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AWASTER

INTERREG ITALY-CROATIA
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AWASTER – Adopting WASTE as Resource

D.1.1.3 Regional secondary market report – Istria County

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INTERREG ITALY-CROATIA PROGRAMME 2021 – 2027
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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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Introduction

The aim of the Regional secondary market report is to assess the functionality of the secondary raw material market in the Republic of Croatia and Istria County. The report and its findings will be used for the development of A.1.2 - Sustainable resources use guidelines and A.1.3 AWASTER Joint Strategy and Action Plan.

The main topics covered in the report include the separate waste collection system at the national and regional levels, a detailed description of categories, quantities, and types of separated and collected waste; an overview of the secondary raw material markets at the national and regional levels; recycling facilities and measures and initiatives for the development and improvement of secondary raw material markets.

Secondary raw material is a material resulting from a recovery process that becomes input in a new production. Secondary raw material (SRM) markets are crucial for a circular economy. This is because SRMs enable recyclables to re-enter the production value chain, which reduces dependency on primary resources as a result. In the Republic of Croatia, the SRM market is evolving, but there is huge potential for an increase in the use of SRMs in the production of new products.

The report analyses the current state of the waste management market and secondary raw materials at the national level and regional level (Istria County). The report outlines national and regional efforts in the waste management processes, and economic potential of secondary raw materials but also highlights current obstacles, particularly at the regional level in implementing waste management policies.

1. Separate waste collection system

1.1. Separate waste collection system in Republic of Croatia

In the Republic of Croatia, the separate collection of municipal waste at the location of the service user is carried out as part of the public municipal waste collection service. According to the priority order of waste management, prevention of waste generation has priority over other procedures, followed by preparation for reuse, then recycling and other recovery procedures, while the waste disposal procedure, which includes waste disposal, is the least desirable waste management procedure[1].
Separate collection of municipal waste at the location of the service user is carried out as part of the public service of collection of mixed municipal and biodegradable waste (public service).

At the location of the billing point of the service user, the service provider (e.g. utility company) is obliged to ensure:

- Collection of mixed municipal waste;
- Collection of biodegradable municipal waste;
- Collection of recyclable municipal waste (waste plastic, waste metal and waste glass, and when appropriate, other types of waste intended for recycling (e.g. waste textiles, waste wood, etc.).

Figure 1 Semi-underground containers for separate collection of waste in the City of Labin

[1] https://gov.hr/hr/odvojeno-prikupljanje-otpada/1322

The following services are provided free of charge for the service user:

- Collection of waste paper, metal, plastic, glass and textiles through containers placed on public surfaces;
- Collection of bulky waste in the recycling yard, mobile recycling yard and once a year at the location of the billing point of the service user.

Separate waste collection is the collection of waste in such a way that the waste is separated according to its type and properties in order to facilitate processing and preserve the valuable properties of the waste. The executive body of the local self-government unit, is obliged to ensure the performance of the public municipal waste collection service in its territory in a high-quality, stable and economically efficient manner, avoiding unreasonably high costs, in accordance with the principles of sustainable development and environmental protection, while ensuring the public nature of the work as separate collection of mixed municipal waste from households and other sources, biowaste from households, recyclable municipal waste, hazardous municipal waste and bulky waste from households would be ensured.

The public service user (natural and legal person) is obliged to hand over hazardous municipal waste to a recycling yard or mobile recycling yard, or to deal with it in accordance with the regulation governing the management of a special category of waste, except for users who are not households, to hand over separately mixed municipal waste, recyclable municipal waste, hazardous municipal waste and bulky waste, and submit bio-waste separately or compost bio-waste at the place of origin. 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 of waste scheduled for disposal, and at the same time utilize the valuable properties of separately collected waste.

Depending on the type of waste, it is possible to discard the waste in containers for separate waste collection or take it away and dispose it of in recycling yards. Municipal companies that manage recycling yards are obliged to receive waste prescribed by the regulations governing waste management. Special categories of waste can also be disposed through organized systems for managing special categories of waste (packaging waste, electrical and electronic waste; waste batteries and accumulators; waste vehicles; waste tires; waste containing asbestos; construction waste; waste textiles and footwear; waste medicines and medical waste).
Special categories of waste are waste streams for which special management conditions are prescribed, such as waste textiles and footwear, waste packaging, waste tires, waste oils, waste batteries and accumulators, waste vehicles, construction waste and waste containing asbestos, medical waste, waste electrical and electronic equipment, waste from the production of titanium dioxide, waste polychlorinated biphenyls and polychlorinated terphenyls, single-use plastics and fishing tools containing plastic.

Croatia is one of the first European countries which has established a refund system for beverage packaging back in 2005. The system is established in such a way that a producer who places drinks on the market in packaging covered by the return fee system (seven-euro cents) is obliged to mark such packaging with the mark of the return fee system.

Figure 2 Machines for returning packaging in the return fee system in the City of Pakrac

A manufacturer who places returnable (reusable) packaging on the market is obliged to mark such packaging with a label for returnable packaging. Refund is a sum of money paid by producers as an incentive measure to encourage the owner to hand over waste packaging from drinks to a seller who has drinks in his offer or to a person who manages a recycling yard and receives the prescribed amount of refund for this. A seller who sells beverages, and whose sales area is larger than 200 square meters, is obliged to collect waste beverage packaging from the consumer. A seller who sells beverages, whose sales area is less than 200 square meters, can collect waste beverage packaging from the consumer if he meets the spatial and technical requirements for the safe collection and storage of waste beverage packaging. To the store (or to the recycling yard), customers can return PET, glass or metal (Fe/Al) beverage packaging with a volume of more than two decilitres marked with the return fee system (return fee seven cents).

Natural persons (citizens) are obliged to separate packaging that is hazardous waste (e.g. packaging from paints, varnishes, thinners, cleaning agents, plant protection agents, etc.) from mixed municipal waste and from other types of waste and hand it over separately to recycling yard or to the seller (in a store) of the products from which this waste packaging was created or to the collector of waste packaging.

A seller who sells products in packaging that creates waste packaging that is hazardous waste is obliged to collect waste packaging that is hazardous waste from natural persons. The seller is obliged

to place a container for the collection of waste packaging that is hazardous waste and in a visible place, at the entrance for consumers to the store, to inform consumers about the possibility of handing over or the obligation to pick up waste packaging that is hazardous waste in his sales area during the entire working hours of the sales point.

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1.1.1. Categories, quantity and type of separated and collected municipal waste at national level

Municipal waste is mixed municipal waste and separately collected waste from households, including paper and cardboard, glass, metal, plastic, bio-waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators and bulky waste, including mattresses and furniture and mixed municipal waste and separately collected waste from other sources, if this waste is similar in nature and composition to household waste, but does not include waste from production, agriculture, forestry, fishing and aquaculture, septic tanks and sewage and waste water treatment devices , including sewage sludge, waste vehicles and construction waste, whereby this definition does not call into question the distribution of responsibility for waste management between public and private entities (Republic of Croatia, 2021). Pursuant to the Waste Catalogue, which is an integral part of the Waste Management Ordinance (Official Gazette, 106/22), municipal waste includes waste that corresponds to types of waste from subgroup 15 01 (waste packaging, including separately collected packaging from municipal waste) and group 20 (waste from households and similar waste from crafts, industry and institutions, including separately collected ingredients) of the catalogue with the exception of the following types of waste: 20 02 02 (soil and stones), 20 03 04 (sludge from septic tanks) and 20 03 06 (waste created by cleaning sewage). Waste from other groups of the Waste Catalogue is not considered municipal waste, except in cases where

municipal waste is assigned a key number from group 19 of the Waste Catalogue after processing procedures. In the Republic of Croatia, since 2016, all municipalities and cities have organized the collection and removal of municipal waste. Coverage of the population by organized municipal waste collection in 2022 was 99.5%. It is also important to explain the term of public service, which according to the definition from the Law on Waste Management, public service includes the collection of mixed municipal waste from households and other sources, biowaste from households, recyclable municipal waste, hazardous municipal waste and bulky waste from households.

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
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
Total:	**121.453.226**	**181.642**		**1.844.382**

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)

When observing the trend, presented also on the figure 1, the amount of generated municipal waste, from 2011 to 2019, the amount is 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, an increase followed (Ministry of Commerce and Sustainable Development, 2023).

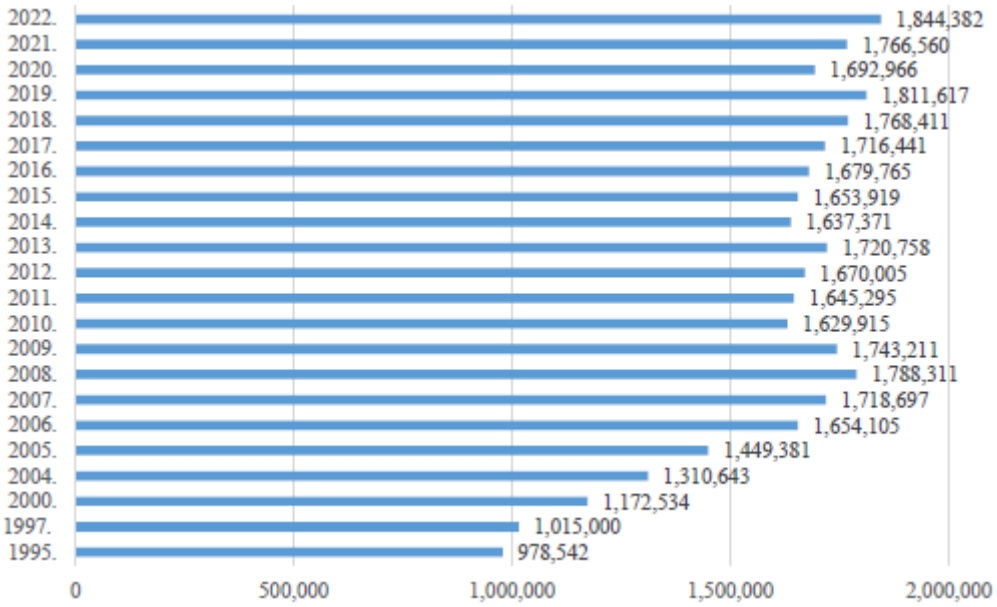

Figure 3 Amounts of total generated municipal waste (in tons) in the Republic of Croatia, 1995-2022. year (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development

The AWASTER project consortium is formed by the representatives from 5 regions that are highly affected by the tourism activities, so it is interesting to assess the trend in the generated amount of waste from the tourism activities.

In the table 2, it can be seen that as a result of the increase in the number of tourist overnight stays, in the period from 2015 to 2019, there was a 93% increase in the amount of municipal waste generated in tourism. In 2020, as a result of the significant drop in tourist overnight stays caused by the COVID-19 pandemic, there will also be a significant drop in the amount of municipal waste from tourism to values before 2015. In 2021 and 2022, with the increase in tourist arrivals, the recorded amount of municipal waste from tourism also increases.

Year	Amount of municipal waste from tourism (t)	Share in total municipal waste
2015.	98.960	6,0%
2016.	139.535	8,3%
2017.	155.958	9,1%
2018.	165.251	9,3%
2019.	171.505	9,5%
2020.	83.794	5,0%
2021.	136.512	7,7%
2022.	181.462	9,9%

Table 2 Amount of municipal waste from tourism, 2015-2022. year (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development)

In the observed year 2022, the amount of municipal waste generated in tourism amounted to 181.642 tons. The largest amounts were recorded in the Istria County, the Primorje-Gorski Kotar, the County of Split-Dalmatia and the County of Zadar, while the smallest amounts were recorded in the County of Virovitica-Podravina, the County of Požega-Slavonia and the County of Koprivnica-Križevačka, which can also be read in table 2.

County	Number of overnight stays by tourists	The amount of waste generated from tourism (t)	The share of the county in the total amount of municipal waste from tourism	Total generated municipal waste (t)	Share of waste from tourism in the amount of communal waste generated in the county
1. Zagreb	280.784	280	0,15%	109.902	0,25%
2. Krapina-Zagorje	442.735	305	0,17%	30.708	0,99%
3. Sisak-Moslavina	78.647	70	0,04%	45.819	0,15%
4. Karlovac	671.971	661	0,36%	41.109	1,61%
5. Varaždin	248.176	193	0,11%	45.582	0,42%
6. Koprivnica-Križevci	53.377	46	0,03%	32.251	0,14%
7. Bjelovar-Bilogora	96.167	70	0,04%	27.063	0,26%
8. Primorje-Gorski Kotar	21.772.506	34.235	18,85%	187.190	18,29%
9. Lika-Senj	3.923.299	5.588	3,08%	27.885	20,04%
10. Virovitica-Podravina	38.675	36	0,02%	24.285	0,15%
11. Požega-Slavonija	77.826	56	0,03%	16.847	0,33%
12. Brod-Posavina	80.770	64	0,04%	38.154	0,17%
13. Zadar	16.937.696	27.828	15,32%	123.982	22,45%
14. Osijek-Baranja	288.481	290	0,16%	95.349	0,30%
15. Šibenik-Knin	7.257.253	10.195	5,61%	59.738	17,07%
16. Vukovar-Srijem	156.377	158	0,09%	53.469	0,30%
17. Split-Dalmatia	21.678.137	32.404	17,84%	264.506	12,25%
18. Istria	35.133.509	52.063	28,66%	157.964	32,96%
19. Dubrovnik-Neretva	9.294.492	13.554	7,46%	75.222	18,02%
20. Međimurje	250.651	273	0,15%	42.415	0,64%
21. City of Zagreb	2.691.697	3.273	1,80%	344.944	0,95%
Total:	121.453.226	181.642		1.844.382	

Table 3 Amounts of waste generated in tourism in 2022, by county (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development)

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%).

