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 **AWASTER**

INTERREG ITALY-CROATIA  
PROGRAMME 2021 – 2027

# AWASTER – Adopting WASTE as Resource

## D.1.1.2 Regional waste management report – Istria County

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INTERREG ITALY-CROATIA PROGRAMME 2021 – 2027

Standard Call for Proposals

Programme priority: Green and resilient shared environment

Specific objective: 2.2: Enhancing protection and preservation of nature, biodiversity and green infrastructure, including in urban areas, and reducing all forms of pollution

Project: AWASTER – Adopting WASTE as Resource

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## 1. Introduction

The regional waste management report for the Istria County presents a primary analysis of waste production and waste management in the Istria County. The purpose of the report is to analyse and address environmental issues connected with the constant increase of waste production, particularly plastic. Istria County is one of the most tourist regions in the Republic of Croatia which implies high seasonal waste production and challenges on how to deal with it.

The report analyses the current state of municipal waste management in Istria County, describes current initiatives for minimizing waste generation and provides insights and recommendations for reducing the environmental impact of waste production, supporting sustainable development, and improving the quality of life in Istria County.

The report covers the detailed geographic and socio-economic description of the Istria County, the waste management system in the Republic of Croatia, an analysis of the composition, categories and type of collected waste at the national and regional level, description of the existing waste management infrastructure, including facilities, devices, and collection systems in Istria County, detailed analysis of the types and sources of collected waste collected within the region, illegal waste disposal sites or illegal landfills, and policies, technologies, and practices for improving waste management system in Istria County.

Together with D.1.1.3 – Regional secondary market report, the Report will be used to develop Guidelines for the sustainable use of resources and for the development of AWASTER Joint Strategy and Action Plan.



## 2. Istria County

### 2.1 Geographic data

The Istria County includes a large part of Istria - the largest Adriatic peninsula. The most extreme west point of the Republic of Croatia is in the Istrian Region (Bašanija, promontory Lako) at the 45° of the northern latitude. Situated in the north-west of the Adriatic Sea, Istria is surrounded by the sea from three sides, while the northern border towards the continent is made up by a line between the Miljski Bay (Muggia) in the direct vicinity of Trieste and the Preluk Bay, right next to Rijeka. Such favourable geographic position, almost at the heart of Europe, half way between the Equator and the North Pole, Istria has always represented a bridge connecting the Middle European continental area with the Mediterranean.

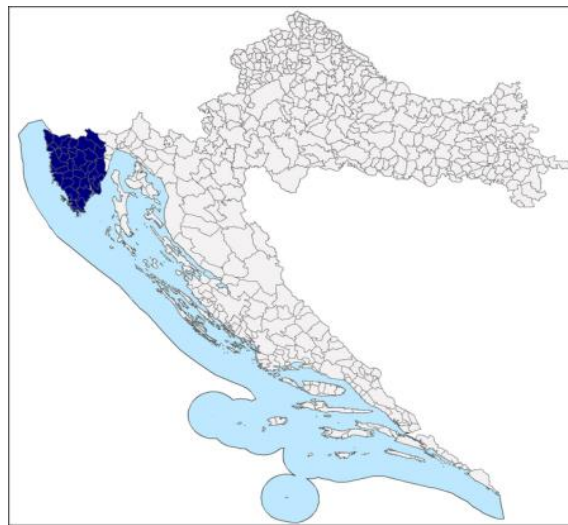


Figure 1 Geographical position of the Istria County

According to the administrative-territorial structure, the Istria County consists of 10 cities and 31 municipalities, while the total number of settlements is 655. The Istrian peninsula covers the surface of 3.476 square kilometers. The area is shared by three countries: Croatia, Slovenia, and Italy. A very small part of Istria, merely the northern part of the Miljski peninsula, belongs to the Republic of Italy. Slovenian coastline with the Kopar Bay and a part of the Piran Bay up to the mouth of the Dragonja River is a part of the Republic of Slovenia. The largest part, or 3.130 square kilometers (90% of the surface), belongs to the Republic of Croatia. Most of the Croatian part of the peninsula is situated in the Istrian Region - 2.820 square kilometers, which is 4,98 per cent of the entire surface of the Republic of Croatia. The remaining part belongs to the Primorsko-Goranska County based on the administrative and territorial subdivision.



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**CLIMATE** - The basic characteristic of the climate of the Istrian peninsula is given by the Mediterranean climate. Along the coast, it gradually changes towards the continent and it passes into continental, due to cold air circulating from the mountains and due to the vicinity of the Alps.

**WATER FLOWS** - Thanks to impermeable flisch layers, Istria does not have scarce water resources. The most significant surface water-flows in the area of the Istrian Region are the Mirna, the Raša, the Boljunčica, the Dragonja Rivers, and the underground Pazinčica. In the water supply sense, there is a significant function of the surface accumulations Butoniga and Boljunčica.



*Figure 2 Butoniga lake*

**COAST** - The length of the Istrian coast, along with islands and islets is 539 kilometres. The west coast of Istria is more indented, and, together with islands, it is 327 kilometres long. East coast, together with islets, is 212 kilometres long. The majority of the Istrian coast is on the Karst and the limestone grounds. The sinking of Karst recess created specific and branched bays, such as the Pula port, the Medulin bay, the Rovinj coast, the Poreč coast and similar. Isolated limestone heights remained as islands. The coast is well developed with lots of bays, deeper small bays, and river mouths. Except for a series of smaller islets in front of the coast from Poreč to Rovinj, the Brijuni archipelago stands out in the south.



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Among legally protected landscape in the Istria County are well-known natural reservations-national park Brijuni, nature park Učka, protected landscape Limski Bay, Motovunska forest, forest park Zlatni Rt and ornithologic reservation Palud near Rovinj, forest park Šijana near Pula and the protected landscape Kamenjak in the extreme south of Istria (Istrian County, 2024).

