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# Sustainable activities in Croatian marinas – towards the “green port” concept

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## ABSTRACT

Due to the intensity of marina activities and global climate change, marinas are facing the challenge of sustainability. Therefore, the concept of “green port” has now become a requirement. In practice, the term “green port” describes the activities of all stakeholders involved in the port business towards a sustainable development of the port. This paper aims to provide an insight into the current application of sustainability principles and the concept of “green port” in Croatian marinas. Therefore, the concept of “green port” is described. Furthermore, the framework (regulations, policies, international and national certificates and programs) for sustainable activities in Croatian marinas are analyzed. The main part of the paper is the analysis of sustainable activities, i.e. practices in Croatian marinas related to eco-spatial design, standardization and awarding system, energy transition, sustainable waste, water and air systems. Therefore, positive sustainable practices in selected Croatian marinas and aspects that need improvement are identified.

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## 1 Introduction

An attractive coastline, good conditions for sailing and yachting tourism during most of the year, good tourist infrastructure and a long tradition are some of the main reasons for the attractiveness of Croatian marinas. Nautical tourism is one of the most important tourism sectors in Croatia. Since marinas use land and sea areas, the implementation of the “green port” concept in marinas is inevitable for sustainable development.

According to the “Ordinance on the categorization of nautical tourism ports and the classification of other facilities for the provision of berth services and accommodation of vessels” [20] (Official Gazette 120/2019, hereinafter referred to as the “Ordinance”), nautical ports are defined as economic-functional entities in which legal or natural persons operate to provide nautical and other services to tourists (trade, hospitality, etc.). Unlike the 2008 Ordinance, the recent edition classifies only marinas as nautical ports. Therefore, nautical anchorages and dry marinas are listed as other objects for berthing and accommodation of vessels.

The Ordinance defines marinas as part of a specially constructed and equipped sea or water area and coastline for the provision of berthing, tourist accommodation and other services to meet the needs of tourists [20].

Marinas include marine, coastal and land areas. In addition, marinas have touristic and other related activities. This makes marinas a complex area in which sustainability should be achieved and maintained. An estimated 6 million boats are anchored in European waters, while 10,000 marinas provide over 1 million berths [5]. According to the “Guidelines for the sustainability of cruising and recreational boating in the Mediterranean region” (including Croatian marinas), approximately 70% of the world’s megayachts sail year-round in the Mediterranean [21]. The marinas are close to full capacity, especially in the western EU-Mediterranean countries during the high season [21]. These data illustrate the intensity of activity in marinas and, consequently, the pressure on sustainability.

According to the United Nations “2030 Agenda for Sustainable Development” (Sustainable Development Goal

-SDG 14), the international community should conserve and sustainably use the oceans, seas, and marine resources for sustainable development [26]. The European Green Deal aims to protect biodiversity and ecosystems, reduce air, water and soil pollution, transition to a circular economy, improve waste management, and ensure the sustainability of the blue economy and fisheries sector by 2030 [7]. Therefore, the detailed blue economy agenda includes several goals that impact marina sustainability: development of renewable offshore energy, decarbonization of maritime transport, greening of ports and development of green infrastructure in coastal areas [8]. The “EU Zero Pollution Action Plan” aims, among other things, to improve water quality by reducing waste, plastic litter in the sea (by 50%) and microplastics entering the environment (by 30%) [9].

The aim of this paper is to analyze the current situation of sustainability in 35 selected public and private Croatian marinas. For the analysis, three aspects, i.e., criteria (Eco-spatial design, standardization, awarding system and education on sustainability; Energy transition; Sustainable waste, water and air systems) are defined with the corresponding sub-criteria that represent the concept of “green port” in Croatian marinas. The criteria and sub-criteria are described in detail in Section 4.

The data were collected as part of the FRAMESPORT project “Framework Initiative Fostering the Sustainable Development of Adriatic Small Ports”. FRAMESPORT is a project co-funded by the Italy-Croatia CBC program. The research was conducted by the Faculty of Tourism and Hospitality Management in Opatija in 2021.

## 2 Green port concept in marinas

To become sustainable, marinas should integrate the “green port” concept into their operations. The overall goal of the “green port” concept should be to provide ports and mobility that secure regional economic development while ensuring a long-term future for natural resources. In the context of ports, the focus has often been on economic outcomes, with less attention paid to social and environmental aspects [30].