Figure 4 Sorting plant for useful waste in the City of Prelog

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 4, 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
Total	**844.837**	**1**

Table 4 Separately collected waste in 2022 / tonne (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development)

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.

1.2. Separate waste collection system in Istria County

In the area of Istria County, in addition to collecting mixed municipal waste directly from users at the point of origin, public service providers (utility companies) collect waste for recycling in their area of operation separately at doorsteps (the so-called "door-to-door" system), via green islands, or containers located on public areas, and through recycling yards (mobile and stationary recycling yard). At recycling yards, citizens are allowed to dispose of smaller quantities of special types of waste generated in households, such as paper, plastic, glass, metals, textiles, problematic waste, bulky waste and other types of waste that the recycling yard is obliged to receive. The removal and disposal of separately collected waste through "green islands", containers for separation at the doorstep and

through recycling yards is not charged (e.g. plastic and metal packaging, paper and cardboard, glass and types of waste that are received in the recycling yard) from the category household users.

Figure 5 Eco island for separate waste collection in Istria County - utility company 6.MAJ Umag (source: www.6maj.hr)

The amount of separately collected waste and the quality of useful waste that can be recycled depends largely on the equipment of a particular area. The most efficient system is certainly collection at the doorstep. This system involves placing plastic and metal packaging in yellow containers, and paper and cardboard in blue containers. Glass is collected through containers on public areas. As for the collection of bio-waste, in the Istrian County, only a small part of the public service providers has enabled the collection of bio-waste via green islands or at the doorstep, which, especially in the summer months, results in increased quantities that end up in mixed municipal waste. The consequence of the above is the large amount of biowaste that ends up at the Kaštijun County Waste Management Center and which results in unpleasant odors for residents living in the immediate vicinity of the landfill. Representatives of local self-government units, as well as public service providers, will have to make considerable efforts in their areas in order to establish a biowaste collection service and thus reduce the amounts that end up in mixed municipal waste.

1.2.1. Categories, quantity and type of separated and collected waste at regional level

According to available data, 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.

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
Total	**28.873**

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. Istrian County with a recovery rate of 24% is at the top of Croatian counties, led by Međimurje County (44%), followed by Koprivnica-Križevci County (38%) and Varaždin County (32%). The counties with the lowest recovery rate within the public service in the amount of 3% are Dubrovnik-Neretva, Lika-Senj and Split-Dalmatia counties. (Table 5). The recovery rate is actually the most important statistical category for waste, as the EU and national targets are set for recycling, not for separate collection (Ministry of Commerce and Sustainable Development, 2023).

County	Total collected within the framework of public service (tonnes)	Disposed (tonnes)	Disposed (%)	Recovered (tonnes)	Recovered (%)	Other (tonnes)
1. Zagreb	76.933	59.900	78%	14.835	19%	2.198
2. Krapina-Zagorje	21.280	17.919	84%	3.308	16%	52
3. Sisak-Moslavina	31.972	27.435	86%	4.424	14%	114
4. Karlovac	28.999	26.123	90%	2.834	10%	42
5. Varaždin	30.238	20.283	67%	9.797	32%	158
6. Koprivnica-Križevci	22.041	13.420	61%	8.471	38%	150
7. Bjelovar-Bilogora	18.947	16.462	87%	2.427	13%	57
8. Primorje-Gorski Kotar	134.992	24.823	18%	29.977	22%	80.192
9. Lika-Senj	20.195	17.867	88%	556	3%	1.772
10. Virovitica-Podravina	16.115	12.873	80%	3.125	19%	117
11. Požega-Slavonija	12.166	10.534	87%	1.612	13%	19
12. Brod-Posavina	26.793	24.624	92%	1.997	7%	172
13. Zadar	88.868	80.389	91%	7.953	9%	326
14. Osijek-Baranja	67.306	49.444	73%	17.671	26%	191
15. Šibenik-Knin	41.181	38.632	94%	1.558	4%	990
16. Vukovar-Srijem	38.321	34.153	89%	3.820	10%	347
17. Split-Dalmatia	181.461	175.828	97%	5.582	3%	51
18. Istria	100.947	4.378	4%	24.710	24%	71.859
19. Dubrovnik-Neretva	52.835	50.656	96%	1.847	3%	332
20. Međimurje	27.589	15.035	54%	12.116	44%	438
21. City of Zagreb	231.453	175.450	76%	55.920	24%	83
Total:	**1.270.429**	**896.227**	**71%**	**214.542**	**17%**	**159.660**

Table 6 Management of municipal waste in 2022 with the rates of disposal and recovery of municipal waste collected as part of public services, by county (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development)

In table 6, it can be noted that the municipal waste recovery rate in the Republic of Croatia is very low, 17%, however, when the additional estimated amounts of waste are added (table 7), then the total percentage of recovery is 34%, and for Istria County 43,3% which still ranks it among the most successful counties in terms of the percentage of municipal waste recovery.

County	The total amount of generated municipal waste (tonnes)	Total amount of recovered municipal waste with additionally determined amounts (tonnes)	Recovery rate (%)
1. Zagreb	109.902	36.600	33%
2. Krapina-Zagorje	30.708	10.205	33%
3. Sisak-Moslavina	45.819	14.577	32%
4. Karlovac	41.109	11.655	28%
5. Varaždin	45.582	21.406	47%
6. Koprivnica-Križevci	32.251	16.057	50%
7. Bjelovar-Bilogora	27.063	8.363	31%
8. Primorje-Gorski Kotar	187.190	67.362	36%
9. Lika-Senj	27.885	6.035	22%
10. Virovitica-Podravina	24.285	9.283	38%
11. Požega-Slavonija	16.847	4.963	29%
12. Brod-Posavina	38.154	9.992	26%
13. Zadar	123.982	33.364	27%
14. Osijek-Baranja	95.349	38.052	40%
15. Šibenik-Knin	59.738	15.254	26%
16. Vukovar-Srijem	53.469	14.705	28%
17. Split-Dalmatia	264.506	65.274	25%
18. Istria	157.964	68.412	43%
19. Dubrovnik-Neretva	75.222	17.968	24%
20. Međimurje	42.412	23.407	55%
21. City of Zagreb	344.944	141.084	41%
Total:	**1.844.382**	**634.018**	**34%**

Table 7 Estimated recovery rates by county in 2022 with additional determined quantities included (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development)

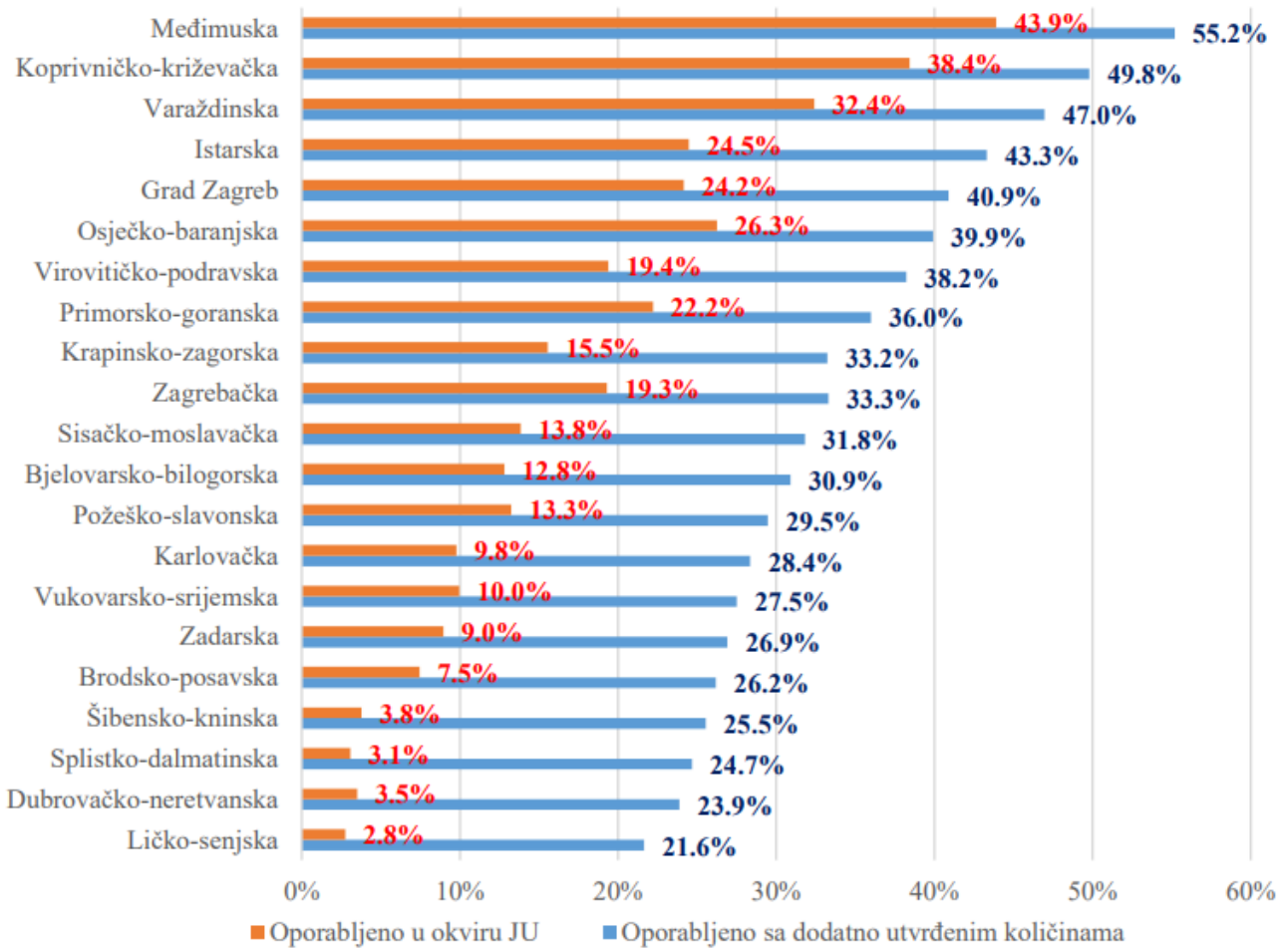

Figure 6 Comparison of recovery rate from public service with included other quantities (source: Report on municipal waste for 2022, Ministry of Commerce and Sustainable Development.)

On the national level, data shows that majority of waste is sent to disposal options and only 6.364,47 tonnes has been sent for recovery and can be viewed as marketable good (Environmental Protection Agency, n.d.). Unfortunately, the quantities are not significant for development of any market at this moment, however it is possible that the recycling potential can be increased in the future.

2. Secondary raw material markets

2.1. Overview of the secondary raw material markets in Republic of Croatia

According to the Waste Framework Directive (EU, 2008), 'recycling' means any recovery operation by which waste materials are reprocessed into products, materials or substances, whether for original or other purposes. It includes the reprocessing of organic material but does not include energy recovery or reprocessing into materials that are to be used as fuels or for backfilling operations.
The definition implies that only waste can be recycled. The status of waste is not defined by its chemical, physical or mechanical material properties or by its product composition or lifetime. Instead, in accordance with the Waste Framework Directive, it is defined by the fact that a holder discards or intends or is required to discard it. The recycling process ends at a single, determinate point at which a secondary raw material is produced. At this point, it is no longer waste, cannot be distinguished from a primary raw material and can be traded in the same way as all other commodities. Eventually, products that contain secondary raw materials as recycled content can be discarded as waste, from which materials can be recycled. Secondary raw material is a material resulting from a recovery process that becomes an input in a new production. Secondary raw material (SRM) markets are crucial for a circular economy. This is because SRMs enable recyclables to re-enter the production value chain, which reduces dependency on primary resources as a result. This role is acknowledged in the EU circular economy action plan of 2020. However, if policy is to help establish or further develop such markets, we need to better understand the currently fragmented SRM markets in the EU (European Environment Agency, 2022).