### 2.2. Population in the Istria County

The Istria County, along with the City of Zagreb, is the only regional self-government unit that has recorded an increase in the number of residents in the last five years. According to the 2021 population census, a total of 195.237 inhabitant's lives in the Istria County.

The average population density of the Istrian County is 69,41 people/km<sup>2</sup>, the highest population density is in the City of Pula-Pola, 1.011 people/km<sup>2</sup>, and the lowest in the Municipality of Lanišće, 1,87 people/km<sup>2</sup>. The average population density is slightly higher than the national average, and it is increased by the population density in the urban centers, Pula - Pola, Rovinj - Rovigno, Labin, Umag - Umag, Novigrad - Cittanova and Poreč - Parenzo.

The population is mostly concentrated in urban centers and 68,30% live in 10 cities, while 31,70% of the County's population lives in municipalities. In addition to the spatial distribution of the population in favor of urban centers, the basic demographic characteristics of the population of the Istria County are a negative natural population movement, a positive migration balance, demographic aging and pronounced multi-ethnicity. The continuous increase in the number of inhabitants of Istria County is the result of a positive migration balance, i.e. a higher number of immigrated versus emigrated population, and not a positive natural increase. In the observed ten-year period, with the exception of 2011, a positive migration balance was continuously recorded, and the biggest difference was recorded in 2019, when a total of 5,484 people immigrated and 3,727 left, so the migration balance amounted to +1,757 people. According to the 2021 population census, 4,390 people immigrated to Istria County, and 3,579 people left, and the migration balance is +811 people (Istrian County, 2024).

### 2.3. Economy

The Istria County with a development index of 108.970 and an average income per inhabitant of 4.670,67 euros is the most developed county in the Republic of Croatia after the City of Zagreb. The gross domestic product (GDP) of Istria County in 2018 was 3.159.864,62 euros, and according to the value of GDP per inhabitant (15.292,06 euros), Istria County is approximately 20% above the average of the Republic of Croatia.

When it comes to the structure of the gross added value of the Istria County, in 2018 wholesale and retail trade, transport and storage, accommodation, food preparation and service dominate with



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35,9%, followed by processing industry with 12,6% and public administration and defense, education, health care and social welfare activities with a 10,6% share.

There are a total of 28.701 registered business entities in the Istria County in 2020, of which 17.425 or 60,7% are trading companies, while 26,1% (7.491) relate to trades and free professions. Biggest number 92,8% of the companies are micro companies, followed by small companies with 6,3%, and medium (0,7%) and large (0,2%) companies. Among the large companies, the most are those in the processing industry (8) and the activities of providing accommodation and preparing and serving food (6). According to FINA data, in 2019, the entrepreneurs of Istria County achieved total revenues in the amount of 4,738 billion euros (4,5% growth), total expenditures of 4,499 billion euros (3,9% growth), and a profit for the period of almost 352 million EUR (down 7,3%), loss for the period of EUR 172 million (down 15,9%) and net profit of EUR 186 million (up 2,8%). Valamar Riviera from Poreč - Parenzo is in first place among companies in terms of total revenue, followed by Maistra from Rovinj - Rovigno and Plava laguna from Poreč - Parenzo. The largest number of employees (26,7%) worked in the provision of accommodation and food preparation and service, followed by the processing industry (22,8%), trade (14,1%) and construction (12,6%). According to the size of the company, the largest number of employees in 2019 worked in micro (35%) and small companies (25%). In large companies, 24% of the total number of employees are employed in two activities - providing accommodation and food preparation and serving (17%) and the processing industry (5%).

When it comes to exports, in the Istria County, the highest value of exports in 2019 was achieved in the processing industry, which accounted for 53,14% of total exports, followed by professional, scientific and technical activities (20,52%) and trade activities (19,55%).

According to data from the Chamber of Crafts of Istria County, at the end of 2020, 8.063 trades were registered. When it comes to the structure of trades, it has seen several changes in the last six years - an increase in the share of service trades, thanks primarily to an increase in the number of trades in the field of intellectual services and a decrease in the share of active trades in activities related to trade, catering and tourism. The share of manufacturing crafts, transport and personal services is stagnating. According to activities, of the total number of trades in the Istria County, the most represented are service activities, which are engaged in by almost 40% of tradesmen, followed by trade trades (17,4%) and trades in the tourism and catering sector (12,9%) (Istrian County, 2024).



### 3. Waste management system

This chapter provides a comprehensive description of the waste management system in the Republic of Croatia and Istria County.

#### 3.1. Waste management system in the Republic of Croatia

About 6 million tons of waste is produced in Croatia every year (about 1,5 tons per person per year). Most of this waste comes from the construction sector and households. The waste management system in Croatia relies mainly on landfilling, 58% of the municipal waste produced in Croatia ends up in one of 80 active landfills in the country. But also, illegal landfilling remains a long-lasting problem. The waste management practice differs from city to city. Only in recent years, recycling efforts have intensified.

The quantity, composition and type of collected waste in the Republic of Croatia are published in the report on waste management in Republic of Croatia. The last one is the one prepared for the year 2022, published in July 2023 and revised in September 2023, by the Croatian Ministry of Economy and Sustainable Development.

In this document, it will be analysed the municipal waste management streams and partially specific waste types. The municipal waste is defined by the Waste Management Act as a mixed municipal waste and separately collected waste from households, including paper and cardboard, glass, plastics, metal, bio-waste, wood, textile, packaging, waste electrical and electronic equipment, waste batteries and accumulators and bulky waste, including mattresses and furniture, as well as mixed municipal waste and separately collected waste from other sources, if that waste is similar in nature and composition to waste generated by households but does not include waste from manufacturing, agriculture, forestry, fishery and aquaculture, septic tanks and sewers, and wastewater treatment plants, including sewage sludge, end-of-life vehicles and construction waste, whereby the issue of division of responsibility for waste management between public and private entities is not affected by the said definition. Methodologically, all the municipal waste providers and other operators report quantities through the electronic system called ROO (register for waste polluters).