The concept of “green port” encompasses environmentally friendly methods of marina activity, operation, and management. The main objective of the “green port” concept is the sustainable development of ports and port regions through environmentally, economically, and socially oriented port management [4]. According to the European Sea Ports Organisation – ESPO, the implementation of the concept “green port” requires interaction between the port authority/management and other port stakeholders [10]. In addition, according to the “ESPO Green Guide 2021 – a manual for European ports towards a green future”, the top ten environmental priorities for European ports are: air quality, climate change, energy efficiency, noise, relations with local communities, ship waste, water quality, garbage/port waste, dredging and port development (land-based) [10].

The main consequences of not implementing the “green port” concept in marinas are [11]:

- Ecosystem disruption: boats stir up sand and mud, reducing water clarity and promoting algae growth,
- Land pollution: plastic and non-plastic contents are not properly recycled and disposed of,
- Water pollution: garbage, wood waste, fuels and other non-biodegradable products (e.g., glass, plastic, metals, hazardous materials, pesticides, fibers, e-waste) are not properly recycled and disposed of,
- Air pollution: fossil fuels and carbon emissions (idling boat engines, burning oil and gas) increase the carbon footprint in the waterfront,
- Noise pollution: it affects the animals’ ability to communicate with potential mates, other group members, their offspring or feeding. It reduces the animals’ ability to perceive environmental cues (to avoid predators, find food, etc.).

For example, plastics account for 80% of all waste in the sea [23]. About 92% of the more than five trillion pieces of plastic waste floats on the surface as so-called microplastics. These are tiny particles up to 5 millimeters in diameter [29]. They are not only a severe problem in the ocean but are also found in enormous quantities in drinking water [29]. According to some estimates, there will be more plastic than fish in the oceans by 2050 if no countermeasures are taken. For example, noise underwater is up to 5 times faster and 60 times farther than in the air. It is estimated that ambient noise in the world’s oceans has increased over the last 50 years, at least by 20 dB at low frequencies (10-500 Hz) compared to pre-industrial conditions [6].

Marinas that implement the “green port” concept can obtain the following benefits [11]:

- preservation of the marine environment,
- protection of marine biodiversity,
- energy transition towards renewable energy sources,
- waste management transition towards circular economy, industrial ecology and life cycle principles (waste=resources),
- water transition from an integrated urban water system to rainwater and recycled wastewater,
- transition towards hybrid, solar-electric, solar-hydrogen boats or cars, autonomous boats and cars,
- transition to sustainable construction through eco and energy efficient buildings,
- attracting new customers,
- improvement of life quality of local community,
- promotion of sustainable urban development of the waterfront,
- increased opportunities for employment,
- increased profit of the marina.

The implementation of the concept of “green port” improves the activities of the marina, considering all aspects of sustainability: environmental, economic and social. As a result, the marina will offer high quality services compatible with the principles of sustainability, create better working conditions for its employees and become more profitable. The marina will not only become more successful as an organization but will also be a driver for the development of the region by enabling sustainable use of the marina site, providing employment opportunities and improving the quality of life of the local community.

### 3 Framework for sustainable activities in Croatian marinas

Compliance with sustainability principles in Croatian marinas is regulated by ordinances, regulations, international and national certificates, and programs. In addition, sustainability has been included in the strategic documents that regulate tourism in Croatia. The Ordinance sets criteria for the categorization of marinas. Marinas in Croatia can be categorized into four categories (two anchors, three anchors, four anchors and five anchors), depending on the criteria for evaluating the variety and quality of services, quality of equipment, facilities and maintenance. Environmental criteria are also established for the classification of marinas, including alternative energy sources, potable water reuse, water savings through new technologies, electricity savings (energy-saving light bulbs, power limiters, automatic shut-off), time limits on marina traffic, parking for visitors, protection of the natural coastline, horticulture of the marina with native species, Blue Flag and ISO 14001 certification. The quality of equipment, facilities and maintenance of the marina also includes sustainability criteria: waste management (pots for waste disposal, regular waste disposal, clean water surface (without oil and other pollutants) and clean green areas in the marina.

Croatian marinas are regularly awarded within the international Blue Flag programme [2] – the most recognized model of environmental education and public information when it comes to the protection of the sea and the coastal zone. The Blue Flag is a recognition awarded for one season only. To receive the Blue Flag, the application must be submitted each year in the prescribed manner. The criteria for awarding the Blue Flag to marinas are divided into several categories: Environmental Education and Information; Environmental Management; Safety and Services; Water Quality; Corporate Social Responsibility; Social/Community Engagement. The main ISO certificates for marinas are ISO 14001 [14] for the environmental protection and ISO 50001 [15] for energy efficiency.