According to the data of the European Environment Agency (EEA) published in the "Research of the European markets of secondary raw materials", it is stated that the markets of recyclable raw materials are mostly insufficiently functional, except for a few raw materials. Improving the market for recycled raw materials is key to achieving a circular economy in the EU, reducing the need to extract natural resources and avoiding the associated environmental impacts.
Applying the assessment criteria to eight common secondary materials markets, the EEA report concludes that only three of them – aluminium, paper and glass – are performing well. These markets provide credible and continuous information to market participants, are international and open, and recycled materials have a significant market share compared to primary materials, the EEA report said.
The five markets for secondary raw materials that are not functioning well are wood, plastic, biowaste, aggregates from construction waste and textiles. According to the EEA analysis, the main problems in these markets are their small size compared to primary materials, weak demand and the lack of common specifications, which reduces the quality of materials for industrial use. In

addition, some materials face special challenges, such as the competing demand for energy use in the case of wood.
In addition to acknowledging the need for more information to enable proper monitoring and assessment of market developments, the EEA report presents several options for overcoming market barriers for recycled raw materials. These include incentives to design products that are more easily recycled, strengthening recycling targets, increasing the content of recycled materials in new products, establishing technical standards for recycled materials and using taxes to equalize price competition with primary raw materials.
The market of secondary raw materials in Croatia is developing in parallel with the economic trends and below and it is driven by EU regulations and national efforts to modernize waste handling and increase recycling rates. Significant advances in the field of waste management and recycling have been achieved, however, for the secondary raw materials market to function fully, significant investments will be needed, both in recycling processes and in production facilities for the use of recycled materials. Croatian waste market consists of following subjects, and the extensive list can be found on Croatian Ministry of Commerce website[2]:

	Type of operation	Number of active permits issued
1.	End of waste operators – produce new product from waste	135
2.	Waste transporters	1300
3.	By product producers	305 permits issued – 203 actives
4.	Waste brokers	300 permits issued – 218 actives
5.	Waste sellers	476 permits issued – 403 actives
6.	Collectors and recovery operators – no permit required	52 permits issued – 36 actives
7.	Collectors and recovery operators –permit required	89 permits issued – 75 actives
8.	RE-use centres	8 permits – 7 actives

Table 8 Waste market operators (Source: Waste operators registry)

In the following, we will convey the substantive research presented in the magazine Tehnoeko in March 2024 on the topic of the market of secondary raw materials in Croatia.

In the field of waste management, C.I.O.S. the group is the leader in the region, and in Croatia, connecting companies specialized in numerous waste recovery procedures, it is the largest group in the sector. It brings together several companies dealing with the recovery of collected waste such as

[2] https://mingo.gov.hr/o-ministarstvu-1065/djelokrug/uprava-za-procjenu-utjecaja-na-okolis-i-odrzivo-gospodarenje-otpadom-1271/gospodarenje-otpadom/ocevidnici-7589/7589

CE-ZA-R, CIAL, EKO-FLOR Plus, Metis and others. Through more than forty business locations in Croatia and twenty in Bosnia and Herzegovina, it annually collects and processes more than one million and one hundred thousand tons of different types of waste. In 2022, they collected about 700,000 tons of metal waste, about 364,000 tons of non-metallic waste, 44,000 tons of scrap vehicles and 17,000 tons of electronic and electrical waste, with a consolidated business income of 389.5 million euros.
CE-ZA-R, the Center for Recycling, is the largest component of the group primarily focused on the recovery and market of metals in which it is the regional leader and a significant stakeholder with an internationally recognized reputation. The company also operates the only private plant for the mechanical-biological treatment of non-hazardous waste in Croatia and the CE-ZA-R foundry. The company is authorized to collect and process EE waste.

EKO-flor Plus d.o.o. is the largest private company with a complete modern infrastructure for municipal waste collection, sorting and composting.

METIS d.d. manage hazardous and non-hazardous waste and waste of special categories in four counties (Istarska, Karlovačka, Ličko-Senjska and Primorje-Gorski Kotar). METIS is one of the oldest companies in the waste management sector in Croatia, founded in 1948, and since 1992 operating as part of the CIOS group.

CIAL d.o.o. is the only aluminum smelter and foundry in Croatia. It processes all concessionally collected aluminum packaging in the territory of the Republic of Croatia, with a capacity of 6,000 tons per year (Dokonal, T., 2024).

The company Hamburger Recycling Croatia is part of an international group, and is focused primarily on paper and plastic. They believe that the secondary raw materials market in Croatia functions at a satisfactory level. According to CEO Jadranko Tomašević "The Croatian market is actually part of the regional, even world market, where the price of individual raw materials is adjusted to supply and demand. In the last 4-5 years, we have had extremes, which alternate, from very low prices to record highs. All this is a consequence of events at the world level. From the coronavirus, the war in Ukraine, and other disruptions in the markets".

According to DS Smith, multinational operator, „domestic collection meets less than 50 percent of the needs of the factory in Belišće. Rolls of paper, the final product of the paper mill, are delivered to domestic packaging factories in Belišće and Koprivnica, in order to provide sustainable packaging solutions on domestic and international markets.

The market itself is currently distorted as not all of the materials collected are classified as marketable (especially plastic currently). The following market size estimation is based on fact that all reported quantities are recycled.

Waste stream/material	Quantity	Share	Price	Total
Paper and cardboard	270.666	0,32	28	7.578.648
Bulky waste	136.837	0,16	0	-
Biowaste	118.806	0,14	0	-
Plastic	91.025	0,11	89,64	8.159.481
Glass	71.709	0,08	65	4.661.085
Wood	57.865	0,07	0,5	28.933
Metal	34.899	0,04	170	5.932.830
WEEE	29.917	0,04	0	-
Textile	4.728	0,01	120	567.360
Batteries	416	0,00	0	-
Other	27.519	0,03	0	-
Total	844.387	1		26.928.337

Table 9 Calculation of market value based on collected materials in 2022. (Source: D.1.1.3 Report made by PP2 SUNCE)

The amounts of waste collected through the public service is estimated at almost 27m EUR, however it does not include the total amounts of collected waste in the country (end of waste materials and byproducts from industry and other waste types collected through national EPR schemes.

The third-party retailers/brokers and operators can gain additional 57.667.240 for further collection and treatment of the separately collected waste (mainly bulky and biowaste) from public sector (municipal waste). This part of the market value is distorted and for public service (municipal solid waste operators) presents costs not incomes.

2.2. Secondary raw material system in the Istria County

In the Istria County, companies which are providing public municipal waste collection services hand over collected waste (mixed and separately collected) to authorized recyclers, or in the case of mixed municipal waste, to the Kaštijun County Waste Management Center.

The system of collection and management of collected waste generates significant costs for companies providing public services, and the economics of separate waste collection largely depends on the purchase prices of individual fractions of municipal waste on the market. According to the

report of the utility company 1.MAJ d.o.o. from Labin, which provides public services in the area of the City of Labin and surrounding municipalities, in 2022 the purchase price of paper and cardboard was around EUR 0.13/kg. However, in 2023, the purchase price was only 0.003 EUR/kg, which reduced the already low income of the company. Battery prices in 2023 ranged between 0.27 - 0.83 EUR/kg, while the purchase of batteries remained at 0.27 EUR/kg. The purchase price of the metal varied from 0.16 EUR/kg to 0.23 EUR/kg.

For the greater part of the collected waste, public service providers have to pay the operators, so we can use the example of the utility company 1.MAJ d.o.o. Labin, note that in 2023, they had to allocate 686.694,005 euros for 4,818 tons. In table no. x, you can compare the collection prices by individual types of waste.

Type of waste	Quantity (tonnes)	Cost (EUR)	Operator
Plastic	703,82	105.639,19	SEKUNDAR USLUGE d.o.o.
Mixed waste	64,58	8.571,06	METIS d.d.
Glass	26,08	782,40	F&M TEHNOVALPROM d.o.o.
Biowaste	54,46	5.683,60	F&M TEHNOVALPROM d.o.o.
Mixed municipal waste	3.924,00	565.426,56	KAŠTIJUN d.o.o.
Biowaste	2,16	302,40	METIS d.d.
Glass packaging	43,56	289,24	METIS d.d.
Total cost	4.818,66	686.694,05	

Table 10 Report on the public service provider´s activities in 2023 – 1.MAJ d.o.o. Labin

The highest cost is the disposal of mixed municipal waste in ŽCGO Kaštijun, which drastically increased the cost of disposal in 2023. This cost amounted to EUR 565,426.56, and is settled from the so-called of the "variable" part of the bill paid by public service users. The most problematic cost that is covered by the regular operations of every public service provider is certainly the disposal of plastic packaging, which amounts to EUR 105.639.19 in the example of the utility company 1.MAJ d.o.o. Labin. The costs of disposal are constantly increasing, and they increased significantly in 2023 primarily due to the increase in the price of disposal of mixed municipal waste in Kaštijun, but also due to the higher price of disposal of plastic and metal packaging, which is 0.2 EUR/kg.

In the Istria County, the management of residual, i.e., mixed municipal waste is solved by the construction of ŽCGO Kaštijun. However, the price of the disposal service at the landfill, as well as the goals of waste management policies are forcing the Istria County to find solutions for the management of dry recycled materials (paper/cardboard, plastic, glass, metals) and bio-waste.

Figure 7 Kaštijun County waste management centre (source: www.kastijun.hr)

In accordance with the goals of waste management for the Istria County, the Istria County prepared an Elaborate on the quantities and flows of waste with the aim of improving and improving the waste management system in the area of the Istria County with the aim of finding the most favourable locations for the construction of a sorting plant and a composting plant in locations that are not specified by spatial planning documentation. For the purposes of the analysis, a decentralized and centralized approach to construction was considered. The analysis found that the centralized approach is more favourable (by approx. 12%), and the macro locations Vodnjan, Poreč, Rovinj or Pula are suggested as the most favourable locations (IPZ UNIPROJEKT TERRA, 2021).

In relation to the technological solutions of the facilities of the sorting facility and plant for the biological treatment of waste, the following solutions were analyzed:

- Sorting plant for dry recyclables and other recyclable waste: automatic sorting plant and semi-automatic/manual sorting plant,
- Plant for biological treatment: tunnel composting, and dry fermentation with utilization of the produced biogas with tunnel composting of the obtained digestate.

Analyzing the existing quantities and composition of waste in the area of Istria County, considering the future fulfillment of waste management goals, analyzing transportation options and finding optimal locations for the necessary new facilities, the conclusion of the analysis was the following:

- It is necessary to build a new facility for the centralized management of separated dry recyclable waste collected (automatic sorting plant).

- It is necessary to build a new facility for the centralized management of separated biowaste (compost).
- It is possible to build the listed facilities of sorting and composting in one location of the recycling center using the advantages of organizational and infrastructural connection of facilities within one recycling center.
- The location of the recycling center would be optimally located in macro locations in the area of Vodnjan, Poreč, Rovinj or Pula.
- Management of bulky and non-hazardous construction waste can be linked organizationally using common processing equipment.
- The total necessary investments in new facilities and equipment, which would serve to upgrade the complete waste management system in the area of Istria County, would amount to approximately EUR 33,285,000.
- It is necessary to connect and improve the system of providing public services and services related to public services with a complete waste management system that includes all necessary facilities and systems adapted to seasonal fluctuations in the amount of municipal waste, in order to be able to meet the goals of waste management prescribed by national and EU regulations.

2.2.1. Recycling facilities

In the Istrian County, recycling process is mainly performed by the operators that are operating also on the national level, so for the purposes of the document we will observe the most important actors at the national level.

Drava International d.o.o. is one of the biggest companies in the recycling business in Croatia and they are the largest Croatian plant for plastic recycling. Drava International primarily deals with recycling or recovery of waste film as well as waste PE (polyethylene) film and waste PET (polyethylene terephthalate) packaging. Recycled products from PET bottles are PET films, and garbage bags are made from polyethylene. The recycling process is fully rounded in the sense that the waste packaging is sorted, recycled, whereby granulated materials are obtained, which in the further production process are transformed into new finished products depending on the needs of the market. The waste generated in the recycling process is used as a raw material for the production of synthetic diesel by the catalytic depolymerization process. In 2023. the company faced a huge fire in the production facilities.

Figure 8 PET bottles prepared for recycling process (source: Pixabay)

The newly established Croatian - Austrian company REKIS d.o.o. is also a good example in the recycling processes in the Republic of Croatia. The company owns a modern plant for the recovery of waste PET packaging from beverages bottles. The production plant is located in Donja Dubrava, Međimurje County. The company uses "bottle to bottle" production technology that includes efficient processes like sorting (Sesotec sorting system), grinding, washing and drying (Lindner Washtech), for production of PET flakes (transparent or colored) wich is later use in the granulation process for the production of recycled PET granules. In the granulation process, the company use highly efficient VACUNITE ® "super-clean" recycling technology (EREMA Vacurema® Basic + Polymetrix SSP V-LeaN) to produce high quality final product - recycled granulate rPET, which is suitable for use in the food industry.