##### 3.1.1. Waste management policies at the national and regional level

Waste management in the Republic of Croatia is defined by the the Waste Management Act (OG 84/21). The Waste Management Act sets out the measures to achieve the objectives specified in the European Green Deal and the Action Plan for a Circular Economy, integrating waste management into circular economy. Within the waste management industry, the measures proposed by the



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European Green Deal supporting the compliance with the existing national obligations arising from the said EU directives on waste are considered to be particularly important, and in particular the objectives to be achieved by 2035, as specified in the Directive 2008/98/EC – to increase waste sorting and recycling rates to 65 % and reduce waste disposal rate to 10 %. In addition to the special measures which give priority to waste prevention, reuse and recycling before final disposal at landfill sites, the directives from the so-called 'waste package ' additional requirements were added to the directive which must be included in the waste management plans of the EU Member States and waste prevention programmes.

As the overarching planning document that aligned the waste management system in Croatia with new goals and policies, the Waste Management Plan of the Republic of Croatia for the period 2023-2028 has been developed, based on the goals set for 2035.

In addition to the National Plan, other planning documents for waste management include the Waste Management Plan of regional self-government units and the Waste Management Plan of the City of Zagreb, which are proposed by the executive body and adopted by the representative body of the regional self-government unit or the City of Zagreb.

In order to contribute to the circular economy of the European Union, the Republic of Croatia has committed to achieve the following goals (Ministry of Economy, 2024):

- At least 50% of the total mass of waste produced in households and waste from other sources whose waste streams are similar to the stream of household waste, including at least paper, metal, plastic and glass, must be recovered by recycling and preparation for reuse;
- At least 55% of the mass of municipal waste must be recovered by recycling and preparation for reuse by 2025;
- At least 60% of the mass of municipal waste must be recovered by recycling and preparation for reuse by 2030 and,
- At least 65% of the mass of municipal waste must be recovered by recycling and preparation for reuse by 2035.

The maximum permitted mass of biodegradable municipal waste, the disposal of which in a calendar year can be permitted by all waste management permits in the Republic of Croatia, is 264.661 tons, which is 35% of the mass of biodegradable municipal waste produced in 1997. The amount of municipal waste disposed of in landfills can be a maximum 10% of the mass of the total produced municipal waste by 2035. In order to contribute to the improvement of the environment and meet the set goals, it is important to ensure separate collection of waste, which would reduce the amount



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of waste scheduled for disposal, and at the same time utilize the valuable properties of separately collected waste.

Besides the Waste law, the waste acquis in Croatia consists of 19 secondary bylaws and 8 ministerial decisions.

Pursuant to Article 111 of the Law on Waste Management (OG 84/21, 142/23), the executive body of a regional self-government unit is obliged to propose the adoption and ensure the implementation of a waste management plan in its territory. The waste management plan is adopted by the representative body of the regional self-government unit. Furthermore, the same body evaluates the Plan at least once every six years, and amends the Plan as necessary. Therefore, in accordance with Article 173, paragraph 1 of the Law, the Istria County was obliged to adopt the Waste Management Plan at the regional level by January 1, 2024 but the adoption was postponed. Cities and municipalities no longer have the obligation to adopt waste management plans.

### 3.1.2. Origin, composition, categories and type of collected waste at national level

Since 2016, all municipalities and cities in the Republic of Croatia have been covered by organized municipal waste collection. In the period from 2014 to 2020, the coverage of the population by organized collection of municipal waste stagnated, and it amounts to about 99%. An increase is recorded in 2021, and in 2022 it is almost 100%.

Data on the generated municipal waste in the Republic of Croatia until 2005 were mostly based on estimates. From 2006 onwards, the quantities are determined according to the data reported by the taxpayers, with an additional assessment of the data for the share of the population that is not covered by organized collection and for the municipalities for which the data was not submitted. It should be emphasized that since 2011, data on municipal waste (waste paper and cardboard, packaging waste, waste edible oils, batteries and accumulators...) from the service sector (schools, kindergartens, offices, hotels, shops...) have also been used in the calculation.) and data on special categories of waste collected within the system organized by Environmental Protection and Energy Efficiency Fund (EPEFF).

The long-term increase in the amount of municipal waste generated since 1995 stopped in 2008, after which a decrease in reported amounts was recorded until 2010, which can be attributed to the economic crisis.



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According to the Report on municipal waste for 2022, developed by the Ministry of Commerce and Sustainable Development, in Croatia in 2022, 1.844.382 tons of municipal waste was generated, which made the total amount reach the highest value in the period from 1995 to 2022. Compared to 2021, this is an increase of 4%. Of the total amount, 1.270.429 tons of municipal waste was reported as part of the public service, while 28.934 tons was additionally reported from collection via containers on public areas. 1.613 tons of municipal waste was additionally collected in recycling yards through the return fee system, and 63.954 t through retail. The remaining amount of 479.451 tons refers to additionally determined amounts, namely to amounts originating from service activities (packaging waste, waste paper and cardboard, waste edible oils, etc.) that can be considered municipal waste and part of the amounts taken within the framework of the national of the system for special categories of waste organized by Environmental Protection and Energy Efficiency Fund (EPEEF), quantities of exported municipal waste, differences in quantities of treated waste (disposed of, composted, digested, etc.) and estimates for the part of the population not covered by organized collection.

