an adequate reception device or the port of destination is unknown and there is a risk that the remains of the cargo could be thrown into the sea. The Port Authority will prohibit the ship from setting sail unless it complies with the order. The categories of waste in question are collected in the vehicles of the authorised concessionaire only by prior notice by the ship's agent. The concessionaire is obliged to hold a valid permit for the collection of a certain type of waste and is obliged to notify the Port Authority of any change related to the permit.

A schematic overview of the ship's waste disposal process is shown on the Figure 2.

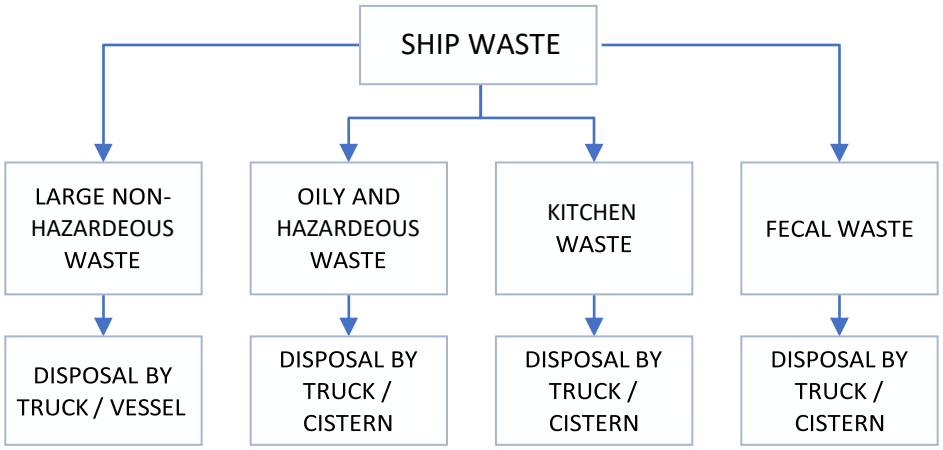

Figure 2: Ship waste disposal types regarding waste type

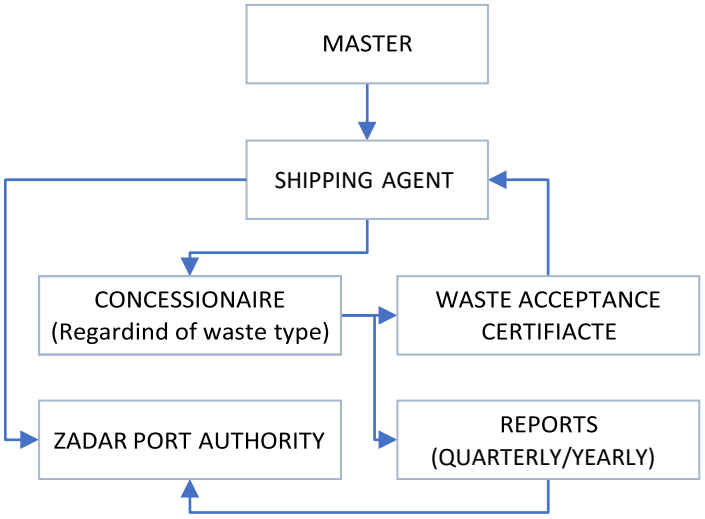

Figure 3: Ship waste disposal flowchart

APPLICATION FOR SUBMISSION OF SHIP'S WASTE

Requests for registration of the handover of ship waste by ships are used to better plan waste reception operations and to avoid unnecessary delays of ships that service authorised concessionaires. The ship's agent (except Croatian warships and public ships, fishing boat or sport and leisure vessel authorised to carry no more than 12 passengers) before arriving at the port of Zadar, is obliged to report fully and accurately to the Port Authority complete ship waste and cargo residues planned to be handed over at the port and enter all basic information, in accordance with Directive 2000/59/EC and the MARPOL Convention and the IMO Instruction. The application of marine litter is made through the application system CIMIS (Croatian Integrated Maritime Information System), i.e., through the form "Reporting of ship waste", in order to approve the reception of the ship to the port and to plan the operations of receiving waste and to avoid delays of ships using port facilities for the reception of waste. Ships are also obliged to provide such information:

- at least 48 hours prior to arrival for the area under the management of the Port of Zadar Authority,

- after reaching the port of call, if the information is available less than 48 hours before arrival at the area under the management of the Port Authority,
- immediately before departure from the previous port of call, if the duration of the trip is less than 24 hours.