The Gold Anchor [24] was developed by the marina industry with the aim of raising standards and providing customer-oriented services. It is a globally recognized and important accreditation that guarantees that the marina bearing the above certificate meets the highest standards

of service and relations with guests. The Yacht Harbour Association (TYHA) Gold Anchor is awarded internationally according to strict criteria and provides additional market exposure to first-class marinas.

As for the strategic documents, the “Nautical Tourism Strategy of the Republic of Croatia 2009 – 2019”, defined sustainability as a crucial way to develop nautical tourism. Tailor-made offers for a nautical tourist who respects nature and the environment and shares the heritage of the ancestors with future generations are defined as a task [18]. The Strategy highlights the following: sustainable use and management of resources, implementation of a control and management system for maritime navigation, equipping ships and nautical ports with devices and equipment for protection against marine pollution, application of new technologies and environmental standards [18]. In 2015, the “Action Plan for the Development of Nautical Tourism”, emphasized the need for more sustainable operation in nautical ports i.e., marinas. In 2016, the Institute of Tourism published an “Action Plan for the Development of Green Tourism”, which highlighted the lack of green technologies in marinas.

The main document for the sustainable development of Croatian tourism until 2030 is the “Sustainable Tourism Development Strategy 2030” (hereinafter referred to as the “Strategy”) [19], adopted by the Government of the Republic of Croatia. According to the Strategy, sustainability is the priority for all Croatian tourism. Specifically for nautical tourism (priority area 1.3. of strategic objective 1 “Year-round and more regionally balanced tourism; development of special forms of tourism and structured product development”) the priority is the development of nautical tourism based on environmental protection and quality of services in marinas. The “National Plan for Sustainable Tourism” is prepared as a medium-term plan for the implementation of the Strategy through concrete measures to operationalize the priority sustainability aspects.

In addition to national strategies and plans, there are also those at the regional and local level, such as the “Action Plan for the Development of Nautical Tourism in Split-Dalmatia County” (2013) and “Tourism Development Strategy of the City of Solin from 2018 to 2025”, which focus on specific sustainability measures for a given geographical area [13].

Compared to the practice of sustainable marinas in neighboring countries in the Adriatic region, Croatia has the advantage of having a clearly defined legal framework and strategies. Montenegro, for example, has made considerable progress in developing its marina business since 2006, but still does not have a defined strategy for developing nautical tourism [16]. Research conducted in Montenegro has shown that nautical tourists with higher purchasing power are the least satisfied with the management of Montenegrin natural resources, while tourists with lower incomes miss recreational facilities in marinas the most. Managers of nautical destinations should be par-

ticularly aware of the fact that as the frequency of visits increases, satisfaction with some aspects of the nautical offer decreases. Therefore, it should be considered that a stronger application of the “green port” concept can be a marketing tool for attracting and retaining tourists, and thus a better long-term positioning of Adriatic marinas in the dynamic tourist market [16].

#### 4 Analysis of sustainable activities in Croatian marinas

The analysis was prepared as part of the FRAMESPORT research project. The questionnaire was distributed to 35 marinas in Croatia (22 ACI marinas and 13 private marinas). In order to collect data relevant to the FRAMESPORT project, certain aspects of sustainability in Croatian marinas were included in the survey. These aspects should be considered as criteria and corresponding sub-criteria that could be used to evaluate sustainability not only of Croatian marinas, but also of other marinas.

In this paper, the current situation of sustainable activities in Croatian marinas is analyzed based on three criteria and their corresponding sub-criteria, which represent the “green port” concept in the studied Croatian marinas. The criteria and sub-criteria are defined as follows:

- Eco-spatial design, standardization, awarding system and education with their corresponding sub-criteria: marina green surfaces, Environmental management system, international and national certificates and awards, education on sustainability for employees and visitors,
- Energy transition, with the corresponding sub-criteria: use of renewable energy sources, promotion of sustainable transport, electric charging station for boats, electric charging station for cars,
- Sustainable waste, water and air systems, with corresponding sub-criteria: waste disposal system, wastewater monitoring system, wastewater filtration system, waste oil and ballast water disposal system, battery disposal, air purification system, desalination system.

In this paper, the data are shown in Table 1 and Table 2 (at the end of this section) according to defined criteria and sub-criteria and the data availability (yes/no/data not available). In the paper, defined criteria in Croatian marinas are estimated based on the share (percentage) of a given sample of all marinas.