In table 1, it is presented the total amount of generated municipal waste in the Republic of Croatia in 2022:

County	Collected within the framework of public service (PS) (tons)	Collected within PS, containers on public areas, return fee in recycling yards and through retail trade (tons)	Share of the county in the total collected amount	Total generated municipal waste (t)
1. Zagreb	76.933	80.868	6,06%	109.902
2. Krapina-Zagorje	21.280	22.677	1,68%	30.708
3. Sisak-Moslavina	31.972	33.753	2,52%	45.819
4. Karlovac	28.999	30.165	2,28%	41.109
5. Varaždin	30.238	34.171	2,38%	45.582
6. Koprivnica-Križevci	22.041	23.933	1,73%	32.251
7. Bjelovar-Bilogora	18.947	19.913	1,49%	27.063
8. Primorje-Gorski Kotar	134.992	136.245	10,63%	187.190
9. Lika-Senj	20.195	20.264	1,59%	27.885
10. Virovitica-Podravina	16.115	18.203	1,27%	24.285
11. Požega-Slavonija	12.166	12.255	0,96%	16.847
12. Brod-Posavina	26.793	28.043	2,11%	38.154
13. Zadar	88.668	90.519	6,98%	123.982
14. Osijek-Baranja	67.306	69.948	5,30%	95.349



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15. Šibenik-Knin	41.181	44.197	3,24%	59.738
16. Vukovar-Srijem	38.321	39.007	3,02%	53.469
17. Split-Dalmatia	181.461	196.024	14,28%	264.506
18. Istria	100.947	119.868	7,95%	157.964
19. Dubrovnik-Neretva	52.835	55.283	4,16%	75.222
20. Međimurje	27.589	32.000	2,17%	42.415
21. City of Zagreb	231.453	257.596	18,22%	344.944
<b>Total:</b>	<b>121.453.226</b>	<b>181.642</b>		<b>1.844.382</b>

Table 1 Total amount of generated waste in the Republic of Croatia in 2022. /Tonne (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development)

From 2011 to 2019, the amount of generated municipal waste is again continuously increasing, ranging between 1,6 million and 1,8 million tons. In 2020, as a result of the COVID-19 pandemic, which resulted in a significant reduction in the work of the service sector (closure of catering establishments, reduced number of tourist overnight stays), the amount of municipal waste fell to the value of 2014. By strengthening the activities of the service sector (catering facilities, significantly increased number of tourist overnight stays, etc.) from 2021, there will be another increase, and the total amount of municipal waste in 2022 will be 1,844,382 t, which is the highest value in the observed period from 1995 to 2022 year (Ministry of Economy and Sustainable Development, 2023).

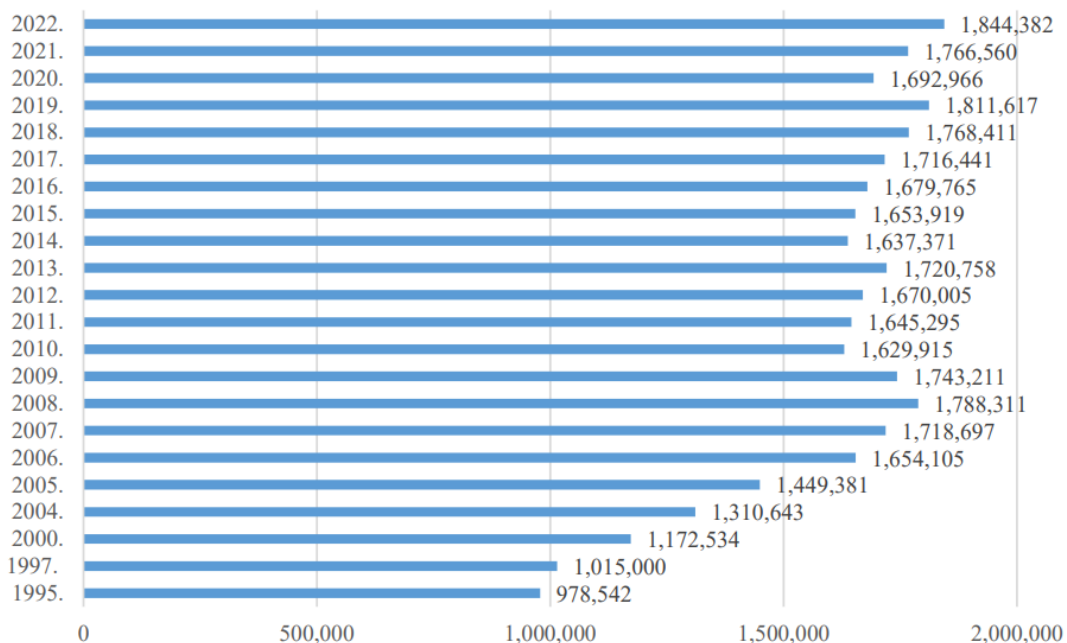


Figure 3 Amount of total generated municipal waste in the Republic of Croatia, 1995-2022.



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When it comes to the separately collected municipal waste (all types of municipal waste except mixed municipal waste), the total amount of generated municipal waste with additional determined amounts in 2022 accounted to 844.387 tons or 46%, while the amount of mixed municipal waste amounted 54 % or 999.995 tons. The dynamics of the increase in the rate of separate waste collection has been somewhat slower in the last two observed years, as a result of impurities that are present in a significant proportion of separately collected waste, especially in biowaste, which in this case is categorized as mixed municipal waste. A comparison of separate collection rates within the public service between 2021 and 2022 showed an increase for 18 counties out of a total of 21. Since the 2010, the quantities of separately collected waste have increased by 370%, with 844.387 tonnes of waste separately collected in 2022. The largest increase in the separate collection of municipal waste compared to the previous year was recorded for glass (35%). There is also a significant increase in the amount of separated collection for plastic (23%) and paper and cardboard (19%).

The recycling rate in 2022 amounts to 34% and 630.882 tons of municipal waste was recycled. National and EU goal for recycling for 2020 by recycling and preparing for reuse at least 50% of the total mass of waste produced was not reached. From the point of view of separate collection of waste within the framework of the public service, in 2022 the rate of separate collection is 24% which is an increase of three percentage points compared to the data for 2021. Separate collection of at least one of the useful types of waste from municipal waste (paper and cardboard, plastic, glass, metal, bulky waste, textiles and biowaste) as part of the public service in 2022 was carried out in 528 local self-government units.

The total breakdown of separately collected waste in Republic of Croatia is shown table 2, and it shows the waste market potential in 2022.