DS Smith is a leading manufacturer of sustainable packaging solutions and paper products and a provider of recycling services worldwide. In Croatia, DS Smith covers the entire process - from the collection of waste paper, the production of packaging paper to the production of cardboard packaging and new packaging solutions. Accordingly, Croatia is one of the few countries that has companies represented in all three divisions of the DS Smith Group:

- Recycling services (DS Smith Unijapapir Croatia d.o.o.)
- Paper products (DS Smith Belišće Croatia d.o.o.)
- Packaging solutions (DS Smith Belišće Croatia d.o.o. and Bilokalnik – IPA d.d.).

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Gumiimpex-GRP d.o.o. is the first company in Croatia to start recycling waste car tires in 2005. The main goal is to reduce the harmful impact on the environment while reusing the valuable properties of rubber. With this, Croatia joins the countries that strive to organize the management of waste tires with quality. Using modern technology, granulate of different sizes is obtained from old, exported tires, the further application of which is present in many economic activities: from construction, infrastructure, transport, agriculture (livestock and gardening) to sports fields of various profiles and urban environments with landscaped areas for leisure, children's playgrounds but also rehabilitation centers.

3. Measures and initiatives for the development and improvement of secondary raw material markets

At the national level, the Fund for Environmental Protection and Energy Efficiency carries out significant activities to encourage waste separation and prepare separated waste for recycling processes. One of the major projects that was carried out was the procurement of containers for the separate collection of communal waste. The procurement was carried out by the Fund for Environmental Protection and Energy Efficiency on behalf of 407 local self-government units that expressed interest and met the conditions for this project. According to the public procurement procedures carried out and contracts concluded with the selected economically most favorable bidders, in the period from September 2019 to July 2021, 1.230.695 containers for the separate collection of municipal waste were delivered to 407 local self-government units: bins (capacity 80,120,240 and 360 l), HDPE and metal containers (770 and 1100 liters), metal bells and bells made of polyester laminate, for the separate collection of waste paper and cardboard, waste plastic, waste glass, bio-waste and recyclable waste. In the Istria County, most of the local authorities used the opportunity to

The second interesting and important initiative performed by the Fund is the pilot project "Reduce food waste, cook for your guests". The project is implemented together with Ministry of Economy and Sustainable Development and the Faculty of Geotechnical Engineering of the University in Zagreb.

For now, the project is being implemented in two hotels – the Park Plaza Histria in Pula, and the Osijek Hotel in Osijek. As part of different activities and education, data are being collected and methods established so that as a result, the project could be applied across Croatia in the kitchens in other hotels. Workshops for the staff of the participating hotels were held, where they were presented with the examples of the hotels that were already applying the principles of planned food management, proper storage of ingredients, and rationally estimating portion size. In cooperation with the hotel staff, measurements were carried out in Osijek Hotel, showing that the quantity of waste was reduced by 11% based on the recommendations and consultations with the hotel staff. The baseline was the measured total food waste quantity in 10 categories, which included meat, eggs, milk and dairy products. From the first measurements, the bread category recorded a 50% reduction, partly because smaller plates were offered along the large ones, so that the guests could have a choice to plate only as much as they knew they would eat (Environmental Protection and Energy Efficiency Fund, 2024).

4. Conclusion

The market of secondary raw materials in the Republic of Croatia functions satisfactorily, the prices of individual raw materials are aligned with supply and demand, and fluctuations in the value and turnover of goods are directly related to various global and geopolitical influences. However, when the data is analyzed at the regional level, as in the case of this report for the needs of the Istria County, one comes to the realization that although the rate of collected waste that is handed over for recycling is significant at 43,3%, municipal companies at the local level encounter with high prices for the purchase of separately collected waste, thus discouraging efforts to increase the separation rate.

In the territory of Istria County, separately collected waste collected as part of a public service is handed over to authorized recyclers, who then either recycle the collected waste or hand it over to processors. However, a significant effort in the coming period will have to be devoted to increasing the rate of separately collected waste, especially bio-waste, which creates significant problems for the Kaštijun County Center for Waste Management. The Istria County prepared an Elaborate on the quantities and flows of waste with the aim of improving and improving the waste management system in the area of the Istriaa County, and the conclusions of the elaborate are the need for the construction of a sorting plant and a composting plant in order to reduce the amount of waste that will end up in Kaštijun and to obtain additional value from the collected waste and thereby contributing to the establishment of a functional circular economy system in the Istria County.

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INTERREG ITALY-CROATIA
PROGRAMME 2021 – 2027

AWASTER – Adopting WASTE as Resource

D.1.1.3 Regional secondary market report – Split-Dalmatia County

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Italy – Croatia

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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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Table of contents

Introduction

In 2022, Split-Dalmatia County collected significant amounts of waste, but a large portion was landfilled, with only 3% being recovered. This poor performance highlights the need for improved waste management practices and infrastructure. The Regional secondary market report will provide a comprehensive analysis of waste management in Croatia, focusing on European Union directives and the national potential for achieving ambitious objectives in waste production, waste management, and waste treatment in Split-Dalmatia County. Secondary raw material markets play a crucial role in this context of challenge and opportunity, enabling recyclable materials to re-enter the production chain and reducing dependency on primary resources.

The main topics covered in the report include the separate waste collection system at the national and regional levels, with a detailed description of categories, quantities, and types of separated and collected waste; an overview of the secondary raw material markets at the national and regional levels; recycling facilities; users of secondary raw materials; and measures and initiatives for the development and improvement of secondary raw material markets.

This report provides a detailed analysis of the current state of the waste management market and secondary raw materials at the national level, particularly in Split-Dalmatia County. The report outlines national and regional efforts, legislative frameworks, and the economic potential of secondary raw materials. By understanding these dynamics, stakeholders can contribute to a better and more sustainable life in Split-Dalmatia County and beyond.

1. Separate waste collection system

1.1. Separate waste collection system in Republic of Croatia (national level)

Croatian legislation is aligned with the EU directives, and the Waste Management Act (NN 84/2021) prescribes measures to achieve the goals of the European Green Deal, particularly a 65% recycling rate for municipal waste and a reduction of waste disposal to 10% of the total amount of waste generated by 2035.

According to the Waste Management Act (2021), waste is any substance or object that the holder discards, intends to discard, or is required to discard. Waste management, therefore, is the process of conducting and directing activities to achieve set goals and relates to activities such as the collection, transportation, recovery including sorting, and disposal of waste, the supervision of these activities, as well as the monitoring and measures implemented at locations where waste has been disposed of (Republic of Croatia, 2021).

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.

The goals of national waste management plan summarized all the obligations and goals set in primary and secondary national legislation and following table presents major waste stream goals:

Br.	Waste type	objective
1.	Municipal waste	Recover through recycling and preparation for reuse at least: • 55% of the mass of municipal waste by 2025, • 60% of the mass of municipal waste by 2030, and • 65% of the mass of municipal waste by 2035. To landfill less than 264.661 tonnes of biodegradable waste; To landfill less than 10% of total waste mass produced by 2035; Increase the collection and treatment of biowaste

2.	Packaging waste	Separately collect and recover, materially or energetically, at least 60% of the total mass waste packaging produced in the territory of the Republic of Croatia. Recycle at least 70% of the mass of total waste packaging by December 31, 2030, at least the following mass of material in the recycling process: • 55% plastic • 30% wood • 80% of unpainted metals • 60% aluminium • 75% glass • 85% paper and cardboard

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

Collection of municipal solid waste in Croatia is not unified and municipalities in general have free choice to select the suitable collection system while the methodology for implementation of "pay as you throw" scheme is unified and prescribed by the national law. Major collection system in the inland (central and eastern Croatia) is door to door collection with very few streams collected with the street container system. On the contrast, majority of municipalities in Croatian coastal area rely on street container systems and limited application of the "pay as you throw" principle due to difficulties in its implementation through street container systems. Another major difference between north and south is the fact that southern part of Croatia rarely or does not collet biowaste at all and thus cannot achieve significant separated collection results. The collection in general is done with larger trucks 6-21 sqm, while some of the municipalities introduced lighter vehicles (7 sqm) in last 10 years.

1.1.1. Categories, quantity and type of separated and collected waste at national level

Since 2011, the amounts of municipal generated waste have been continuously increasing, ranging between 1.6 million and 1.8 million tons. In 2020, as a consequence of the COVID-19 pandemic, which led to a significant reduction in the service sector (closure of hospitality establishments, a decrease in the number of tourist overnight stays), the amounts of municipal waste fell to the levels of 2014. With the increase in service sector activities (hospitality establishments, a significant increase in the number of tourist overnight stays, etc.) from 2021, the amount of municipal waste rose again, and in 2022, the total amount of municipal waste reached 1,844,382 tons, which is the highest value in the observed period from 1995 to 2022 (Ministry of Commerce and Sustainable Development, 2023). The same report also shows that total municipal solid waste originating from public service represents 1.270.429 tonnes, and the rest originates from commercial activities.

Since the 2010, the quantities of separately collected waste has 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.

The following figure shows the amount of produced, separately collected and treated biowaste. In 2022. Croatia has produced 489.404 tonnes of municipal biowaste, out of which 118.806 tonnes (24%) was separately collected and 95.471 tonnes (19.5%) were treated by composting or anaerobic digestion.

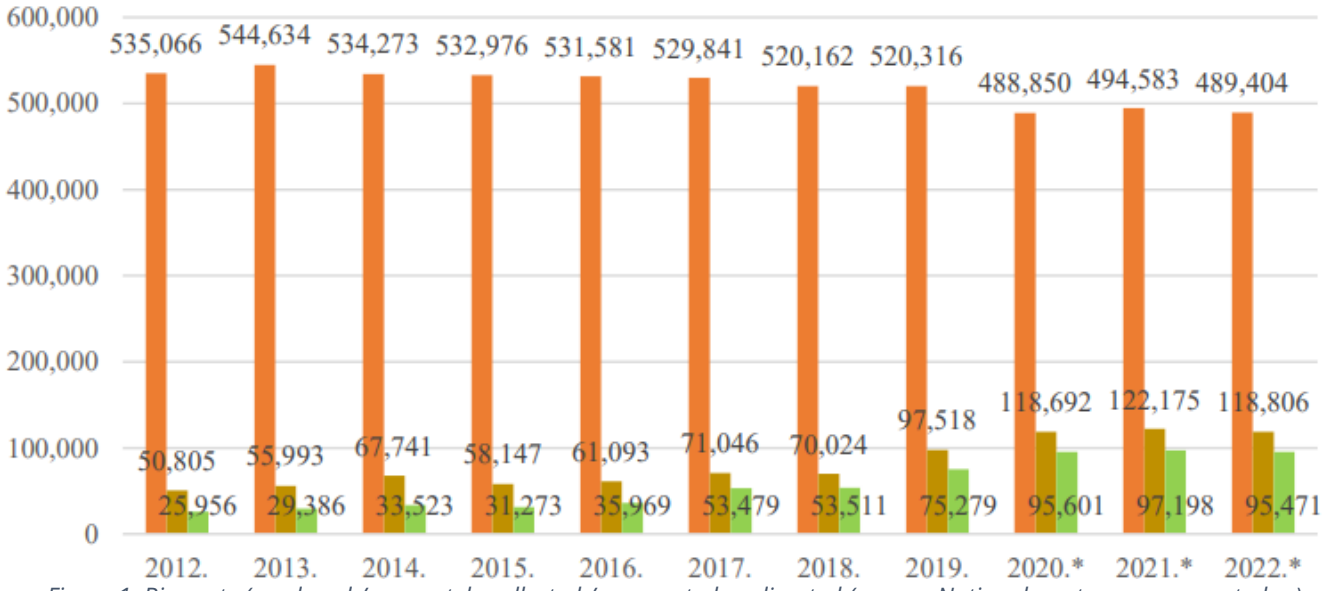

Figure 1. Biowaste (produced / separately collected / composted or digested (source: National waste management plan)

The total breakdown of separately collected waste in Republic of Croatia is shown in the next figure, 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	34.899	0,04
WEEE	29.917	0,04
Textile	4.728	0,01
Batteries	416	0,00
Other	27.519	0,03
Total	844.387	1

Figure 2. Separately collected waste in 2022 / tonne (source: ROO – National polluters register)

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.

1.2. Separate waste collection system in Split-Dalmatia County

In 2022, the total amount of collected waste was 187.185 tonnes, out of which 150.659 tonnes were collected from households, 29.330 tonnes from hospitality business sector (mostly mixed waste) and 6.207,03 tonnes from other business users. 989,33 tonnes of waste were additionally collected through street containers infrastructure.

Out of total amount of collected waste 148.903,26 tonnes have been landfilled, which leaves the capacities for further landfilling for less than 3 years of operation. The total amount of separately collected waste through collection service was 30.326 tonnes, while drop-off option through civil amenity site (recycling yard) resulted with 5.534,42 tonnes of separately collected waste. Since none of the cities or municipalities have reached the recycling targets set by legislation (50% by 2020), all of them have to pay the national fee for landfilling for total of 56.499 tonnes resulting with damages in taxes worth approximately 1.694.970 EUR.