Green surfaces cover 57% of Croatian marinas, which means that almost half of marinas consist only of classical construction elements (buildings, access roads...). In the modern eco-spatial design of marinas, green areas are indispensable. The percentage of green areas varies from marina to marina, e.g., Marina Tribunj has 40% green areas, while Olive Island Marina has only 5% green areas. According to the previously mentioned Ordinance, the horticultural design of marinas is one of the criteria for en-

vironmental protection. For example, during the modernization of ACI Marina Rovinj, special attention was paid to the greening of marina areas with native Mediterranean and evergreen plants and trees. In addition, sensory systems were installed for the irrigation of the green areas in the Marina Rovinj [1].

ISO 14001 Environmental management system [14] is a framework that a company or organization can follow to establish an effective Environmental management system. An Environmental management system is a set of procedures and practices that enable an organization to reduce its environmental impact and increase its operational efficiency. Therefore, the Environmental management system should be considered as a basis for marinas to implement the “green port” concept. Almost 63% of Croatian marinas have the ISO 14001 Environmental management system, and the remaining Croatian marinas should tend to implement the ISO 14001 Environmental management system, as it can provide assurance to management, employees and external stakeholders that the environmental impact in the marina is measured and improved. In terms of international and national certificates and awards, about 74% of Croatian marinas have been awarded the Blue Flag, most of them continuously for years. For example, in 2009 there were 20 marinas in Croatia with the Blue Flag [22], while in 2022 there are 30 marinas with the Blue Flag [25]. Marina Punat was the first Croatian marina to be awarded the Blue Flag in 1998 [17]. In addition to the Blue Flag, some marinas (e.g., ACI Marina Umag, Marina Borik and Marina Kornati) have been awarded with Green Energy and Green Sail. In Croatia, marinas can obtain the special “ZelEn” certificate awarded by HEP OPSKRBA d.o.o., the national energy company for the production, distribution and supply of electricity [12]. This certificate for high environmental responsibility is awarded based on the production of electrical energy 100% from renewable sources. ACI d.d. (JSC), for example, successfully completed the recertification of management systems in accordance with the international standard ISO 9001:2005 and again received the “ZelEn” certificate. Gold Anchor is another awarding system. For example, marina Punat received the Gold Anchor certificate. Croatian marinas are actively engaged in educating their employees and visitors about sustainability (only two analyzed marinas – Parentium and Kremik, do not provide this type of education).

Renewable energy sources (solar energy, wave energy, hydrogen, wind turbines, biomass power plants, etc.) contribute to sustainability in marinas by reducing emissions of pollutants such as greenhouse gasses. As for Croatian marinas, about 66% of marinas rated the use of renewable energy sources as high, while 23% of marinas rated it as low. Only one marina rated the use of renewable energy sources as medium and 3 marinas do not use renewable energy sources. Marina Žut, for example, uses solar energy, among other sources, to generate electricity. ACI,



for example, has received the ISO 50001:2011 certificate. The ISO 50001:2011 standard sets out the requirements for establishing, implementing, maintaining and improving an energy management system that enables an organization to take a systematic approach to improving energy performance, including energy efficiency, energy use and energy consumption [15]. ACI is a leader in the conversion of marinas to green energy in Croatia. Recently, ACI applied for the “North Adriatic Hydrogen Valley” project, which aims to apply hydrogen as a renewable energy source [1]. Sustainable transport is promoted by 66% of marinas. Only 14% of the marinas have electric charging stations for boats. Regarding electric charging stations for cars, the situation in marinas is better, as 51% of marinas have them. Nevertheless, there is room for improvement, especially in terms of charging stations for boats.

All marinas have a waste disposal system, waste oil and ballast water disposal system and regular battery disposal. The wastewater monitoring system includes the analysis of elements, behavior and estimation of parameters, optimization in real time and safety. It is a system consisting of measurement sensors, a control panel and a communication unit for monitoring the wastewater [27]. The wastewater monitoring system is used in almost each of the studied marinas (not only in one marina – Marina Vrsar). Wastewater filtration system is used in 83% of the analyzed Croatian marinas. The wastewater in marinas comes from washing boats and removing antifouling coating, which is very harmful to the environment as it releases heavy metals, of which copper is particularly significant and dangerous. Unlike degradable organic substances, heavy metals do not disappear, but remain in the environment, either in the sea or in underwater sediments, or they end up in fish and marine organisms. The harmfulness of fecal sanitary wastewater refers to the microbiological pollution to humans and the harmfulness of ingesting polluted wastewater, which promotes the growth of algae and the reduction of local oxygen concentration in the sea [3]. For example, Marina Trogir, Marina Split and Marina Olive Island have the chemical-physical device for purification of waste water from wash-

ing boats. The purified water can be used for irrigation of green areas in the marina. The air purification system and desalination system are the most critical points. None of the analyzed marinas does not have air purification system. Only two marinas (Marina Žut and Marina Piškera) have desalination system. These two elements are very important because the air quality should be continuously improved and the water source should be treated with great care. It is estimated that the gap between global water supply and demand will reach 40% by 2030 if no changes are made in water use [28].