The announcement form prescribed by the Plan forms an integral part of it and is submitted to the competent institutions through the information system CIMIS.

WASTE COLLECTION PROCEDURE FROM SHIPS

1. The arriving ship master is obliged to refer to his maritime agency the form "Reporting of ship waste".
2. Upon receipt of the request by the ship, the maritime agent shall forward the request for the waste collection needs to the selected concessionaire; The ship's maritime agent and the selected concessionaire shall arrange the time and manner of collection of the ship's waste or cargo residues.
3. The maritime agent is obliged to inform the Port Authority of the anticipated waste collection, the name of the concessionaire who will carry it out and the estimated time at which the intended waste collection will be carried out; The concessionaire may take samples of oily waters to determine the chemical-physical ingredients of oily waste.
4. After completing of waste collectionn, the Concessionaire is obliged to issue to the master of the ship a Certificate of Waste Collection/Waste Delivery Receipt (Annex 7. Form 07/18), and the ship is obliged to forward a copy of it to a maritime agent.
5. A copy of the signed and stamped Waste Collection Certificate/Waste Delivery Receipt is submitted by the maritime agent via CIMIS to the authorities.

All waste from ships must be collected separately in accordance with the Annexes of MARPOL 73/78 of the Convention and the waste categories of MARPOL 73/78 of the Convention.

REMARKS REGARDING INADEQUATE SERVICES

Upon receipt of comments on the inadequacy of port waste reception facilities from ships, the person responsible for applying this Plan will take the necessary corrective actions to eliminate inadequate service and obtain the satisfaction to the service users. Inadequacy of port reception facilities for marine waste with a description of the causing reasons may also be reported to the port authority.

REQUESTS FOR DATA COLLECTION AND DELIVERY

Concessionaires are obliged to submit in writing to the Port of Zadar Authority:

Quarterly monthly reports on the total quantity and type of waste collected in the Port Authority area, 30 days after the end of the quarter. Annual report on the total quantity and type of waste disposed of in the Port Authority, submitted within 30 days after the end of the calendar year. Reports shall be submitted to the appropriate department of the Port Authority.

WASTE MANAGEMENT FEES

The cost collection system is determined through the maximum amount determined on the day of signature of the concession contract with the concessionaire.

TEMPORARY WASTE DISPOSAL LOCATIONS

The locations of temporary disposal of waste from port activities are listed in the internal regulations of the port concessionaires.

PERSON RESPONSIBLE FOR PLAN APPLICATION

The Department for Operations and Security and Technical Affairs and Maintenance of the Port of Zadar Authority is in charge for application of this Plan. The list of concessionaires and contact persons, working hours and types of waste collected in the area of the Port Authority, are included in the Waste Management Plan. Contacts of the concessionaire are also provided through the port authority's website - www.port-authority-zadar.hr. Concession approvals for the completion of the activities of reception and further disposal of various types of waste are a good control mechanism of the Port of Zadar Authority. In order to obtain the necessary concession approvals, it is necessary for concessionaire to prove that it has been registered for waste management and displosal activities, and that it meets the professional human resources for the performance of the activity for which it has previously applied for a concession.

2.3. SWOT analysis

	ADVANTAGES	WEAKNESSES
INTERNAL	• Port legislative and procedures involvind waste management are very clear and acknowledged by all parties involved • The current approach for waste management monitoring and address all the environmental hazards identified by National and EU authorities	• Lack of specialised equipment and facilities for monitoring and cleaning of environmental hazards and waste • No Action Plan on Waste Management • No ISO regulated procedures related to waste management • Non-existing long-term strategic environmental waste management plan • Relations between the maritime agent, the waste disposal concessionaire and the shipping companies should be improved • Port Regulation was recently updated but it has not fully taken into consideration the current needs of the port • Lack of personnel in charge for waste management • Rising trend of passenger and cruise ship travels will cause an increase in the greenhouse gas emissions which highlights the need for the harmonization of policies and actions to strengthen environmental sustainability and port energy efficiency at cross-border level