The dominant method for collection of waste traditionally has been street container system which historically did not bring significant separate collection results.

Outside of municipal waste streams (public service stream) additional 377.598 tonnes was collected by the economic operators where 20.475 tonnes are similar to municipal waste and 15.803 tonnes were sent for recycling. It is also interesting that 365.112,15 tonnes of materials were recycled as those are dominantly various types of ferrous and non-ferrous metals.

1.2.1. Categories, quantity and type of separated and collected waste at regional level

Total quantities of separately collected waste from public service in Split-Dalmatia County amount at 18.482 tonnes, which in context of market development does not represent significant mass for development of circular economy models.

Waste stream	From public service / tonnes
Biodegradable waste	2216
Metal	192
Textile	104
Paper	1.355
Plastic	634
Glass	203
Other	13.778
Total	

Figure 3. Quantities of collected MSW in 2022. (source: ROO public database compared with HAOP report)

According to the national waste report, the situation is even worse as municipal companies running the waste management systems heavily rely on landfilling – even for separately collected waste. The Split-Dalmatia County in 2022. has landfilled 97% of collected municipal waste from public service (175.828 tonnes) and recovered 3% or only 5.582 tonnes of waste. The recovery rate is actually the most important statistical category for waste, as the EU and national targets are set for recycling, not for separate collection (Ministry of Commerce and Sustainable Development, 2023). With achieved results, from public service category, Split-Dalmatia County shares the last place with Dubrovnik–Neretva County and Lika-Senj County which also recover only 3% of totally collected materials.

Slightly better statistics arise when the other types of collections are added and Split-Dalmatia County accounts for 25% of recovery, however it is still among the lowest performing counties in Croatia.

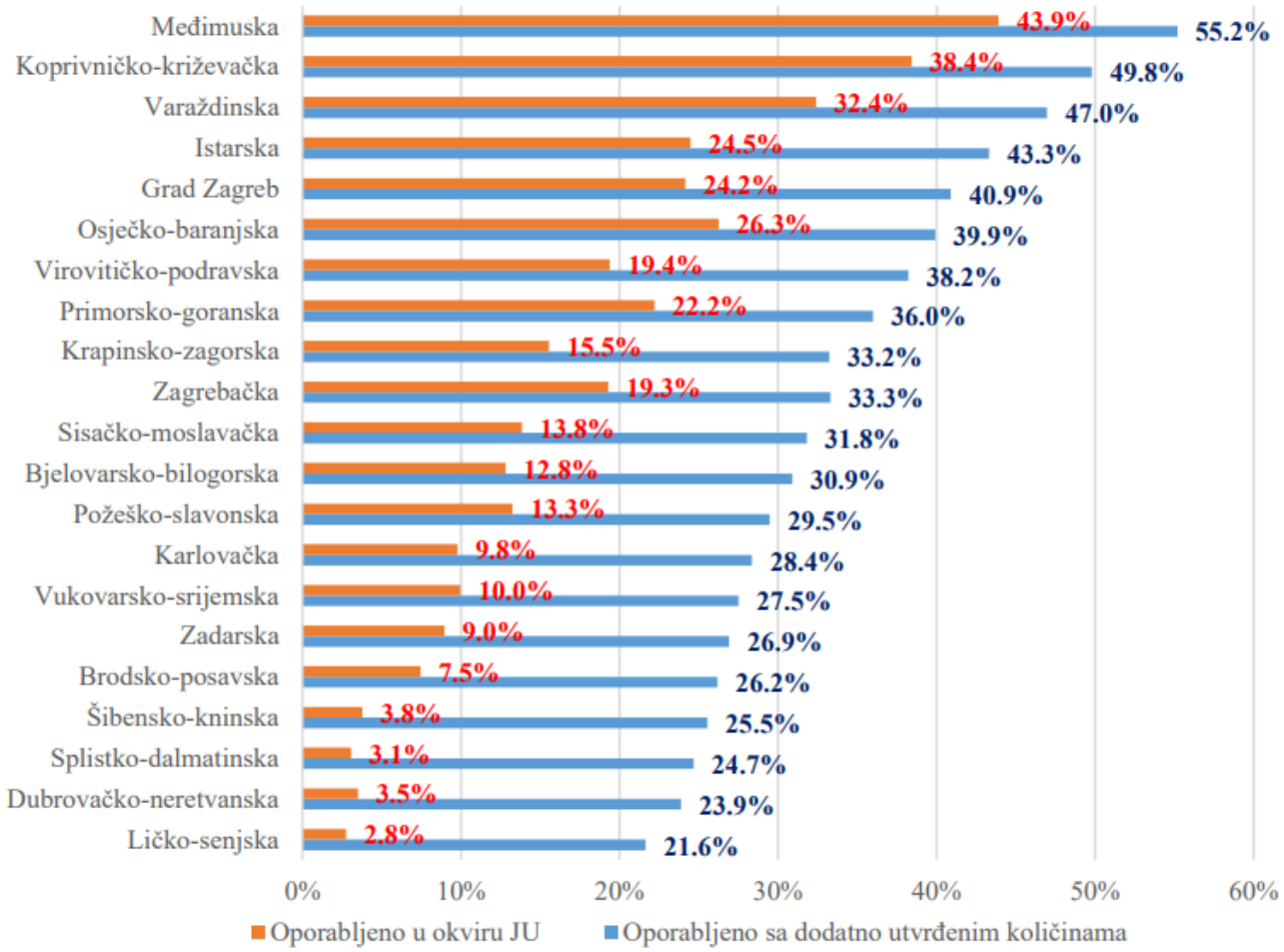

Figure 4. Comparison of recovery rate from public service with included other quantities (source: Ministry of environment, waste report 2022.?)

EWC CODE	Waste type	collected	temporary storage	landfill (D1-D7 + D12)	D10	Other D	R1	R2-R11 without composting	PP, R12 + R13
15 01 01	Paper and cardboard packaging	596,07	0,56						595,51
15 01 02	Plastic packaging	476,80	2,44						474,36
15 01 04	Metal packaging	24,28	0,01						24,27
15 01 05	Multilayer packaging	3,54							3,54
15 01 07	Glass packaging	92,51	0,71						91,80
15 01 10*	Packaging contaminated by hazardous substances	1,60							1,60
15 01 11*	Metallic packaging containing a hazardous solid porous matrix	0,01			0,01				
20 01 01	Paper and cardboard	758,95							758,95
20 01 02	Glass	110,35	2,94						107,41
20 01 08	Biodegradable kitchen and canteen waste	1.501,35		1.501,35					
20 01 10	Cloth	73,00	0,88						72,13
20 01 11	Textile	31,14	0,72						30,42
20 01 13*	Solvents	0,03			0,03				
20 01 19*	Pesticides	0,10			0,10				
20 01 21*	Fluorescent tubes and other mercury-containing waste	0,11							0,11
20 01 23*	Discarded equipment containing chlorofluorocarbons	1,90	0,11						1,79
20 01 25	Edible oil and fat	2,88	0,38					1,76	0,74
20 01 26*	Other oil and fat	2,88					2,88		
20 01 27*	Paint, inks, adhesives and resins containing hazardous substances	3,22	0,36			2,86			
20 01 28	Paint, inks, adhesives and resins	1,50	0,39		1,12				
20 01 30	Other detergents	0,01			0,01				
20 01 32	Medicines	0,36			0,10				0,26
20 01 33*	Batteries and accumulators	0,18	0,02				0,17		
20 01 34	Other batteries and accumulators	1,32	0,06				1,05		0,22
20 01 35*	WEEE	132,97	1,89						131,07
20 01 36	Other WEEE	48,54	1,49						47,05
20 01 37*	Wood containing hazardous substances	3,14	3,14						-
20 01 38	Other wood	2.040,40	23,34						2.017,06
20 01 39	Plastic	157,00	1,10						155,90
20 01 40	Metal	167,44	0,97						166,47
20 02 01	Biodegradable waste	711,64		674,14					37,50
20 03 01	Mixed municipal waste	160.738,08		160.738,00					
20 03 07	Bulky waste	13.777,65	5,05	12.126,28					1.646,31
	Total	181.460,95	46,56	175.039,77	1,37	2,86	4,10	1,76	6.364,47

Type of operation	Quantities/ tonne
Temporary storage	46,56
Landfill D 1 Deposit into or on to land (e.g. landfill, etc.) D 2 Land treatment (e.g. biodegradation of liquid or sludgy discards in soils, etc.) D 3 Deep injection (e.g. injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc.) D 4 Surface impoundment (e.g. placement of liquid or sludgy discards into pits, ponds or lagoons, etc.) D 5 Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.) D 6 Release into a water body except seas/oceans D 7 Release to seas/oceans including sea-bed insertion D 12 Permanent storage (e.g. emplacement of containers in a mine, etc.)	175.039,77
D10 - Incineration on land	1,37
Other D	2,86
R1 - Use principally as a fuel or other means to generate energy	4,10
R2-R11 without composting	1,76
Exchange of waste for submission to any of the operations numbered R 1 to R 11	6.364,47

The data shows that majority of waste is sent to disposal options and only 6.364,47 tonnes has been sent for recovery and can be viewed as marketable good (Environmental Protection Agency, n.d.). Unfortunately, the quantities are not significant for development of any market at this moment, however it is possible that the recycling potential can be increased in the future.

2. Secondary raw material markets

2.1. Overview of the secondary raw material markets in Republic of Croatia

Secondary raw material is a material resulting from a recovery process that becomes an input in a new production. Secondary raw material (SRM) markets are crucial for a circular economy. This is because SRMs enable recyclables to re-enter the production value chain, which reduces dependency on primary resources as a result. This role is acknowledged in the EU circular economy action plan of 2020. However, if policy is to help establish or further develop such markets, we need to better understand the currently fragmented SRM markets in the EU (European Environment Agency, 2022).

The waste management market in Croatia is evolving, driven by EU regulations and national efforts to modernize waste handling and increase recycling rates. While significant progress has been made, challenges such as public awareness, illegal dumping, and financial constraints remain. Continued investment, education, and adherence to sustainable practices are crucial for Croatia to achieve its

waste management goals and EU targets. Croatian waste market consists of following subjects, and the extensive list can be found on Croatian Ministry of Commerce website[1]:

	Type of operation	Number of active permits issued
1.	End of waste operators – produce new product from waste	135
2.	Waste transporters	1300
3.	By product producers	305 permits issued – 203 active
4.	Waste brokers	300 permits issued – 218 active
5.	Waste sellers	476 permits issued – 403 active
6.	Collectors and recovery operators – no permit required	52 permits issued – 36 active
7.	Collectors and recovery operators –permit required	89 permits issued – 75 active
8.	RE-use centres	8 permits – 7 active

Figure 5. Waste market operators (source: waste operators registry)

In the field of waste management, C.I.O.S. the group is the leader in the region, and in Croatia, connecting companies specialized in numerous waste recovery procedures, it is the largest group in the sector. It brings together several companies dealing with the recovery of collected waste such as CE-ZA-R, CIAL, EKO-FLOR Plus, Metis and others. Through more than forty business locations in Croatia and twenty in Bosnia and Herzegovina, it annually collects and processes more than one million and one hundred thousand tons of different types of waste. In 2022, they collected about 700,000 tons of metal waste, about 364,000 tons of non-metallic waste, 44,000 tons of scrap vehicles and 17,000 tons of electronic and electrical waste, with a consolidated business income of 389.5 million euros (Dokonal, T., 2024).

The company Hamburger Recycling Croatia is part of an international group, and is focused primarily on paper and plastic. They believe that the secondary raw materials market in Croatia functions at a satisfactory level. According to CEO Jadranko Tomašević "The Croatian market is actually part of the regional, even world market, where the price of individual raw materials is adjusted to supply and demand. In the last 4-5 years, we have had extremes, which alternate, from very low prices to record highs. All this is a consequence of events at the world level. From the coronavirus, the war in Ukraine, and other disruptions in the markets" .

[1] https://mingo.gov.hr/o-ministarstvu-1065/djelokrug/uprava-za-procjenu-utjecaja-na-okolis-i-odrzivo-gospodarenje-otpadom-1271/gospodarenje-otpadom/ocevidnici-7589/7589

According to DS Smith, multinational operator, „domestic collection meets less than 50 percent of the needs of the factory in Belišće. Rolls of paper, the final product of the paper mill, are delivered to domestic packaging factories in Belišće and Koprivnica, in order to provide sustainable packaging solutions on domestic and international markets."

The market itself is currently distorted as not all of the materials collected are classified as marketable (especially plastic currently). The following market size estimation is based on fact that all reported quantities are recycled.