The research results indicate the following shortcomings:

- lack of green surfaces in marinas: it is necessary to redesign existing areas or new marinas should incorporate these elements into the architectural design process;
- untapped potential in standardization and awarding system: marinas that do not yet have certificates and awards should strive for the Blue Flag, as the Blue Flag is the most recognizable to marina visitors. Marinas that already have the Blue Flag should strive for other certificates, such as Gold Anchor, Green Energy, etc.;
- slow energy transition: application of alternative energy sources should be accelerated to adopt more sustainable energy sources and technologies and should be seriously considered as one of the top priorities for marinas;
- lack of the air purification system and desalination system, which should be given special attention in terms of implementation of the “green port” concept in the future, as they have been identified as the most critical.

In order to improve the sustainability of their activities, marinas have challenges such as regulations, ownership, concessions, financial resources, spatial planning, human resources, technology, etc., that affect the implementation of the “green port” concept. These challenges require detailed analysis and therefore should be considered as topic for future research.

**Table 1** Eco-spatial design/ Standardization and awarding system/ Education/ Energy transition

Marina	Green surfaces	Environmental management system	International and domestic certificates and awards	Education on sustainability for employees and visitors	Use of renewable energy sources (-/Low/Medium/High)	Promotion of sustainable transport	Electric charging station (ECS) for boats	Electric charging station (ECS) for cars
ACI Marina Umag	+	ISO 14001	Blue Flag Green Sail Green Energy	+	High	+	-	+
ACI Marina Rovinj	+	ISO 14001	Blue Flag	+	High	+	-	+
ACI Marina Pula	-	ISO 14001	Blue Flag	+	High	+	-	-
ACI Marina Pomer	+	ISO 14001	Blue Flag	+	High	+	-	+
ACI Marina Opatija	+	ISO 14001	Blue Flag	+	High	+	-	+
ACI Marina Cres	+	ISO 14001	Blue Flag	+	High	+	-	+
ACI Marina Supetarska Draga	-	ISO 14001	Blue Flag	+	High	+	-	+
ACI Marina Rab	-	ISO 14001	Blue Flag	+	High	-	-	-
ACI Marina Šimuni	-	ISO 14001	Blue Flag	+	High	-	-	-
ACI Marina Žut	-	ISO 14001	Blue Flag	+	High	-	-	-
ACI Marina Piškera	-	ISO 14001	-	+	High	-	-	-
ACI Marina Jezera	+	ISO 14001	Blue Flag	+	High	+	-	-
ACI Marina Vodice	+	ISO 14001	Blue Flag	+	High	+	-	+
ACI Marina Skradin	-	ISO 14001	Blue Flag	+	High	+	-	-
ACI Marina Trogir	-	ISO 14001	Blue Flag	+	High	-	-	-
ACI Marina Split	-	ISO 14001	Blue Flag	+	High	+	-	-
ACI Marina Milna	-	ISO 14001	Blue Flag	+	High	+	-	-
ACI Marina Vrboška	-	ISO 14001	Blue Flag	+	High	-	-	-
ACI Marina Palmižana	-	ISO 14001	-	+	High	-	-	-

Marina	Green surfaces	Environmental management system	International and domestic certificates and awards	Education on sustainability for employees and visitors	Use of renewable energy sources (-/Low/Medium/High)	Promotion of sustainable transport	Electric charging station (ECS) for boats	Electric charging station (ECS) for cars
ACI Marina Korčula	-	ISO 14001	Blue Flag	+	High	-	-	-
ACI Marina Veljko Barbieri, Dubrovnik	+	ISO 14001	Blue Flag	+	High	-	-	+
ACI Marina Dubrovnik, Dubrovnik	-	ISO 14001	Blue Flag	+	High	-	-	+
Marina Vrsar (Montraker)	+ (15%)	-	-	+	Low	+	-	+
Marina Funtana (Montraker)	+ (5%)	-	-	+	Low	+	-	-
Marina Veruda (Tehnomont d.d.)	+ (30%)	-	Blue Flag	+	Low	+	-	+
Marina Parentium	+ (5%)	-	Blue Flag	-	Low	-	+	+
Marina Borik, (D-Marin)	+ (18%)	ISO for management	Blue Flag, Green Sail, ISO for nautical tourism services	+	-	-	-	+
Marina Tribunj (D-Marin)	+ (40%)	-	Blue Flag	+	No	+	+	-
Olive Island Marina (Marina Signum d.d.)	+ (5%)	-	Blue Flag	+	Medium	+	-	+
Marina Kornati	+ (10%)	-	Blue Flag Croatian Tourist board and local awards	+	Low	+	+	+
Marina Hramina	+ (20%)	-	-	+	Low	+	-	+
Marina Betina	+ (10%)	-	-	+	Low	+	+	+
Marina Kremik	-	-	-	-	No	+	-	-
Marina Novi	+ (30%)	-	-	+	High	+	+	+
Marina Mitani	+ (10%)	-	-	+	Low	+	-	-