Waste stream/material	Quantity/tonne	Share
Paper and cardboard	270.666	0,32
Bulky waste	136.837	0,16
Biowaste	118.806	0,14
Plastic	91.025	0,11
Glass	71.709	0,08
Wood	57.865	0,07
Metal	136.512	7,7%
WEEE	181.462	9,9%
Textile	4.728	0,01
Batteries	416	0,00
Other	27.519	0,03
<b>Total</b>	<b>844.837</b>	<b>1</b>

Table 2 Separately collected waste in 2022 / tonne (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development)



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The breakdown shows that paper is the most collected material in Croatia (32% of total quantities) although it does not have the highest statistical potential. Bulky waste represents 16%, however, in most of the municipalities it ends up landfilled or mechanically treated. Biowaste represents 14% and plastic 11%. It has to be noted that several packaging types run through parallel system run by National Fund for Environmental Protection and Energy Efficiency and does not exactly enter the market through same channels as ones used by public service companies.

### 3.2. Waste management system in the Istria County

According to the Article 10 of the Waste Management Law, the executive bodies of local and regional self-government units are obliged to ensure the conditions and implementation of prescribed waste management measures in their area, and several units of local and regional self-government can, by agreement, ensure the joint implementation of waste management measures. One of the most important obligations of local self-government units is to ensure the performance of the public municipal waste collection service in a high-quality, sustainable and economically efficient manner while avoiding unreasonably high costs and in compliance with the principles of sustainable development and environmental protection. As part of using the public municipal waste collection service, producers and owners of waste are encouraged to submit waste separately with the aim of reducing the amount of mixed municipal waste, the share of biowaste in the generated amount of mixed municipal waste, which increases at the same time quantities of separately collected and recycled paper and cardboard, glass, metal, plastic, biowaste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, bulky waste, including mattresses and furniture, and waste classified into special categories waste, the management of which is governed by the regulations governing special management categories of waste.

#### 3.2.1. Waste management facilities, devices and collection systems in the Istria County

In the territory of the Istria County, the public service of municipal waste collection is organised by 9 public companies founded by the local self-government unit.

Service provider / Local self-government unit	Service provider / Local self-government unit
<b>1. MAJ d.o.o. Labin</b>	<b>PULA HERCULANEA d.o.o. Pula</b>
Kršan	Barban
Labin	Fažana - Fasana
Raša	Ližnjan - Lisignano
Pičan	Marčana
Sveta Nedelja	Pula - Pola



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<b>6. MAJ d.o.o. Umag</b>	Svetvinčenat
Brtonigla - Verteneglio	<b>USLUGA d.o.o. Pazin</b>
Buje - Buie	Cerovlje
Grožnjan - Grisignana	Gračišće
Novigrad - Cittanova	Karojba
Oprtalj - Portole	Lupoglav
Umag - Umago	Motovun - Montona
<b>CONTRADA d.o.o. Vodnjan</b>	Pazin
Vodnjan - Dignano	Sveti Petar u Šumi
<b>KOMUNALNI SERVIS d.o.o. Rovinj</b>	Tinjan
Bale - Valle	<b>USLUGA POREČ d.o.o. Poreč</b>
Kanfana	Funtana - Fontane
Rovinj - Rovigno	Kaštelir - Labinci - Castelliere-S. Domenica
Žminj	Poreč - Parenzo
<b>MED EKO SERVIS d.o.o. Medulin</b>	Sveti Lovreč
Medulin	Tar-Vabriga - Torre-Abrega
<b>PARK d.o.o. Buzet</b>	Višnjan - Visignano
Buzet	Vižinada - Visinada
Lanišće	Vrsar - Orsera

Table 3 Overview of public service provision in the Istria County

Waste management includes the activities of collection, transportation, recovery, including the sorting and disposal of waste, including the supervision of the performance of these activities, supervision and measures carried out at the locations where the waste was disposed of, and actions taken by the waste dealer and intermediary in waste management. Pursuant to Article 27 of the Waste Management Act, a legal or natural person is authorized to take possession of a shipment of waste if:

- has a permit for waste management,
- manages the recycling yard,
- is registered in the register of persons who perform waste management activities as a waste collector or unlicensed recycler or as a waste dealer who can take possession of waste,
- taking possession of certain waste is permitted by a regulation regulating special categories of waste,
- is a user of waste sludge in agriculture, whereby he is authorized to take over a shipment of waste sludge in accordance with a special regulation,
- manages a cemetery or crematorium and is authorized to take over waste shipments in accordance with the special regulation on medical waste.



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Istria County is one of the first in Croatia which has implemented the Integrated waste management system. The system was established with the construction of the Kaštijun Waste Management Center, which serves as an organized, economically oriented and comprehensive way of managing waste from the Istria County area.

The Kaštijun Waste Management Center is managed by the public company Kaštijun d.o.o. which was founded in 2007, and started in 2008 with preparatory work for bringing the company into operation for providing the services for which it is registered. After the completion of the construction of the Waste Management Center, the company concluded a contract with all suppliers of the public service for the collection of mixed municipal waste from the area of Istria County, and the delivery of waste and its processing began on July 2, 2018.

The Center has a total area of 16,6 ha and consists of several technical and technological units, the most important of which are the entrance - exit zone (5,2 ha), the work zone (2,9 ha) and the zone for processing and disposal of waste (8,5 ha).

The following processes take place at the Center:

- collection and reception of collected municipal waste;
- biological processing;
- mechanical processing;
- biological processing on the bioreactor surface;
- waste water treatment.





Figure 4 Kaštijun Waste Management Center (source: [www.kastijun.hr](http://www.kastijun.hr))

In ŽCGO "Kaštijun" waste is accepted from public service suppliers or delivered from transfer stations by trucks with special semi-trailers. When collecting waste, control, documentation verification and weighing are carried out, and the waste is sent for further processing. The management system of all processes (acceptance and processing waste) is fully automated. The waste is unloaded into the reception pit of the plant for mechanical-biological treatment (hereinafter MBO). Before the treatment process, the waste is shredded. Shredding and homogenization ensure more optimal management of the processing process.