Waste stream/material	Quantity	Share	Price	total
Paper and cardboard	270.666	0,32	28	7.578.648
Bulky waste	136.837	0,16	0	-
Biowaste	118.806	0,14	0	-
Plastic	91.025	0,11	89,64	8.159.481
Glass	71.709	0,08	65	4.661.085
Wood	57.865	0,07	0,5	28.933
Metal	34.899	0,04	170	5.932.830
WEEE	29.917	0,04	0	-
Textile	4.728	0,01	120	567.360
Batteries	416	0,00	0	-
Other	27.519	0,03	0	-
Total	844.387	1		26.928.337

Figure 6. Calculation of market value based on collected materials in 2022. (source: own calculation based on market prices)

The amounts of waste collected through the public service is estimated at almost 27m EUR, however it does not include the total amounts of collected waste in the country (end of waste materials and byproducts from industry and other waste types collected through national EPR schemes.

The third-party retailers/brokers and operators can gain additional 57.667.240 for further collection and treatment of the separately collected waste (mainly bulky and biowaste) from public sector (municipal waste). This part of the market value is distorted and for public service (municipal solid waste operators) presents costs not incomes.

2.2. Secondary raw material system in the Split-Dalmatia County

Separately collected waste in Split-Dalmatia County is mostly sent directly to third party brokers and smaller part directly to recycling facilities in county (mostly hard density plastics).

2.2.1. Recycling facilities

Out of 135 recovery facilities in Croatia who treat municipal waste with R3 Code, only few are located in SD county and thus we will elaborate and present the national factsheet of recycling capacities. The Companies with R3 are as follows:

a) Eko-Imotski who recycled 10.858 tonnes of various types of wood
b) Mold d.o.o. who recycled 272,95 tonnes of plastic

Total amount of plastic treated with R3 code in the Republic of Croatia is 48.608 tonnes which is 51% of total collected plastic, which means majority was exported. The most dominant company out of 21 operators is definitely DRAVA international which recovered 34.023 tonnes of plastic in 2022. The issue with the company is definitely the fire that broke in the October of 2023. The fight with the fire lasted for 11 days. The fire caught the storage with more than 3.000 tonnes of PET which was valued at 1.2 million euros (Bastalić, J., 2023). The work in factory was discontinued due to the fire and the consequences on the national market are still yet to be seen. The company incomes in 2022 were calculated at 55m EUR.

Figure 7 Fire broke in the Drava international factory in Osijek (picture: sib.net.hr)

The good example is newly established Croatian-Austrian company REKIS d.o.o. which has a modern facility for the recovery of waste PET packaging from beverage bottles. The production facility is located in Donja Dubrava, Međimurje County. The company REKIS d.o.o., and their "bottle to bottle" production technology, which includes efficient processes of sorting, grinding, washing and drying,

produces crushed PET (transparent or colored) which is later used in the granulation process for the production of recycled PET granulate. In 2022, the factory has recycled 729,7 tonnes of waste. The company POS plast d.o.o. from Vrbovec recovered 2.725 tonnes of various types of materials, mainly HDPE plastics.

In 2015, DS Smith as multinational company has bought the paper mill in Belišće where majority of their collected paper is recycled. In 2022, DS smith factory has recycled 244.257 tonnes of paper and cardboard which accounts for 90% of all collected paper in entire Croatia. The rest of paper capacities are owned by Hartmann d.o.o. who recycled 25.441 tonnes of waste.

The recovery of wood in 2022 amounted at 98.800 tonnes, out of which 85.565 tonnes (87% of total R3 amounts) were recycled in Kronospan CRO d.o.o. factory in Bjelovar where new wood boards are produced.

Regeneracija d.o.o. from Zabok has in 2022 recycled 4.599 tonnes of textile waste, however, due to its capacities, majority of materials used in production is imported end of waste or byproducts from textile industry.

Additional significant recycling capacities are to be found for waste tyres where company Gumiimpex recycled 25.077 tonnes of waste tyres, however this does not account as municipal solid waste.

2.2.2. Users of the secondary raw material

Most of the above-mentioned recyclers use the materials in their internal processes. This fact can be applied to factories such as DS Smith Belišće factory where entire national separate collection can be recycled and made into new paper and packaging products. Similar situation is also with the Kronospan recycling of wood which is entirely recycled in Croatian city Bjelovar. Gumiimpex and Regeneracija also recycle the product directly in their premises producing rubber surfaces products or fleece insulating materials. The only dispersed distribution material are plastics which are distributed to variety of producers. With regards to company Mold d.o.o. from Solin, their entire recycling quantities are also used directly in production of new products such as construction tools and materials.

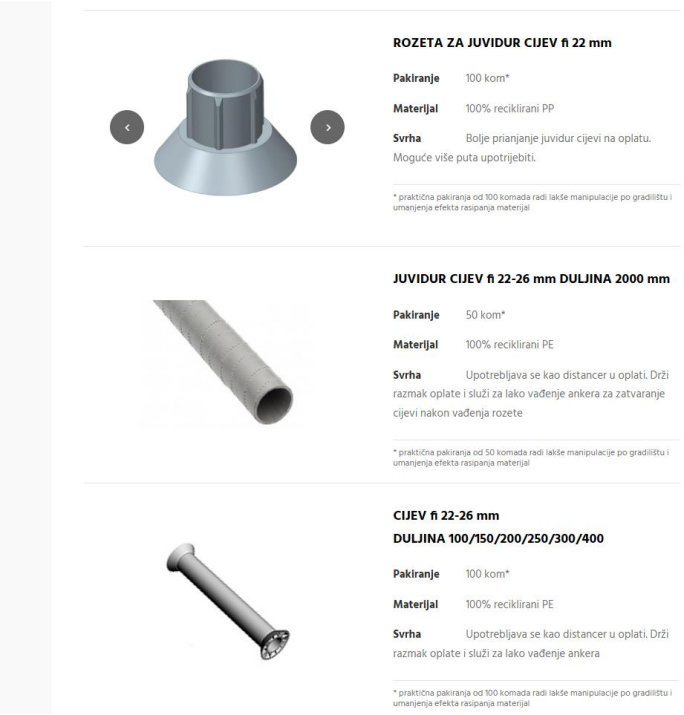

Figure 8 Production assortment MOLD d.o.o.

3. Measures and initiatives for the development and improvement of secondary raw material markets

There are no many activities in the sector of secondary raw materials, however it is important to state that during 2020 the national Fund for Environmental Protection and Energy efficiency has distributed total of 1.230.695 units of different types of waste collection bins and containers for separate waste collection. This has so far resulted with significant increase of separate waste collection on national level. On Split-Dalmatia County level, the initiative resulted with increase of municipalities using advanced separate collection system. Although the results are not comparable as the containers were not in use during 2023, the significant increase will be shown on 2023 statistics. Compared to 2020, in 2022 Split-Dalmatia County has landfilled 2.000 tons less, and in 2023 148.903 tonnes which is almost 10% less than 2020. This improvement generates additional quantities of materials which could also stipulate development of market (preparation for recycling and recycling in general).

Additionally, Croatian NGO Sunce from the City of Split has developed 2 advanced programmes for reduction of plastic in the Split-Dalmatia County, namely for Cities of Stari

Grad and Trogir. The project named “For plastic free Croatian Islands” and its expert team have developed action program for increasing the separate waste collection rate and waste prevention activities. The methodology used was WWF tool used for waste management planning with consideration to marine environment and reduction of marine litter.

In the end, we have to highlight the company Mold d.o.o. from Solin which since its start in 2017 developed full portfolio of recycled materials products for construction and uses majority of plastic materials.

4. Conclusion

The waste market landscape in Split-Dalmatia County, as detailed in this report, highlights significant challenges and opportunities in the pursuit of sustainable practices. Despite considerable waste collection efforts in 2022, the region's performance remains suboptimal, with only 3% of waste being recovered and the majority still being landfilled. This underscores the urgent need for enhanced waste management infrastructure and practices.

Croatia's alignment with EU directives and national legislation, such as the Waste Management Act (NN 84/2021) and the Waste Management Plan for 2023-2028, provides a robust framework for achieving ambitious recycling and waste reduction targets. However, the current state of waste management in Split-Dalmatia County indicates that more focused efforts are needed to meet these goals, particularly in increasing the recycling rates and reducing dependency on landfills.

The separate waste collection system and the secondary raw material markets are pivotal components of this effort. The report's analysis of these systems at both the national and regional levels reveal a fragmented yet evolving landscape. The significant increase in separately collected waste since 2010, alongside the potential of secondary raw materials, presents a clear path forward. However, challenges such as public awareness, illegal dumping, and financial constraints must be addressed.

For Split-Dalmatia County, enhancing the efficiency of waste collection systems, increasing the capacity and capability of recycling facilities, and fostering the development of secondary raw material markets are essential steps. Measures and initiatives aimed at improving these areas will not only help meet legislative targets but also contribute to a more sustainable and circular economy.

By understanding and addressing these dynamics, stakeholders in Split-Dalmatia County and beyond can play a crucial role in transforming waste management practices, ultimately leading to environmental, economic, and social benefits for the region. Continued investment in education, infrastructure, and sustainable practices will be key to achieving these outcomes and ensuring a more sustainable future.

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List of tables and illustrations

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PROGRAMME 2021 – 2027

AWASTER – Adopting WASTE as Resource

D.1.1.3 Regional secondary market report – Veneto Region

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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

Work Package:	WP1 – Circular economy – current state analysis
Activity:	A.1.1 – Regional background analysis
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Editor:	Sara Ferigo (SINLOC)		
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Table of contents

1. Introduction

The present deliverable is one of the five regional reports foreseen by Activity 1.1 Regional background analysis, which is part of the WP1 Circular economy – current state analysis of the Interreg IT-HR AWASTER project.

The report assesses the functionality of secondary raw material (SRM) market in the Veneto region and contains information on the supply and demand side of the market.

The findings and challenges detected will be used to develop subsequent project activities, in particular A.1.2 Sustainable resources use guidelines and A.1.3 Joint Strategy and Action Plan development.

Together with D.1.1.2 Regional waste management report, the present deliverable represents a high-quality database on which stakeholders can base their requests for financing the measures provided for in the Joint Action Plan from EU funds and other sources.

Moreover, it will be used by the PP and AP in their daily work to reinforce the use of the circular economy principles also after the project end.

2. Separate waste collection system

2.1. Separate waste collection system in the Italian Republic (national level)

Regulatory framework

- Legislative Decree No. 152 of 3 April 2006, *Consolidated Environmental Act* (Part IV)
- Law No. 60 of 17 May 2022, *Provisions for the Recovery of Waste in the Sea and Inland Waters and for the Promotion of the Circular Economy* ("Save the Sea" Law)
- Legislative Decree No. 196 of 8 November 2021, *Implementation of Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the Reduction of the Impact of Certain Plastic Products on the Environment*
- Legislative Decree No. 197 of 8 November 2021, *Transposition of Directive (EU) 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 that Amends Directive 2010/65/EU and Repeals Directive 2000/59/EC*
- *Classification of Waste. SNPA Guidelines* No. 24/20: the documents provide a methodological approach for the agency system to classify waste according to procedural schemes by phases, operational indications, and useful examples for identifying the code and assessing the hazardousness of waste
- Ministerial Decree of the Ministry for the Environment, Land and Sea Protection No. 264 of 13 October 2016, *Regulation Laying Down Indicative Criteria to Facilitate the Demonstration of the Requirements for the Qualification of Production Residues as By-Products and not as Waste*
- Law No. 166 of 19 August 2016, *Provisions Concerning the Donation and Distribution of Food and Pharmaceutical Products for Social Solidarity Purposes and to Limit Waste*
- Prime Ministerial Decree of 10 August 2016, *Identification of the Overall Treatment Capacity of Urban Waste Incineration Facilities in Operation or Authorised at the National Level, as well as Identification of the Residual Need to be Covered by the Construction of Urban Waste Incineration Facilities with Recovery*
- Decree of the Ministry for the Environment, Land and Sea Protection of 26 May 2016, *Guidelines for Calculating the Percentage of Separate Collection of Municipal Waste*
- Decree of the Ministry for the Environment, Land and Sea Protection No. 134 of 19 May 2016, *Regulation Concerning the Application of the Climate Factor (CFF) to the Formula for the Efficiency of Energy Recovery from Waste in Incineration Plants*
- Decree of the Ministry for the Environment, Land and Sea Protection No. 101 of 12 May 2016, *Regulation Laying Down the Identification of Methods for the Collection, Disposal and*

Destruction of Explosive Products, Including Expired Ones, and Waste Produced by the Ignition of Pyrotechnic Articles of Any Kind, Including Those for Rescue Needs, Pursuant to Article 34 of Legislative Decree No. 123 of 29 July 2015

- Decree of the Ministry for the Environment, Land and Sea Protection No. 121 of 31 May 2016, *Regulation Laying Down Simplified Procedures for Carrying out Free Collection Activities by Distributors of Very Small WEEE (Waste Electrical and Electronic Equipment), as well as Technical Requirements for Carrying Out Preliminary Collection Storage Activities at Distributors and for Transport*
- Ministry of Environment Decree No. 132 of 2 April 2024 *Criteria and Methods for the Application of the Tax Credit for Enterprises that Purchase Recycled Materials Derived from Separate Collection* - Implementation of Article 1, Paragraph 690, of Law No. 197/2022 - Indication of Technical Requirements and Certifications Suitable for Documenting the Eco-Sustainable Nature of Products and Packaging

National Strategy for the Circular Economy[1]

In 2017, following a wide public consultation, the document ***Towards a circular economy model in Italy. Document of framework and strategic positioning*** has been published, with the purpose of providing a general overview of the circular economy as well as defining the strategic positioning of Italy on this matter, in consistency with the commitments adopted under the Paris Agreement on climate change, the United Nations 2030 Agenda on sustainable development, the G7 and the European Union. Also, on 2017 the context changed highlighting the urgency of an intervention in order to reduce gas emissions and tackle the effects of climate change. Thus, new Plans and Programs have been provided at European level in order to support the transition towards circular models. Moreover, a fast technological development allowed the identification of new production sectors which are capable of generating new value chains instead of the traditional ones maximizing the recovery and recycling of the waste. Also, recent circumstances such as the pandemic and the Ukranian crisis pointed out the need to turn to a national supply chain of energy and raw materials. **The transition to a complete circular economy represents a strategic goal for Italy which is deficient of raw materials and geographically marginal compared to the large markets of central Europe**, in order to deal with the major transformations that are affecting the global economy such as:

- the review of the globalization process which is causing new protectionisms aimed at the strengthening of the industrial bases of individual countries or geographical areas;
- the spreading of the effects of the new digital revolution;

[1] https://www.mase.gov.it/pagina/riforma-1-1-strategia-nazionale-l-economia-circolare

- the environmental emergency and the need to start a green transformation process of the economy with the purpose to reduce gas emissions and the use of natural resources.