	OPPORTUNITIES	THREATS
EXTERNAL	• Implementation of sea, air and noise real-time monitoring • Improving existing waste collection infrastructure • Introduce stimulations for shippers who conscientiously treat ship waste, i.e., disincentives to improper treatment of marine waste • Act on all key stakeholders in the process through educational actions; Offer alternative educational ecological excursions for cruiser passengers, organize underwater cleaning in the harbour basin • To hire an additional employee in the operational sector of the Port of Zadar Authority with tasks and responsibilities regarding monitoring environmental and waste management plans, and their implementation • Nominate Port of Zadar for ECOPORTS membership • Focus on energy efficient and sustainable waste management solutions for maritime transport and port operations • Existing policies and strategies support environmentally efficient and safe maritime transport which is in line with project objectives of energy efficient and sustainable technologies in ports and maritime transport in general (Transport Development Strategy of the Republic of Croatia 2017-2030, Maritime Development and Integrated Maritime Policy Strategy of the Republic of Croatia 2014-2020, National Policy Framework on Alternative Fuels) • Using EU funding for financing planned activities and projects	• No long-term Plan for environmental sustainability and waste management • Lack of specialised equipment and facilities for monitoring and cleaning of environmental hazards and waste • Inadequate personnel training could lead to inefficient implementation of the waste management Action Plan • Low interest from stakeholders for the implementation of project pilot activity and new technologies

3. Port environmental risk assesment

3.1. Legislation

Port of Zadar Authority acknowledges the importance of environmental protection and issues arising from the port activities and which are related to the port area, sea, noise, and air quality. To minimize the negative effects on the environment, Port of Zadar Authority implements a series of activities and regulations on the port area under their jurisdiction. In this sense, the main priorities of the Port of Zadar Authority include effective management of waste from ships and operations and procedures with hazardous substances from ships. It also lays down the regulations on the maintenance of order which need to be followed to preserve safety and security in the port area. However, Port of Zadar Authority does not havea separate environmental policy plan which would consider the European and nationalenvironmental legislation, as well as the international environmental regulations and which would be designed for the evaluation of the environmental performance of port activities.

3.2. Port waste sources identification

In the port area under the jurisdiction of the Port of Zadar Authority, about 120 tons and about 60 m3 of ship waste are disposed of annually. From permanent waste collection capacities in the port area under the jurisdiction of the Port of Zadar Authority there are containers for municipal waste in the city port of Zadar or the passenger port of Gaženica, as well as a container for the reception of waste oils, oily rags and oil filters in the fishing port of Gaženica. Analizing various aspects of port of Zadar activities/modalities three major categories can be identified as potential waste generating sources – cruise ships, RO-RO ships (ferries) and fishing boats. Each of which have very specific and different legal and actual waste generating conditions. The first category – cruise ships actually present the greatest and most challenging waste generating source but at the same time the most regulated one by means of national and international legislative. As such it actually represents the least concerning category who's proper implemenation is only threatened by increase in number of cruise ship calls (as witnessed in years before COVID-19 pandemic) and possible inadequate concessionaires' capacities to meet increased waste management demand. Waste produced by this category therefore is properly managed and disposed even taking into consideratrion tourists visditng Zadar and nearby attractions are actually just transiting through port area and not actually generating any waste on premises. The only possible concern regarding this waste generating category is related to possible sea and air pollution which at this time cannot be monitored by Port of Zadar Authority due to lack of such measuring equipment. Which is therefore recognized as necessary and very important part of port waste management action plan.
Second category comprises of traffic directed towards RO-RO vessels which actually along with their usual RO-RO function are ate the same time used as passenger liner service therefore generating a bit more individual/communal waste i.e., bottles, paper and small

amounts of organic waste from passengers. Generally speaking, this category is not tackled by legislative on individual level rather on personal sense for environmental responsibility andis generating rather small amount of communal waste. Although very different in terms of communal waste production levels this category, similarly to previously mentioned one might be generating certain level of sea and air pollution, which at this stage as previously mentioned, cannot be empirically determined in real time due to lack of adequate equipment and therefore properly managed except on statistical basis.

The third category comprises of waste produced by fishing vessels activitres which in general falls under the same waste management policies as previously mentioned categories.

4. Feasible port waste management systems implementation

Proposal for measures and activities to initiate under the ECOWAVES project:

1. Impementation of real-time monitoring fro air, sea nd noise quality in areas under Port Authority of Zadar jurisdiction;
2. Install multiple “Eco Islands” providing possibility to separate small waste in both international and domestic terminals.

4.1. Port specific waste management prerequisites

As mentioned in previus (sub)chapters Port of Zadar Authority’s implemented waste management procedures are fully in compliance with international and national legislative but lack of real-time monitoring equipment for sea, air and noise quality would greatly improve and enable timely identification and prevention of potentially hazardeous waste incidents. Furthermore, installation of “Eco Islands” would provide additional possibility to increase environmental conceousness and improve waste management on both national and international port terminals. All the prerequisites for fullfilling such implementations have been met by Port Authority of Zadar providing ground for implemenation of forementioned equipment.