For the collection of municipal waste at the local level, six transshipment stations (Labin, Pazin, Buzet, Umag, Poreč and Rovinj) were built in the Istria County, planned and distributed according to the amount of waste in the county, in order to ensure the rational transportation of waste from the transshipment stations to the center for waste management within project activities.





Figure 5 Location of the Kaštijun Waste Management Center and transshipment stations (Source: [www.kastijun.hr](http://www.kastijun.hr))

With the operating start of the Kaštijun Waste Management Center, the previous method of waste management in the Istria County was abandoned. In the past, waste management in Istria County was dedicated to the activity of collecting, transporting and disposing of municipal waste and non-hazardous production waste with a low or no degree of separate collection of useful parts of waste and hazardous waste or waste recovery. Waste management was carried out by 7 public utility companies that managed 7 official waste disposal sites in the County where municipal and non-hazardous industrial waste are disposed: Donji Picudo (Umag), Košambra (Poreč), Lokva Vidoto (Rovinj), Kaštijun, (Pula), Cere (Labin), Jelenčiči (Pazin), Griža (Buzet). 7 waste disposal sites had a total area of 36,8 ha, where about 120.000 tons of waste were disposed annually. Of that, about 80% represented municipal waste and about 20% non-hazardous production waste. Other non-hazardous and hazardous industrial waste was disposed of by authorized collectors and transported to authorized processors in the Istria County and Croatia or exported in accordance with international regulations<sup>1</sup>.

During the first years of the Kaštijun Waste Management Center operation, a number of issues has arisen, mainly due to fact that the design documentation for the construction and equipping of the

<sup>1</sup> <https://www.kastijun.hr/hr/zeleno-srce-istre/gospodarenje-otpadom/>



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Center was created several years ago, some projected parameters, especially regarding the planned quantities and delivery dynamics, did not prove to be realistic. It was also determined that the moisture content in the composition of the waste brought for processing is higher than the planned values.

The mentioned problem was tried to be solved during the summer season of 2019, when the biodrying process was shortened, which occasionally caused the spread of unpleasant odors from the area of ŽCGO Kaštijun. On the initiative of the Istria County, a working group was formed in December 2019 to coordinate the work of the County Center for Waste Management "Kaštijun". Tasks of the Working Group to co-determine, propose and coordinate the undertaking of necessary activities by recognized stakeholders with the main goal of preventing excessive daily amounts and inappropriate content of waste that is processed, which ultimately leads to the appearance of unpleasant odors, especially in the tourist season. The work of the Working Group, which is still active, is focused on goals related to the composition of mixed municipal waste that enters the mechanical-biological treatment plant for processing. With the aim of reducing unpleasant odors during the previous period, two new bioboxes were added to the MBO plant, which extended the drying time, and the ventilation and air filtration system from the biological treatment process was upgraded. Improvements in the process of operation of the bioreactor disposal site included the horizontal degassing system and connection to the flare and covering of the bioreactor disposal site. The company also expanded the capacity of transport equipment by acquiring 6 additional trailers, and a device for the purification of ferrous and non-ferrous metals was acquired, which is planned to increase the share and quality of the separated metal fraction from waste (secondary raw material). During 2023, the Center received 69.194 tons of mixed municipal waste, the processing of which resulted in 44.719 tons of non-composted fraction intended for further processing and 7.375 tons of fuel from waste (SRF).

### 3.2.2. Origin, composition, categories and type of collected waste at regional level

According to the Report on municipal waste for 2022, developed by the Ministry of Commerce and Sustainable Development, in 2022, 100.947 tons of municipal waste were collected in the Istria County as part of public service, of which 32.038 tons were collected separately, i.e. 32% of the total amount collected, which represents an increase of 5% percentage points in separately collected waste in compared to 2021. When the additionally determined amounts are added, the total amount of municipal waste generated in the Istria County amounts to 119.868 tons, of which 50.958 tons or 57% were collected separately.



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Table no. 4 presents an overview of the total amount of municipal waste collected as part of the public service, the amount of mixed municipal waste, the number of inhabitants covered by organized collection, the amount of municipal waste per inhabitant and the rate of separate collection, in the Istria County for the year 2022.

Local government unit	Total collected municipal waste within the framework of public service per LGU (t)	Mixed municipal waste collected as part of a public service (t)	Number of inhabitants covered by organized municipal waste collection (t)	Kg/per inhabitant (t)	Rate of separate collection within the framework of the public service
Balle – Valle	826	772	1.170	706	6%
Barban	877	660	2.494	352	25%
Brtonigla – Verteneglio	920	830	1.523	604	10%
Buje – Buie	1.989	1.472	4.451	447	26%
Buzet	1.553	814	5.997	259	48%
Cerovlje	301	212	1.458	206	29%
Fažana – Fasana	2.364	1.310	3.463	683	45%
Funtana – Fontane	1.863	1.489	907	2054	20%
Gračičće	235	184	1.311	179	22%
Grožnjan – Grisignana	313	245	662	473	22%
Kanfanar	660	564	1.498	440	14%
Karolja	313	237	1.415	221	24%
Kaštelir Labinci – Castelliere S. Domenica	626	332	1.463	428	47%
Kršan	618	423	2.838	218	32%
Labin	3.529	1.944	10.488	336	45%
Lanišće	36	27	270	132	25%
Ližnjan – Lisignano	1.672	1.111	4.087	409	34%
Lupoglav	196	153	836	234	22%
Marčana	2.050	1.326	4.225	485	35%
Medulin	5.641	4.064	6.481	870	28%
Motovun – Montona	286	222	912	313	22%
Novigrad – Cittanova	3.143	2.559	3.883	809	19%
Oprtalj – Portole	321	267	746	430	17%
Pazin	1.616	1.126	8.306	195	30%