Therefore, it is necessary to update the strategic lines identified in 2017 to make them consistent with the new global challenges. For these reasons the "National strategy for the circular economy" is a programmatic document providing actions, objectives and measures that are intended to be pursued as institutional policies with the purpose to ensure an effective transition towards a circular economy.

In particular, the *National strategy for the circular economy* intends to define new administrative and fiscal tools in order to strengthen the market of secondary raw materials with the purpose to make them competitive in terms of availability, performance and costs compared to virgin raw materials. To this end, the National Strategy produces its effects on the material purchase chain (Minimum Environmental Criteria for green purchases in the Public Administration), on the criteria on the basis of which a waste shall cease to be a waste (End of Waste), on the extended producer responsibility, on the role of the consumer and on the widespread of sharing practices and "product as a service". Furthermore, the Strategy represents an essential 12 tool in order to achieve the climate neutrality objectives and to define a roadmap of actions and measurable targets from now until 2035. On 30 September 2021, the Ministry for the Ecological Transition launched a public consultation on the "National Strategy for the Circular Economy: Programmatic Guidelines for Upgrading" which is a document structured in five main sections:

1. Reference framework of the national strategy for the circular economy
2. The national context
3. The Italian strategy
4. Measurement and monitoring of circularity
5. Strategic guidelines, areas of intervention and tools.

The public consultation expired on 30 November 2021 and allowed the Ministry for the Ecological Transition to gather over 100 contributions related to the five sections.

These contributions, where considered relevant, have been included in the text of this document.

In particular, the following topics have been introduced or implemented in the original text:

- eco-design;
- reuse and repair;
- end of waste;
- critical raw materials and development of a secondary raw materials market;
- green public procurement and minimum environmental criteria;
- strategic industrial supply chains;
- industrial symbiosis;
- extended producer responsibility;

- digitization.

In particular, the Strategy aims to achieve certain quantitative targets in terms of recycling for the following types of waste:

- 55% municipal waste
- 65 packaging waste
- 25% wood packaging
- 70 ferrous packaging
- 50% plastic packaging
- 50% aluminium packaging
- 70% glass packaging
- 75% paper and cardboard.

The National Waste Management Programme[2]

The *National Waste Management Programme (PNGR)* is the strategic guidance tool for the Italian Regions and Autonomous Provinces, setting macro-objectives, defining criteria, and outlining the strategic directions for the formulation of regional waste management plans. The PNGR, alongside the National Waste Prevention Programme, is one of the strategic and operational pillars of the National Strategy for the Circular Economy. It aims to ensure that planning criteria meet the objectives of EU legislation to prevent disputes and promote sustainability, efficiency, effectiveness, and cost-efficiency across waste management systems nationwide, in line with territorial cohesion objectives. Overcoming the gap in waste management facilities between regions is thus a priority. This objective is crucial to ensuring integrated waste management across the entire nation and complying with European targets on reducing final disposal. The National Waste Management Programme is one of the reforms under the NRRP (National Recovery and Resilience Plan), Mission 2 "Green Revolution and Ecological Transition", Component 1 "Sustainable Agriculture and Circular Economy". Component 1 addresses several topics, including the national programme for waste management, the establishment of new waste management facilities, and the modernisation of existing ones. The overall objectives of the National Waste Management Programme (PNGR), in adherence to the purposes, principles, and priority criteria defined respectively by Articles 177, 178, and 179 of Legislative Decree No. 152/2006, are as follows:

- to reduce the planning and facility gap between different regions, pursuing progressive socio-economic rebalancing and rationalisation of the facility and infrastructural system according

[2] https://www.mase.gov.it/pagina/riforma-1-2-programma-nazionale-la-gestione-dei-rifiuti

to criteria of sustainability, efficiency, effectiveness, and cost-efficiency, in line with the principles of self-sufficiency and proximity;
- to ensure the achievement of objectives related to prevention, preparation for reuse, recycling and recovery of waste, and reduction of disposal, also considering producer responsibility regimes (EPR) for the waste produced;
- to rationalise and optimise the facility and infrastructural system through regional planning based on complete waste traceability and identification of pathways leading to the short-term bridging of the facility gap by describing existing systems and analysing flows; supporting the concurrent reduction of potential environmental impacts, which should also be assessed through the adoption of life cycle assessment (LCA) of integrated waste management systems;
- to ensure facility endowment with high-quality standards in both management and technology;
- to promote a waste cycle management approach that substantially contributes to achieving climate neutrality objectives;
- to define priority actions to enhance communication and environmental awareness regarding waste and circular economy.

National Waste Prevention Programme (NWPP)
Adopted and approved with DD of 7/10/13, based on EU Directive 2008/98, it must be updated every 6 years and can be included within the Waste Management Plan or be a standalone plan. The Programme sets prevention targets for 2020 compared to the values recorded in 2010:
- 5% reduction in municipal waste per unit of GDP;
- 10% reduction in hazardous special waste per unit of GDP;
- 5% reduction in non-hazardous special waste per unit of GDP.

Decree on Preparation for Reuse
The decree of 10 July 2023, No. 119 *Regulation laying down the conditions for exercising preparations for reuse in a simplified form, pursuant to Article 214-ter of Legislative Decree No. 152 of 3 April 2006* was published in the Official Gazette on 1 September 2023. The decree defines the operational methods, technical and structural equipment, and minimum qualification requirements of operators necessary to carry out such operations, the maximum quantities that can be used, the origin, types and characteristics of the waste, as well as the specific conditions of use under which products or components of products that have become waste are subject to preparation for reuse operations. To this end, the annexes to the Regulation specify the characteristics and technical equipment required for a preparation for reuse centre, the catalogue of acceptable waste, and the maximum quantities that can be used. The regulatory intervention, by allowing the opening of preparation for

reuse centres through a simplified procedure, represents a tool that enables greater interception of those waste streams (e.g. WEEE) which, through repair operations, can regain market value, with the same functions and safety guarantees as the original product.

2.1.1. Categories, quantity and type of separated and collected waste at national level

According to the 4th ***SNPA Environmental Report 2023***[3], in Italy, the **amount of waste disposed of in landfills has been steadily declining**, with the percentage dropping from 63.1% in 2002 to 17.8% in 2022, although still far from the European targets (which propose reducing to below 10% by 2035). In parallel, in 2022, the trend of increasing separate waste collection continued, with a rise of 1 percentage point compared to 2021, reaching 65% at the national level. Regionally, in 2022, the lowest percentage of municipal waste disposed of in landfill was achieved by the Campania region (1.1%), followed by Lombardy, Friuli-Venezia Giulia, Emilia-Romagna, and Trentino-Alto Adige, while the remaining Italian regions recorded percentages above the 10% threshold. The number of operational landfills in Italy, totalling 117 facilities in 2022, distributed across the North (50), Centre (25), and South (42), decreased compared to the previous year. In 2022, the highest percentage of separate waste collection was achieved by the Veneto region, with 76.2%, followed by Sardinia, with 75.9%.

The 2023 edition of the ***Urban Waste Report***[4], presented by ISPRA, also highlights that, despite the increase in GDP and household spending, **national municipal waste production decreased by 1.8% in 2022 compared to 2021**, while the percentage of separate waste collection increased (65.2% of total production). According to the data, Italy produces 29.1 million tonnes of municipal waste; this figure decreased by 544,000 tonnes (-1.8%) compared to 2021. According to ISPRA, the fluctuating trend in waste production can be attributed to various factors, including the introduction of new legislative provisions or health or socio-economic reasons, such as the 2020 pandemic and the 2022 international crisis. Except for 14 municipalities with a resident population over 200,000 inhabitants, where there was a slight increase (0.4%) between 2021 and 2022, the report highlights that waste production decreased in all major Italian geographical areas, specifically by 2.2% in the North and by 1.5% in the Centre and South. In absolute terms, Northern Italy produces over 13.8 million tonnes of waste, the Centre 6.2 million tonnes, and the South almost 9 million tonnes. In 2022, each Italian citizen produced an average of 494 kg of waste, with an average annual cost per inhabitant of €192.3

[3] https://www.snpambiente.it/snpa/rapporto-ambiente-snpa-edizione-2023/

[4] Rapporto rifiuti urbani - Edizione 2023 (ISPRA)
https://www.isprambiente.gov.it/it/pubblicazioni/rapporti/rapporto-rifiuti-urbani-edizione-2023-dati-di-sintesi

(it was €194.5 in 2021). According to the ISPRA Report, in 2022, separate waste collection increased (+1.2 points compared to 2021), accounting for 65.5% of total production. In quantitative terms, the dimension of separate waste collection remained stable (18.9 million tonnes), as did the existing gap between Northern and Southern Italy. In 2022, the recycling rate of municipal waste stood at 49.2%, an increase compared to 2021 (48.1%) but still insufficient to reach the target of 65% by 2030 set by the regulations. The waste management facilities operating in 2022 totalled 654. Over half of these are dedicated to the treatment of the organic fraction of separate collection, although not all regions yet have sufficient structures to handle the quantities produced. Regarding packaging and packaging waste, all the commodity fractions have already largely achieved the European targets set for 2025, except for plastic, which is nevertheless close to the target (48.9% against a target of 50%). Among separately collected waste, the organic fraction remains the most collected in Italy (38.3% of the total), followed by paper and cardboard with 19.3% of the total, glass (12.3%), and plastic (9%). The recovery of the organic fraction is mainly carried out in integrated anaerobic-aerobic treatment plants (50.8% of the quantities sent to organic fraction management facilities), followed by composting plants (44.4%); the remaining 4.8% is managed in anaerobic digestion plants.

Together with the annual Urban Waste Report by ISPRA, the ***Report on Energy Recovery*** from Waste in Italy was also published. According to the study, the number of facilities in Italy in 2022 totalled 188, including incinerators and anaerobic digestion plants for the organic fraction and sewage sludge, which produced approximately 7 million MWh of energy, enough to meet the needs of around 2.6 million households. The report also highlights a shortage of facilities in Southern Italy.

According to the 2023 ***Recycling Report in Italy***[5], the prices in the respective markets for secondary raw materials heavily influence the economic balance of companies, which have to navigate a climate of profound political and economic instability, complicating investments and future prospects. Despite this scenario, **Italy continues to be one of the European Union countries with the best recycling performance, reaching 72% in 2020**, **against a European average of 53%,** with peaks of excellence in packaging.

For Italy, according to the Foundation for Sustainable Development, the production of wastepaper (amounting to almost 7 Mt) saw a 6% decrease in 2022 compared to the previous year, mainly due to increased energy costs and geopolitical issues. This decline did not, however, dampen exports, with about 1.5 Mt of paper being sent abroad (nearly 10% more than in 2021). Asia remains the primary market, accounting for 55% of the total. Regarding plastic materials, the mechanical recycling

[5] https://www.ricicloinitalia.it/il-rapporto-2023/

market experienced a slight downturn in 2022 due to rising energy costs, fierce competition from virgin materials, and imports of polymers at competitive prices from Asian countries. Although separate collections are steadily improving, ensuring a good supply of recycled materials, the real challenge lies in the demand for recycled polymers. The significant increase in the selling prices of recycled materials has forced many sectors to resort to virgin polymers to stay competitive. This is particularly true for lower-added-value recycled polymers, for which the final markets would not be sufficient to absorb the quantities produced. In the glass sector, the production of bottles and jars increased in 2022 to meet consumer demands for safety and environmental sustainability. However, the price of glass cullet has risen to the point where many glassworks are returning to virgin raw materials. This discrepancy needs to be addressed, primarily by enhancing the demand for recycled glass. Overall, the amount of recycled glass used in the glass industry was 3.5 Mt, over 60% of the glass produced.