4.2. Accordance with International/EU/national/local waste management legislative

Actions proposed in this document are in accordance with the following EU directives:

- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive 2000/60/EC) [1],
- Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage [2],
- Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive; Consolidated text) [3],
- Directive 2010/65/EU of the European Parliament and of the Council of 20 October 2010 on reporting formalities for ships arriving in and/or departing from ports of the Member States and repealing Directive 2002/6/EC [4],
- Directive 2019/883 of the European Parliament and of the Council of 17 April 2019 on port reception facilities for the delivery of waste from ships, amending Directive 2010/65/EU and repealing Directive 2000/59/EC [5].

The government of Croatia has adopted several regulations and other instruments which deal with the provision of port reception facilities including waste management, as follows:

- Law on Environmental Protection (OG 82/94, 128/99),
- Maritime Law (OG 17/94 74/94, 43/96),
- Sea Port Law (OG 108/95, 6/96, 97/00),
- Law on handling dangerous substances, loading and unloading dangerous substances, bulk cargo, and other cargoes in ports (OG 108/95),
- Law on waste categories (OG 27/96),
- Maritime environment and coastal management strategy [6],
- Maritime waste management plan [7].

Discharge at sea of oily water mixtures from the machinery spaces of ships and garbage might be carried out in the jurisdictional, navigable marine waters of the country in compliance with the respective criteria of MARPOL 73/78 (and its' Annexes I to V). Port Authorities are responsible to organize and provide reception facilities for ship-generated wastes. According to Sea Port Law No. 108/95, 6/96, 97/00), basically all ports open for international traffic are required to provide reception facilities.

At this moment environmental issues are tackled within the following internal documents:

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- Ordinance on determining the class and quantity of hazardous substances from ships [9],
- Ordinance on determining the class and quantity of dangerous substances that may be handled in the port, that is, that may be carried by a ship entering the port area and places in the port of Zadar where these substances will be handled [10],
- Regulations on the maintenance of order and terms of using the port area under the jurisdiction of the Port of Zadar Authority also lay down safety and security measures [11].

According to Article (56), (56a) and (58) of Maritime Code (OG 181/04, 76/07, 146/08, 61/11, 56/13, 26/15, 17/19), Article 3 of the Code of 2013. Paragraph 1(7) Regulations on the conditions to be met by ports (OG 110/04), Articles 62(1) and (2). Regulations on the conditions and manner of maintaining order in ports and other parts of inland sea waters and territorial seas of the Republic of Croatia (OG 90/05, 10/08, 155/08, 127/10, 80/12, 56/13, 7/17), Articles 4 and 5 of Directive 2000/59/EC, the guidelines of the IMO of MPEC.1/Circ.834/Rev.1.1 of March 2018, and Article 19(1)(11). The Statute of the Port of Zadar Authority, the Board of Directors of the Port of Zadar Authority, adopts the Waste Management Plan from ships in the port area it manages. The plan is refreshed every three years.

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- All entities using the port are obliged to comply with and comply with the provisions of the Maritime Code of the Republic of Croatia (OG 181/04, 76/07, 146/08, 61/11, 56/13, 26/15, 17/19), and the Ordinance on the Order and Conditions of Use of the Port of Port of Zadar Authority.

4.3. EU/International port waste management good practices review

THE DOVER SEA AWARD FOR CRUISE WASTE MANAGEMENT

The Port of Dover is the UK's second busiest cruise port, welcoming over 25 cruise lines and 200,000 guests each year. As part of the Port's work to improve waste management performance, Dover introduced its Safety Environment Awareness (SEA) Award in 2017 to acknowledge outstanding performance on recycling rates and waste procedure compliance. Within just one year, the percentage of recycling of cruise ship waste increased from 23% to 40%.

NORTH ADRIATIC SEA PORT AUTHORITY (NASPA): INVESTIGATING HOW TO REDUCE SHIP NOISE POLLUTION, PROVIDING CRUISE SHIPS WITH RECOMMENDATIONS

Mindful that emissions reductions targets must address all forms of pollution, the North Adriatic Sea Port Authority (NASPA) launched a series of projects to monitor and reduce noise pollution, working alongside academics from the University of Padua. Since 2007, NASPA has carried out acoustic characterisations to monitor ship noise emissions. According to the measures obtained from the acoustic models, NASPA provided a set of recommendations to reduce cruise ships noise, with the result of a targeted reduction of noise pollution in previously badly affected areas.