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Piñan	405	253	1.719	236	37%
Poreč – Parenzo	12.810	7.820	16.666	769	39%
Pula – Pola	23.834	15.909	52.220	456	33%
Raša	876	522	2.811	311	40%
Rovinj – Rovigno	10.750	6.690	12.968	829	38%
Sveta Nedelja	700	450	2.898	242	36%
Sveti Lovreč	398	199	962	414	50%
Sveti Petar u Šumi	370	303	1.043	355	18%
Svetvinčenat	741	519	2.179	340	30%
Tar-Vabriga – Torre-Abrega	2.612	1.943	1.990	1312	26%
Tinjan	400	303	1.728	232	24%
Umag - Umago	7.558	6.301	12.767	592	17%
Višnjan – Visignano	817	461	2.098	390	44%
Vižinada – Visinada	425	236	1.136	374	44%
Vodnjan – Dignano	2.704	1.914	5.838	463	29%
Vrsar – Orsera	2.671	1.982	1.944	1.374	26%
Žminj	927	761	3.363	276	18%
<b>TOTAL</b>	<b>100.947</b>	<b>68.909</b>	<b>195.211</b>	<b>517</b>	<b>32%</b>

Table 4 total amount of municipal waste collected as part of the public service in the Istria County

The quantities of individual types of separately collected municipal waste in 2022 in the Istria County are shown in table 5:

Waste stream	Quantity/tonnes
Paper	6.934
Plastic	4.330
Glass	2.391
Metal	323
Bulky waste	10.888
Textile	468
Biowaste	3.539
<b>Total</b>	<b>28.873</b>

Table 5 Quantities of individual types of separately collected municipal waste in 2022 in the Istria County (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development)

Regarding the recovery and disposal of municipal waste, Istria County had a recovery rate of 24% within the framework of public services, while 4% was disposed of in landfills. The largest part of municipal waste collected as part of the public service, 72%, ended up in the Kaštijun county waste management center.



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Amounts of separately collected municipal waste fractions collected within the framework of public service with included amounts of municipal waste collected through containers on public surfaces for the year 2022 for each local government unit in the Istria County is presented in the table 6.

LGU	Paper (t)	Plastic (t)	Glass (t)	Metal (t)	Bulky waste (t)	Textile (t)	Biowaste (t)
Balle – Valle	33,22	21,46	0,00	0,04	0,00	0,01	0,05
Barban	60,55	106,52	29,14	0,00	21,08	0,00	0,00
Brtonigla – Verteneglio	47,38	0,00	33,60	0,00	0,00	0,00	0,00
Buje – Buie	130,07	11,04	94,00	8,32	103,08	2,87	6,07
Buzet	181,64	170,05	65,70	14,22	142,58	33,62	104,76
Cerovlje	19,55	32,32	9,93	1,96	6,73	4,13	2,04
Fažana – Fasana	84,64	89,59	59,75	1,57	504,32	11,34	299,78
Funtana – Fontane	58,22	52,94	40,49	0,00	153,64	0,00	69,12
Gračičće	11,88	22,98	3,96	0,64	3,38	1,65	0,73
Grožnjan – Grisignana	41,76	0,00	17,33	0,00	0,00	0,00	0,00
Kanfanar	41,76	52,81	0,00	0,02	0,36	0,02	0,01
Karolja	18,64	29,06	7,26	0,86	4,95	3,50	1,47
Kaštelir Labinci – Castelliere S. Domenica	55,36	61,24	31,76	0,00	110,60	0,00	34,98
Kršan	37,59	6,75	7,89	2,00	104,17	2,97	0,00
Labin	481,87	128,06	144,12	21,53	456,05	14,87	15,26
Lanišće	1,42	4,40	2,40	0,00	0,58	0,00	0,00
Ližnjan – Lisignano	94,23	113,85	70,04	0,00	276,43	6,72	0,00
Lupoglav	11,32	17,26	3,89	0,63	2,71	1,52	0,59
Marčana	80,55	114,42	56,09	2,18	466,35	2,72	0,00
Medulin	312,45	241,16	148,51	59,27	311,45	5,81	463,48
Motovun – Montona	18,30	21,63	6,90	1,04	4,95	2,50	0,84
Novigrad – Cittanova	238,33	7,00	146,92	2,90	89,32	0,60	12,51
Oprtalj – Portole	28,06	0,00	13,99	0,00	0,00	0,00	0,00
Pazin	115,46	132,90	26,54	11,24	41,59	36,31	38,36



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Piñan	38,71	9,38	11,04	2,00	59,38	1,49	0,00
Poreč – Parenzo	843,45	503,07	282,10	16,26	2.366,18	1,08	697,79
Pula – Pola	1.695,86	1.147,65	316,02	22,86	3.130,14	276,05	1.251,19
Raša	95,02	29,89	28,38	10,00	122,51	1,49	0,00
Rovinj – Rovigno	1.219,43	552,39	278,89	80,62	1.046,58	40,92	181,62
Sveta Nedelja	87,91	23,55	15,85	2,00	100,68	1,49	0,00
Sveti Lovreč	30,15	34,48	21,18	0,00	87,58	0,00	26,32
Sveti Petar u Šumi	17,32	22,62	9,07	1,03	4,71	3,04	1,08
Svetvinčenat	64,21	67,49	31,62	0,00	56,58	1,68	0,00
Tar-Vabriga – Torre-Abrega	79,73	88,36	29,97	0,00	375,28	0,00	95,57
Tinjan	24,14	36,35	9,96	1,23	7,43	3,96	1,65
Umag - Umago	495,50	15,77	243,39	11,87	148,26	1,30	66,48
Višnjan – Visignano	70,28	72,18	39,97	0,00	134,02	0,00	39,54
Vižinada – Visinada	31,94	43,22	24,03	0,00	63,57	0,00	25,39
Vodnjan – Dignano	174,41	164,72	81,43	36,81	90,65	0,00	1,07
Vrsar – Orsera	78,89	73,22	51,95	5,87	269,90	0,72	101,17
Žminj	56,07	60,92	10,06	4,44	20,46	3,50	0,00