+ = yes; - = no/data not available

Source: Authors – according to the data collected from research conducted within the FRAMESPORT project

**Table 2** Sustainable waste, water and air systems

Marina	Waste disposal system	Battery disposal	Wastewater monitoring system	Wastewater filtration system	Waste oil and balast water disposal system	Air purification system	Desalination system
ACI Marina Umag	+	+	+	+	+	-	-
ACI Marina Rovinj	+	+	+	-	+	-	-
ACI Marina Pula	+	+	+	-	+	-	-
ACI Marina Pomer	+	+	+	+	+	-	-
ACI Marina Opatija	+	+	+	+	+	-	-
ACI Marina Cres	+	+	+	+	+	-	-
ACI Marina Supetarska Draga	+	+	+	+	+	-	-
ACI Marina Rab	+	+	+	-	+	-	-
ACI Marina Šimuni	+	+	+	+	+	-	-
ACI Marina Žut	+	+	+	+	+	-	+
ACI Marina Piškera	+	+	+	+	+	-	+
ACI Marina Jezera	+	+	+	+	+	-	-
ACI Marina Vodice	+	+	+	+	+	-	-
ACI Marina Skradin	+	+	+	-	+	-	-
ACI Marina Trogir	+	+	+	+	+	-	-
ACI Marina Split	+	+	+	+	+	-	-
ACI Marina Milna	+	+	+	+	+	-	-
ACI Marina Vrboska	+	+	+	+	+	-	-
ACI Marina Palmižana	+	+	+	+	+	-	-
ACI Marina Korčula	+	+	+	+	+	-	-
ACI Marina Veljko Barbieri, Dubrovnik	+	+	+	+	+	-	-
ACI Marina Dubrovnik, Dubrovnik	+	+	+	-	+	-	-
Marina Vrsar (Montraker)	+	+	-	+	+	-	-
Marina Funtana (Montraker)	+	+	+	+	+	-	-
Marina Veruda (Tehnomont d.d.)	+	+	+	+	+	-	-
Marina Parentium	+	+	+	+	+	-	-
Marina Borik, (D-Marin)	+	+	+	+	+	-	-
Marina Tribunj (D-Marin)	+	+	+	+	+	-	-
Olive Island Marina (Marina Signum d.d.)”	+	+	+	-	+	-	-
Marina Kornati	+	+	+	+	+	-	-
Marina Hramina	+	+	+	+	+	-	-
Marina Betina	+	+	+	+	+	-	-
Marina Kremik	+	+	+	+	+	-	-
Marina Novi	+	+	+	+	+	-	-
Marina Mitan	+	+	+	+	+	-	-

+ = yes; - = no/data not available

**Source:** Authors – according to the data collected from research conducted within the FRAMESPORT project



## 5 Conclusion

Implementing the concept of “green port” improves a marina’s environmental performance, energy efficiency, competitiveness and social awareness. In this research, sustainability practices in Croatian marinas were analyzed from the following aspects (criteria): eco-spatial design, standardization and awarding system, education on sustainability, energy transition, sustainable waste, water and air systems.