CLEAN AIR PROJECTS IN THE PORT OF TALLINN

To ensure that outdoor air in the Port's locations of operation is clean and of high quality, the Port of Tallinn has employed a number of innovative solutions in close cooperation with its customers and partners, including:

- Taking heavy goods vehicles and cars out of the city centre and developing the MuugaVuosaari route;
- Mitigating odour nuisances caused by the cargo of oil terminals by installing three stationary air quality monitoring systems and an e-nose network around the Muuga Harbour;
- Granting eco-friendly vessels, a discount on port dues based on the Environmental Ship Index (ESI). In 2019, the Port gave an ESI Index-based discount for 1,439 port calls, i.e., 19% of all port calls.

PORT OF VALENCIA: GREEN PORTS: DIGITAL TOOLS TOWARDS SUSTAINABILITY

As part of the net-zero emissions strategy of the Valenciaport cluster, led by the Port Authority of Valencia, Fundación Valenciaport and the Port Authority of Valencia are working together on the GREEN C Ports project to pilot the use of sensors, big data and artificial intelligence in the Port of Valencia to reduce the impact of port operations on the city, monitor emissions from ports and vessels and optimise performance of port operations. Alongside Baleària, Inerco, and Gas2Move, the Port will upgrade its environmental sensors networks to develop a Port Environmental Performance IT platform that will receive real-time data from the sensors network, from existing operating systems in the port (i.e., PCS) and from vessels, vans and trucks. The project aims to decrease port traffic congestion and reduce CO_2 emissions by 10% from trucks in the Port. Further benefits will be the monitoring and prediction of air quality and noise levels to generate notifications to government institutions when certain levels will be exceeded. Finally, the project will serve to inform shippers about the real emissions generated by their shipments in door-to-door transport chains between the Valencian region and the Balearic Islands.

CABINS TO CONTROL AIR QUALITY AND ENVIRONMENTAL FACTORS IN THE PORT OF VALENCIA

The Port of Valencia has just installed its third cabin to monitor air quality and other environmental factors at the Port of Segunto. The 3 booths can record up to 8 different gases and particles which allows for a precise analysis of air quality around the port. Using the latest technology, the cabin can measure in real time the concentration of sulphur dioxide (SO_2), nitrogen oxides ($NO/NO_2/NO_x$), ozone (O_3), carbon monoxide (CO) and PM10 and PM2.5 particles. A meteorological station has also been equipped in each of the three cabins and allows to collect information on wind speed and direction, rainfall, solar radiation, temperature, humidity, and barometric pressure. In addition, the port's acoustic level can be assessed, thanks to sound level meters.

The two cabins which were already in the Port of Valencia are part of the GREEN C PORTS project, coordinated by the Valenciaport Foundation and co-financed by the European Union. The data collected is publicly available on the website of the Port Authority, as well as on the website on the Regional Ministry of Agriculture, Rural Development, Climate Emergency and Ecological Transition.

PORT OF DOVER: ACHIEVING EMISSIONS REDUCTIONS TARGETS THROUGH SOLAR ENERGY AND BUILDING DESIGN

The Port of Dover is working hard to make its existing and new operations sustainable, aiming to reduce its carbon footprint by 5% each year towards a net zero carbon future. The Port has been successful in achieving a 49% carbon reduction since 2007, more than double relevant British and European targets. 4,837 individual photovoltaic panels have been installed on the roof of the new Dover Cargo Terminal West, with an additional 933 panels installed at the former Eastern Docks multi-storey car park to improve energy efficiency and increase the amount of energy obtained from renewable sources.

ENVIRONMENTAL INCENTIVES AT THE PORT OF HELSINKI

Environmentally influenced financial incentives play an important part of the Port of Helsinki's role of green facilitator. The Port offers environmental discounts on vessel fees for Environmental Ship Index (ESI) points, noise level in downtown harbour and for environmental investments. The Port also offers cruise ships a discount on waste fees, if they leave their wastewater in port reception facilities. Reviewing the results of these fees, the Port has found that the waste fee discount for cruise ships has been particularly effective. For example, in the last cruise season, close to 100 % of cruise passenger generated wastewater was sorted in waste reception facilities. Environmental benefits are not just limited to clients. Employees also have the possibility to benefit from the Port's green ambitions through its employee commuting policy. The Port encourages its employees to use public transportation and bicycles by offering seasonal tickets for public transports and the possibility to buy a bicycle as an employee benefit.