Table 6 Separately collected municipal waste fractions collected within the framework of public service in the Istria County

### 3.2.3. Illegal waste disposal sites or illegal landfills

Although a lot has been said and written about the harmful impact of illegal waste disposal on the environment, and thus on human health, in recent years, all produced waste is not always properly processed by recovery or disposal procedures. Unfortunately, citizens and companies do not hand over a certain amount of waste to authorized waste collectors, but rather dispose of it outside the designated locations. In previous years, the reasons for this behavior could possibly be sought in the unavailability of the service, i.e. the area not being covered by organized waste collection. Today, the public waste removal service is available in all parts of the Istria County, and considerable funds have been invested over the past years in addition to the infrastructure for the selective collection of certain useful types of waste, and in education about sustainable waste management.

Despite the above, there are still locations with improperly disposed waste in the territory of the Istria County, the reasons for the creation and "survival" of which can be found in the irresponsible behavior of natural and legal persons who carry out economic activities, but also in the local



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population, which avoids paying fees for waste removal through its irresponsible behavior. Unfortunately, due to the large area and the inability of the competent services to control the entire area, it is very difficult to accurately determine the total number of locations and the total amount of improperly disposed waste.

The first official list and rehabilitation plan of illegal landfills was prepared by the Istria County in 2006. The list has undergone several revisions, the last of which was in October 2010, when locations were added to the list for which the competent environmental protection inspection of the Ministry of Nature and Environment of the Republic of Croatia issued decisions to local self-government units on the need to remove improperly disposed waste by unknown perpetrators. Furthermore, the Istria County, as part of the implementation of the EU project DIVA - Remediation of illegal landfills and raising awareness of their harmfulness, created and put into operation a network application for recording and monitoring the remediation of discarded waste in the territory of the Istria County. The project was implemented as part of the IPA CBC SI-HR 2007-2013. of the pre-accession EU program in the period from 04/2011 to 03/2013.

In accordance with the reports on the implementation of the Waste Management Plan of the Croatian local self-government units, most cities and municipalities in the Istria County have enabled citizens to report possible new locations where waste has been improperly disposed of via the LGUs' websites. As an additional measure to reduce the number of illegal landfills where waste is improperly disposed of, LGUs have mostly organized communal services that visit the site and monitor rehabilitated and possibly newly created locations (Istrian County, 2023).



## 4. Measures and initiatives for the development and improvement of the waste management system in the Istria County

Most of the local self-government units in the Istria County educate the population about the obligation to collect municipal waste separately, usually through providers of public services for the collection of mixed and biodegradable municipal waste. The educations are primarily related to obligations and the method of separate collection of municipal waste, and are carried out through circular letters sent with invoices, announcements on websites and information leaflets. Some local self-government units also educate the population through local daily newspapers, announcements through radio stations and leaflets, promotional actions and workshops.

In the following paragraphs we will describe some of the examples of good practice in the Istria County in the field of raising awareness and improvement of the waste management system in the Istria County.

City of Labin is working intensively and responsibly on preserving the environment so that its citizens can all enjoy the benefits of a clean and healthy environment. One of the successful projects implemented by the City of Labin and the utility company 1. MAJ d.o.o. was the „Green Habits for a Sustainable Labin Area “. The purpose of the project was to build and raise awareness of citizens and guests of Labin and municipalities of Labin area about the importance of responsible municipal waste handling, waste prevention, proper household waste separation, household composting, and reusing objects in order to reduce the amount of waste disposed at landfills. 21 activities that were carried out through the project included design and implementation of: leaflets, brochures, posters, specialized TV and radio shows and commercials, specialized website, public educational forums, workshops for children, educational and informative materials for preschool and school children, costumed plays and performances for preschool children, competition in schools, educational picture and coloring books for children, marking dates related to environmental protection, banners for publication on Internet portals, paid advertisements in electronic and print media, leaflets for foreign tourists at tourist centers, workshops for people with disabilities and children with special needs and social media campaigns. As part of the project City of Labin has also joined the initiative of the European Waste Reduction Week and was selected by EWWR Secretariat among the three best projects in Europe.



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Figure 6 Green habits for a sustainable Labin area

Utility company 1.MAJ from Labin is also very active in education of end users in various topics such as proper separation of waste, the structure of the waste management system in Labinština, the possibilities available to users, the benefits of environmental care through the care of waste, commemoration of the "European Waste Reduction Week", collection schedule, etc. Among other things, these channels promoted the conclusions, visuals and ideas of the projects "Green Habits for Sustainable Labin Area" and "Plastic-Free Market". In addition, "Plastic-free Brands" emblems were placed next to the football field of the City Stadium in Labin and in the SC "Franko Mileta" hall. Direct education is conducted by sending information leaflets to all users from the household category along with bills.



## 5. Conclusion

The regional waste management report for the Istria County presents a primary analysis of waste production and waste management in the Istria County. The purpose of the report is to analyse and address environmental issues connected with the constant increase of waste production, particularly plastic. Istria County is one of the most tourist regions in the Republic of Croatia which implies high seasonal waste production and challenges on how to deal with it.

Istrian County is one of three counties in the Republic of Croatia with established centralised collection of municipal waste in the scope of the County Waste Management Centre Kaštijun. With the operating start of the Kaštijun Waste Management Center, the previous method of waste management in the Istria County was abandoned. During the first years of the Kaštijun Waste Management Center operation, a number of issues has arisen, mainly due to fact that the design documentation for the construction and equipping of the Center was created several years ago, some projected parameters, especially regarding the planned quantities and delivery dynamics, did not prove to be realistic. It was also determined that the moisture content in the composition of the waste brought for processing is higher than the planned values. This is the reason why on the county level it is important to foster the increase of the separate collection of waste and to ensure processing of collected waste through the development of sorting plant and compost plant.



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