Regarding the eco-spatial aspect, the research revealed that Croatian marinas should pay attention to greening their areas and improving the ecological design of marina areas, as almost half of the marinas do not have greened areas. As far as standardization and awarding system are concerned, Croatian marinas have made progress in the last decade. First, more Croatian marinas are receiving the international “Blue Flag” award for compliance with sustainability principles. In addition, most Croatian marinas comply with the ISO 14001 standard for Environmental management systems. Furthermore, marinas have received domestic certificates and awards, such as the ZelEn certificate for marinas that use 100% renewable energy sources for electricity generation. Energy transition towards alternative/renewable energy sources is an important part of sustainable activities in marinas. More than half of the marinas rated the use of renewable energy sources as high. However, a portion of marinas use renewable energy sources at low levels or not at all. In addition, sustainable transportation is not promoted in half of marinas. Regarding electric charging stations, charging stations for boats are missing, while half of the marinas have charging stations for cars. As for sustainable waste, water, and air systems, the current situation is satisfactory. All marinas have waste disposal systems, waste oil and ballast water disposal systems and battery disposal systems. Only one marina does not have a wastewater monitoring system. Furthermore, most marinas have a wastewater filtration system. However, there is a significant lack of air purification system and desalination system.

Despite certain shortcomings, Croatian marinas have made progress in sustainability practices, i.e. the “green port” concept. As for further efforts, sustainability and implementation of the “green port” concept in Croatian marinas are recognized and supported in the “Sustainable Tourism Development Strategy 2030” and the “National Sustainable Tourism Plan” for the 2030 perspective.

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## References

- [1] ACI marinas (2022). „Uloga nautike u promociji i pozicioniranju destinacije te važnost održivog razvoja turizma“; available at: <https://aci-marinas.com/hr/plavo-i-zeleno-kako-do-odrzivog-nautickog-turizma/> [accessed: 20 October 2022]
- [2] Blue Flag Programme (2022). „Pure water, clean coasts, safety and access for all“; available at: <https://www.blueflag.global/> [accessed: 25 September 2022]
- [3] Burza nautike (2021). „U Hrvatskoj još uvijek postoje marine i kampovi koji ne vode brigu o otpadnim vodama“; available at: [https://www.burzanautike.com/hr/u\\_hrvatskoj\\_jos\\_uvijek\\_postoje\\_marine\\_i\\_kampovi\\_koji\\_ne\\_vode\\_brigu\\_o\\_otpadnim\\_vodama/7066/5](https://www.burzanautike.com/hr/u_hrvatskoj_jos_uvijek_postoje_marine_i_kampovi_koji_ne_vode_brigu_o_otpadnim_vodama/7066/5) [accessed: 03 September 2022]
- [4] Chiu, R.H, Lin, L. H., Ting, S. C. (2014). „Evaluation of Green Port Factors and Performance: A Fuzzy AHP Analysis“, *Mathematical Problems in Engineering*, Vol. 2014, p. 1-12., doi: <https://doi.org/10.1155/2014/802976>.
- [5] European Boating Industry (2020). „Facts and Figures“; available at: <https://europeanboatingindustry.eu/about-the-industry/facts-and-figures> [accessed: 03 September 2022]
- [6] European Commission (2019). „European Marine Observation and Data Network (EMODnet)“; available at: <https://emodnet.ec.europa.eu/en/map-week-%E2%80%93-underwater-noise-indicator> [accessed: 04 September 2022]
- [7] European Commission (2019). „Protecting the environment and oceans with the Green Deal“; available at: [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/protecting-environment-and-oceans-green-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/protecting-environment-and-oceans-green-deal_en) [accessed: 04 September 2022]
- [8] European Commission (2022). „Sustainable Blue Economy“; available at: [https://oceans-and-fisheries.ec.europa.eu/ocean/blue-economy/sustainable-blue-economy\\_en](https://oceans-and-fisheries.ec.europa.eu/ocean/blue-economy/sustainable-blue-economy_en) [accessed: 04 September 2022]
- [9] European Commission (2022). „Zero pollution action plan“; available at: [https://environment.ec.europa.eu/strategy/zero-pollution-action-plan\\_en](https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_en) [accessed: 04 September 2022]
- [10] European Sea Port Organisation (2021); „ESPO Green Guide 2021 – a manual for European ports towards a green future“; available at: <https://www.espo.be/media/ESPO%20Green%20Guide%202021%20-%20FINAL.pdf> [accessed: 04 September 2022]
- [11] Green Business Bureau (2021). „Sustainable Guide for Marina Owners and Operators: Getting Started“; available at: <https://greenbusinessbureau.com/industries/sustainable-guide-for-marina-owners-and-operators-getting-started/> [accessed: 10 September 2022]
- [12] HEP Opskrba (2022). „Zelena energija“; available at: <https://zelen.hep.hr/zelena-energija/sto-je-zelen/11> [accessed: 10 September 2022]