CLEAN SHIPPING AT THE PORT OF AMSTERDAM

Since 2011, the Port of Amsterdam has provided discounts for vessels listed in the ESI with a point score of 25 or higher. The maximum incentive equals a 6-10% discount per call and is double for vessels that use LNG for their main or auxiliary engine. Over 30% of ships entering the port last year received a discount based on the ESI point score. Furthermore, inland vessels with a Green Award certificate are also granted discounts, from 5% for a 'bronze' certificate up to 20% for a 'platinum certificate'. Further discounts are already in place for vessels that report their emissions at berth. In this way, Amsterdam facilitates both emissions reduction and the monitoring needed to ensure evidence-based policies going forward.

WASTE WATER TREATMENT FACILITY AT KIEL'S OSTSEEKAI

The Port of Kiel has long been investing to ensure a cleaner Baltic Sea. Most recently, the Port has invested in a capacity increase to ensure marine protection and to meet future regulatory requirements. The system was Germany's efficient ship waste-water reception facility when it went into operation in June 2017. The investment comprises the construction of quay-side pressure pipes leading into storage tanks equipped with technology for analysis and treatment. The connection to the municipal wastewater system has been established using pump stations and further pressure pipes. The facility was put into operation in the cruise season 2017 and has a capacity of up to 300m3 of wastewater per hour. This represents a tenfold increase in the wastewater reception capacity at Ostseekai and a significant boost for the protection of the Baltic Sea.

PLASTICS REDUCTION CAMPAIGN OF THE PORT OF ALGECIRAS

In 2021 will enter into force the new EU rules relating to ban on certain single-use plastics. Furthermore, the Action Plan for implementation of the 2030 Agenda towards a Spanish Strategy for Sustainable Development proposes to "significantly reduce marine pollution of all kinds." The Port Authority of Algeciras has responded to these regulations with a number of actions:

- Installation of water jets in offices, and of glass jugs in meeting rooms instead of plastic single-use bottles;

- Distribution of reusable bottles among workers to avoid the generation of waste from plastic bottles and cups;
- Substitution of plastic cups for cellulose cups in buildings with pumps;
- Placement of 80-liter containers for the deposit of single-use plastic containers use, and its collection in all buildings managed by the Port Authority;
- Installation of a "Comeplastic Whale" as a container for collecting plastics in the Port of Tarifa in collaboration with the City of Tarifa;

Extension of this policy to the specifications of contracts and concessions, inviting the Port's main dealers, companies and organisations related to the environment port (as well as other public and local administrations) to adhere to the policy.

PORT OF BARCELONA: ELIMINATION OF PLASTIC BOTTLES

In order to contribute to the elimination of the use of plastic containers, an initiative was launched in 2019 by the Port of Barcelona to replace plastic bottles used by the Port Authority workers with a system of water sources with water treatment located in the common spaces and in the offices of the organisation's buildings. So far, 30 water sources have been installed, leading to a saving of 118,680 plastic water bottles. The Port hopes to consolidate and extend this scheme, reducing waste directly at the source without needing to implement reuse or recycling initiatives.

PORT OF VIGO: ML-STYLE

The ML-Style project of the Port of Vigo aims to develop a comprehensive management system for waste from fishing ports (including food plastics, polystyrene boxes, disused gear and marine litter). This involves the installation of waste collection facilities and campaigns to communicate their work on waste collection to stakeholders and the local community. In addition, a study of potential innovative measures for the management, treatment and recovery of materials found in the marine environment will be carried out, seeking a commercial outlet for waste as raw materials for the manufacture of clothing and fashion accessories.

CIRCULAR ECONOMY AT THE PORT OF AMSTERDAM

The Port of Amsterdam aims to become a hotspot for the circular economy in Europe. To this end, the Port has been active in establishing a strategy to attract businesses and entrepreneurs. The Port has actively sought out organisations that are passionate about transforming society and the ways we use resources. The Port links those organisations to existing industries and activities, e.g., the city waste cluster, energy production, biorefineries, chemicals and liquid terminals. An example is the cooperation set up to fish for plastics in the Amsterdam canals and process these different streams of plastics into new products. To enhance innovation in this field, Port of Amsterdam has set up the incubators Prodock and Prodock 2.0, where start-ups and scale-ups have the opportunity to connect with other circular and biobased initiatives.