- [13] Institute for Tourism (2018). „Tourism Development Strategy of the City of Solin from 2018 to 2025“; available at: <http://www.iztztg.hr/en/main-projects/research-projects/?tid=160> [accessed: 10 September 2022]
- [14] International Organization for Standardization (2022). „ISO 14001 – Environmental management“; available at: <https://www.iso.org/iso-14001-environmental-management.html> [accessed: 11 September 2022]
- [15] International Organization for Standardization (2022); „ISO 50001:2011 Energy management systems — Requirements with guidance for use“; available at: <https://www.iso.org/standard/51297.html> [accessed: 11 September 2022]
- [16] Kovačević Z., Šekularac-Ivošević S. (2022). Management Framework for Sustainable Nautical Destination Development: The Case of Montenegro; *Sustainability*, 14(18):11476, doi: <https://doi.org/10.3390/su141811476>
- [17] Marina Punat (2022). „Environment-friendly Marina“; available at: <https://www.marina-punat.hr/about-marina-punat/environment-friendly-marina/317> [accessed: 15 October 2022]
- [18] Ministry of Maritime Affairs, Transport and Infrastructure (2008). „Nautical Tourism Development Strategy of the Republic of Croatia 2009-2019“; available at: <https://mmpi.gov.hr/UserDocsImages/arhiva/Strategija%20razvoja%20nautickog%20turizma%20ENGL%201.pdf> [accessed: 15 October 2022]
- [19] Ministry of Tourism and Sport of the Republic of Croatia (2022). „Sustainable tourism development strategy until 2030 to be drawn up“; available at: <https://mint.gov.hr/news-11455/sustainable-tourism-development-strategy-until-2030-to-be-drawn-up/22090> [accessed: 28 September 2022]
- [20] Ordinance on the categorization of nautical tourism ports and the classification of other facilities for the provision of berth services and accommodation of vessels; *Official Gazette* 120/2019; available at: [https://narodne-novine.nn.hr/clanci/sluzbeni/2019\\_12\\_120\\_2374.html](https://narodne-novine.nn.hr/clanci/sluzbeni/2019_12_120_2374.html) [accessed: 16 October 2022]
- [21] Plan Bleu – Regional Activity Centre of Mediterranean Action Plan (2022). „Guidelines for the sustainability of cruises and recreational boating in the Mediterranean region“; available at: [https://planbleu.org/wp-content/uploads/2022/04/Guidelines\\_planbleu\\_Cruise\\_FINAL.pdf](https://planbleu.org/wp-content/uploads/2022/04/Guidelines_planbleu_Cruise_FINAL.pdf) [accessed: 17 October 2022]
- [22] Poduzetništvo.org (2009). „Poduzetništvo-poduzetnički portal“; available at: <http://www.poduzetnistvo.org/news/plave-zastave-dobilo-115-plaza-i-20-marina> [accessed: 17 October 2022]
- [23] Ritchie, H. (2021). „Where does the plastic in our oceans come from?“; available at: <https://ourworldindata.org/ocean-plastics> [accessed: 17 October 2022]
- [24] The Yacht Harbour Association (2022). „Gold Anchor“; available at: <https://www.tyha.co.uk/gold-anchor> [accessed: 17 October 2022]
- [25] Udruga Lijepa naša (2022). „Međunarodna Plava zastava za plaže i marine“; available at: <https://www.lijepa-nasa.hr/plava-zastava/> [accessed: 30 October 2022]
- [26] United Nations (2022). „Conserve and sustainably use the oceans, seas and marine resources for sustainable development“; Department of Economic and Social Affairs; available at: <https://sdgs.un.org/goals/goal14> [accessed: 30 October 2022]
- [27] United Nations Industrial Development Organization (2022). „Real-time Online Wastewater Monitoring System“; available at: [http://www.unido.or.jp/en/technology\\_db/8057/](http://www.unido.or.jp/en/technology_db/8057/) [accessed: 30 October 2022]
- [28] World Economic Forum (2022). „Ensuring sustainable water management for all by 2030“; available at: <https://www.weforum.org/impact/sustainable-water-management/> [accessed: 20 October 2022]
- [29] Yachting magazine (2022). „Sailing in an ocean of plastic: facts about plastic waste in the seas“; available at: <https://www.yachting.com/en-gb/news/sailing-in-an-ocean-of-plastic> [accessed: 20 September 2022]
- [30] Žgaljić D., Tijan, E., Jugović A., Poletan Jugović T. (2019). „Implementation of Sustainable Motorways of the Sea Services – Multi-criteria analysis of Croatian Port System, Sustainability“; *Open Access Journals* (2071-1050). Volume 11 (23), 6827, doi: 10.3390/su11236827.