USE OF RAINWATER FOR CLEANING IN THE PORT OF SANTANDER

Aiming to improve its water management, Santander Port Authority identified the problem that tap water was being utilised for the cleaning of the port area, with negative economic and environmental consequences. To address the issue, the Port Authority sought to utilise the copious natural resource of rainwater to avoid water wastage.
A system of gathering rainwater from warehouse roofs and storing it in two deposits of 160 m3 and 935 m^3 was put in place. This water is then used to clean the port area, to dampen dusty materials, and in case of emergencies such as fire. The system was also digitalised so that tap water could be used if there was a lack of rainwater and to monitor the overall consumption of both rain and tap water. The project has helped the Port of Santander achieve its sustainable management aims, creating an efficient and sustainable solution to reduce the consumption of natural resources and energy.

Generally, nominating and acceptance of the port of Zadar into the ECOPORTS initiative/membership would have multiple benefits. It would allow better monitoring of European Ports standards and overall better monitoring of ecological processes at the port. The powerful promotional component of the ECOPORTS stamp should not be ignored either. There are currently not enough human or professional resources within the system to introduce ISO standards, however, the introduction of the standards in question should certainly be pursued.

4.4. Applicable EU/International port waste management good practices at port

Most of port waste management good practices mentioned in previous chapter are applicable in Port of Gaženica, whereas some are already being implemented throughout other EU projects (i.e., photovoltaic panels through SUSPORT project) whereas for others tackling ship waste management Port Authority of Zadar already has defined and applied such procedures. Good addition to Port of Gaženica waste management would be installation of several “Eco islands” providing additional waste collection and pollution prevention measure on both passenger area as well as on ferry terminals providing all users to additionaly participate in raising overall environmental awareness and responsibility.
Additionally, the only uncovered section of port waste management remains monitoring of air, sea and noise pollution. As it can be seen from forementioned good practices quite number of ports are recognizing importance of such waste monitoring systems. Such systems can provide real time data which would enable port authority to molre precisely determine pollution sources, especiallty regarding high number of vehicles, Ro-Ro (ferries) and cruise ships traversing thorugh port area during summer season.

4.5. Implementation assessment

4.5.1. Shortcomings

The Port Authority of Zadar ship waste disposal system is designed simply and therefore is still being efficient. The shortcomings are mainly related and highlighted in the the peak load periods (mostly summer) when the existing quantity and volume of containers for municipal and other waste is not sufficient to receive waste, which is compensated through more frequent waste discharging operations. An additional shortcoming is the fact that the Port of Zadar Authority is still a very small (and understaffed) institution. Due to lack of employees, it still doesn't have a separate person and/or service solely in charge of environmental and waste monitoring. Therefore, the existing services, in addition to their special tasks, are also casually dealing with the above issue. For the same reason, the Port of Zadar Authority has not yet implemented the ISO standard in the waste management policy. It also lacks general environmental and waste management plan which would take care of proper implementation of ISO standard regarding environmental and waste management procedures. An additional disadvantage is the absence of measuring equipment used for air, sea and noise real-time monitoring.

4.5.2. Feasible/proposed solutions for overcoming identified shortcomings

All of the forementioned shortcoming present opportunities through implementation of their feasible solutions. Although deficiency of qualified employees cannot be addressed through activities of EUROWAVES project, implementation of real-time air, sea and noise monitoring equipment and "Eco Islands" in ferry port area shall be properly addressed through ECOWAVES project.

4.5.3. Investment (costs) assessment

Budget foreseen by ECOWAVES project for activities implementation regarding Port Authority of Zadar should suffice for the procurement and implementation of air, sea and noise real-time monitoring system including mobile sea quality monitoring device as well as for implementation of several "Eco Islands" and several specialized mobile waste management containers.
Conducted initial assessement provided preliminary cost value of air, sea and noise real-time monitoring system including installation and 12-month 24/7 on site service and tutoring aroung 25.000,00 EUR + VAT (25% in Croatia) whilst the remeining amount would suffice for procurement and installation of several "Eco Islands" and specialized mobile waste management containers.

5. Port waste management systems/solutions action plan

5.1. Proposed port waste management activites

Sensoring part of the real-time air and noise monitoring system is anticipated to be installed on the rooftop of main terminal building with monitoring software easily available to Port Authority of Zadar. Sea quality monitoring equipment was planned as mobile unit allowing monitoring of several remote locations (city peninsula as well as Port of Lamjana located on Ugljan island).
"Eco Islands" are anticipated to be installed throughout and surrounding main terminal building and fishing part of Port of Gaženica as well as in city peninsula and Port of Lamjana.

5.2. Time plan

Activites proposed in this document should be prepared and carried out as shown on the Figure 4. After initial state-of-the-art analysis provided through this document, procurement process is anticipated to last two months due to legal requirements. After successfully conducted procurement, implementation process should be compleded by the end of June 2022. Hopefully, there will be no delays, but certain discrepancies from defined time plan cannot be excluded due to logistics disturbances and equipment shortages caused by COVID-19 pandemic.

PERIOD / *ACTIVITY*	X/21	XI/21	XII/21	I/22	II/22	III/22	IV/22	V/22	VI/22
State-of-the-art analysis									
Procurement									
Implementation									

Figure 4.: Time plan

5.3. Funding sources

Funding for planned port waste management activities has been anticipated through the following sources:

- EU Interreg ADRION Programme – ECOWAVES project
- EU Operational Programme Competitiveness and Cohesion
- The Environmental Protection and Energy Efficiency Fund (FZOEU)
- Innovation and Networks Executive Agency (INEA)

- Connecting Europe Facility (CEF)
- Horizon 2020 – Smart, green, and integrated transport + Secure, clean, and efficient energy
- European Structural and Investment (ESI) funds
- European Fund for Strategic Investments (EFSI)
- Innovation Fund (INNOVFUND)
- INTERREG
- Republic of Croatia national budget
- Private investors – concessionaires
- Croatian Bank for Reconstruction and Development (HBOR).

6. Conclusion

Measures and actions defined throughout this document are mentioned to cope with some existing issues regarding waste management and overall pollution monitoring.

Port of Zadar Authority does not have a separate environmental policy plan which would consider the European and national environmental legislation, as well as the international environmental regulations and which would be designed for the evaluation of the environmental performance of port activities. However, Port of Zadar acknowledges the importance of environmental protection and issues arising from the port activities and which are related to the port area, sea, noise, and air quality. In order to minimize the negative effects on the environment, Port of Zadar Authority implements a series of activities and regulations on the port area under their jurisdiction. In this sense, the main priorities of the Port of Zadar Authority include effective management of waste from ships and operations and procedures with hazardous substances from ships. It also lays down the regulations on the maintenance of order which need to be followed in order to preserve safety and security in the port area.

It would be useful to implement a separate environmental policy plan within the port of Zadar dealing with the issues of monitoring and reporting of environmental impact in the port area and also laying down specific short-term and long-term actions in view of environmental protection. This document would be multipurpose as it would aim at: waste management, energy and cost savings, better environmental performance, fulfilling legislative targets on carbon footprint.

Since Port of Zadar represents a frequent port with a large number of passengers and vehicles, besides the management of waste collection from ships, it is necessary to pay special attention to the maintenance of the land part of the port in such a way as to ensure a quality and separate reception of small municipal waste produced by passengers. Recycling of waste and postulates of the circular economy currently exist only in traces and are currently located outside the port area. The circular economy is a system built on reduction, reuse and recycling because waste is considered a valuable resource. In accordance with the above mentioned as one of the activities within the ECOWAVES project, the purchase of containers for the collection of various types of waste of the so-called "Eco Island" on the mainland part of the port area intended for all port users is also foreseen. Furthermore, the port has all the national documents and procedures around waste disposal, however, and undercapicity of personnel within the Port of Zadar Authority as well as other key entities causes poorer monitoring over these processes. Therefore, implementation of real-time air, sea and noise monitoring system is seen as important step towards improving Port of Zadar waste management system.

Currently there are no stimulation system in place for ships in case of conscientious management of ship waste, i.e., in case of non-compliance with port rules, only penalties in case they are caught in violation. In the future is is very important to define rewarding procedures for conscientious ships/cruise companies properly managing their waste (as mentioned under good practices review).

Although not directly associated with ECOWAVES project is is a great opportunity to mention another way of improving destination cooperation and initiatives in terms of organized

periodic cleaning of the port area including underwater areas and other educational actions that would address various target groups - from tourists, local population, concessionaire employees, port authority and other public services arriving in the port area. In any case, it can be concluded that in terms of sustainable development Zadar as a destination and the Port of Zadar Authority made great positive strides in the previous period and thus solved a large part of the problems in sustainable destination management. It is the turn to eliminate minor shortcomings, but with the necessary long-term strategic thinking towards the development of activities and procedures in waste management.

All proposed measures and actions proposed within this document would definitely bring closer Port of Zadar for nomination and acceptance into the ECOPORTS initiative/membership would have multiple benefits. It would allow better monitoring of European Ports standards and overall better monitoring of ecological processes at the port. The powerful promotional component of the ECOPORTS label should not be ignored either. There are currently not enough human or professional resources within the system to introduce ISO standards, however, the introduction of the standards in question should certainly be pursued.

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