Italy is almost entirely dependent on foreign sources for both aluminium and copper and produce only secondary recycled aluminium. In 2022, Italy remained the leading European producer of electric arc furnace steel (with 85% of steel from scrap), contributing more than 30% to the EU's electric steel production. Due to the heavy reliance of the Italian manufacturing industry on metal imports, improving the collection of this fraction is increasingly strategic for our economy. For wood, energy recovery and recycling are in strong competition: out of the 50 Mt of wood waste generated in the European Union in 2020, 20 Mt were recycled, and the rest was incinerated. In Italy, 97% of recycled wood material is transformed into particle boards used by the furniture and furnishing industry. Today, panel manufacturers mainly use wood from the post-consumer recovery chain. Regarding organic waste, over 2 Mt of compost was produced in 2021 from the transformation of organic matrix waste treated by composting plants and integrated anaerobic digestion facilities. The integration of composting with the anaerobic digestion process also made it possible to obtain over 400 million m^3 of biogas, partly used for electricity production (around 440 GWh) and thermal energy (over 120 GWh), with a portion used to produce biomethane, which reached 136 million m^3.

Regarding the textile sector, analysis by the Foundation for Sustainable Development shows that the only segment that has worked so far has been reuse, thanks in part to social cooperatives, generating a very active second-hand market, while textile waste recycling is still a challenge to be developed. As for recycled aggregates produced from construction and demolition (C&D) waste, experts from the Foundation suggest policy recommendations, such as using Minimum Environmental Criteria in public tenders to encourage their use, improving the performance of materials through new facilities, and streamlining the end-of-waste criteria to allow classification as secondary raw materials rather than waste.

According to the ***Circular economy report Italy 2024,*** the overall situation in Italy can be described according to some key numbers and a diagram of the materials flow.

Table 1 Key numbers of circular economy in Italy in 2023 in comparison to EU

Indicator	Italy	EU average
Overall recycling percentage (%)	52	58
Circular use of material rate (%)	18,7	11,5
PIL in relation to every kg of consumed resources (%)	3,7	2,5
Per capita use consumption of materials (t)	12,8	14,9

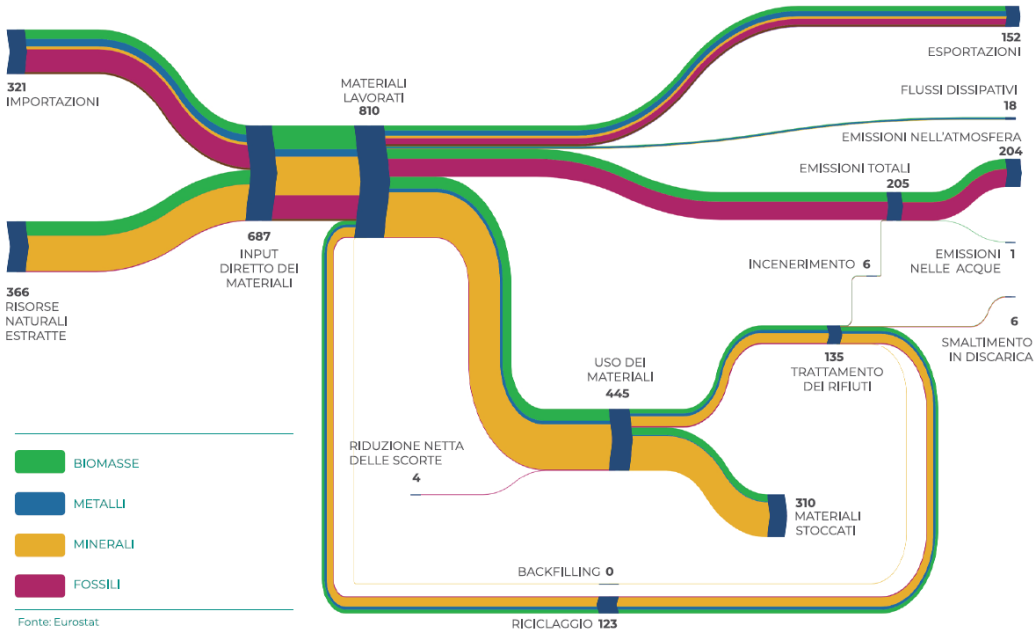


Figure 1 Flow diagram of materials in Italy in 2022 (Eurostat)

According to the latest data, **Italy has increased its municipal waste recycling rate from 37.6% to 49.2% over a decade** and is part of the group of 9 countries in line with European targets[6].

[6] La normativa europea ha fissato specifici obiettivi per la preparazione per il riutilizzo e il riciclo dei rifiuti urbani (55% entro il 2025, 60% entro il 2030 e 65% entro il 2035) ed alcuni tra gli Stati membri sono vicini a raggiungere - o addirittura già hanno raggiunto - tali target. (Early Warning Report, European Commission, 2023)

Even more positive data, both for the EU27 and especially for Italy, relate to the recycling rate of all waste, both special and municipal. The indicator shows a constant growth in our country, with an increase of 8 percentage points and a recycling rate of 72% for all waste, special and municipal, in 2020.
Also highly positive is the recycling rate of packaging which, in comparison at the European level, shows Italy achieving the best performance, with an overall packaging recycling rate of 71.7% compared to the EU average of 64%.
Finally, the issue of waste management must consider the WEEE (Waste Electrical and Electronic Equipment) sector, whose quantity is steadily increasing. The recycling of electronic and electrical waste allows for the recovery of various precious metals, including critical raw materials. Despite the high recycling rates of collected WEEE, the WEEE collection rate, compared to the average placed on the market in the preceding three years, remains very low relative to the EU target set at 65% since 2019. In Italy, the WEEE collection rate in 2021 was only 33.8%, significantly lower than the EU average, which is also low and far from the target but still at 46.2%.

Recycling rate of municipal waste[7]
The trend in the municipal waste recycling rate in Italy over the last available five-year period has grown by 3.4 percentage points. According to ISPRA[8] data, the recycling rate in 2022 stood at 49.2%, which is essentially in line with the target set by the Waste Framework Directive for 2020 (50%) and which must be increased to meet the further targets established by Directive 2018/851/EU.

[7] The indicator measures the proportion of urban waste recycled out of total urban waste production. Recycling includes material recycling, composting, and anaerobic digestion.

[8] For monitoring the indicator related to urban waste recycling, since last year ISPRA has been applying the new criteria established by Directive 2018/851/EU and the related implementing decision 2019/1004/EU. The new methodologies for accounting are more stringent for the new targets and have been designed to ensure that the calculated percentages are truly representative of the actual recycling capacity.

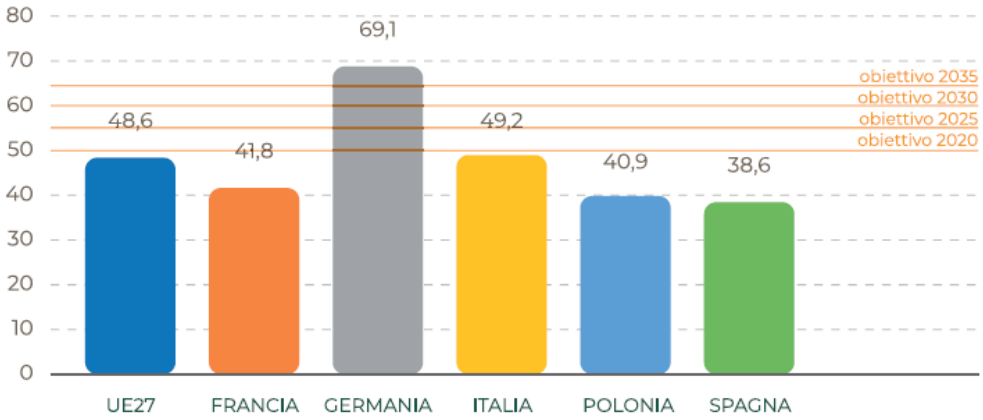


Figure 2 Recycling rate of municipal waste in the five major EU countries in 2022 (in %) (Eurostat)

Rate of urban waste recycling[9]

Examining the five main countries of the European Union, Italy, with a 72% recycling rate, firmly remains at the top, while the other countries record performances below the EU average (58%).

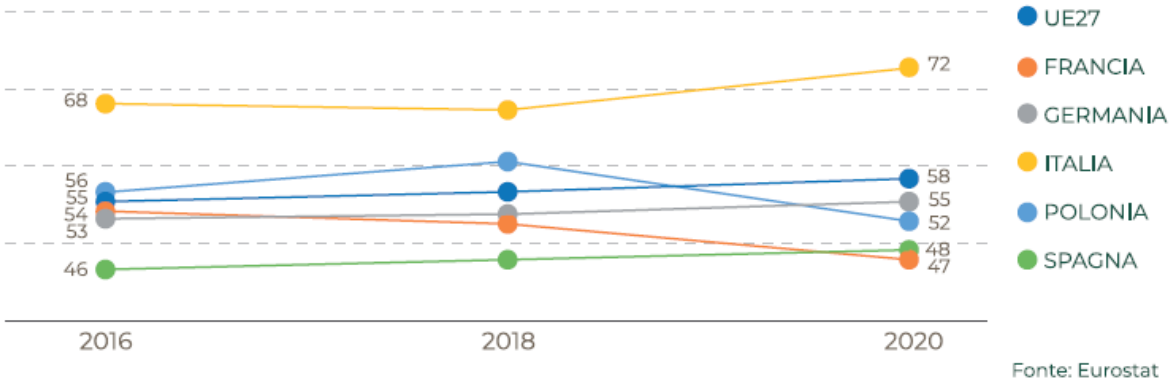


Figure 3 Waste recycling rate in the five major EU countries in the period 2016-2020 (in %) (Eurostat)

Recycling Rate of Specific Waste

- **Paper and cardboard, glass, steel, and wood**

[9] The indicator measures the proportion of recycled waste (excluding landfill, energy recovery operations, and the category of inert waste) compared to the total quantity of waste treated. The recycling percentage allows monitoring the amount of material reintroduced into the economy derived from waste generated by households and businesses. The indicator covers both hazardous and non-hazardous waste.

Considering the Eurostat data for 2021, the latest available year, a diverse picture emerges. Italy is currently in an advanced stage of the journey towards achieving the European Union's packaging waste recycling targets, having already reached the 2025 targets in all five examined sectors. Particularly commendable are the results achieved in the recycling of glass, aluminium, and wood packaging waste, where the minimum recycling rate set as a target for 2030 has already been exceeded. The paper and cardboard packaging sectors are also very close to this target. Finally, regarding the recycling of steel packaging waste, our country records a recycling rate that surpasses the 2025 target.

- **Total packaging waste recycling rate**

Italy, which in 2017 recorded a figure below the European average, reached a recycling rate of 71.7% in 2021, almost 8 percentage points higher than the EU27 average (64%). In 2021, Italy achieved the highest recycling rate for all packaging waste among the five main European countries.

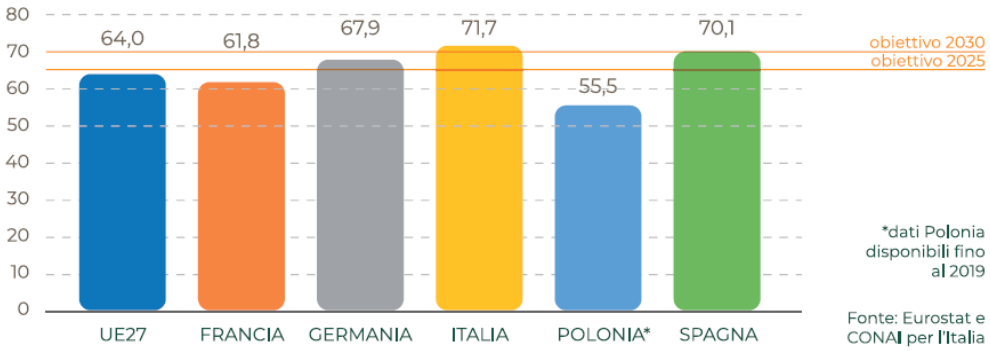


Figure 4 Packaging waste recycling rate in the five major EU countries in 2021 (in %)

- **Recycling rate of plastic packaging waste**

The European Union has set two minimum recycling targets for plastic packaging waste: 50% by 2025 and 55% by 2030. Over the past five years, Italy has achieved a 6-percentage point increase, raising its recycling rate from 41.8% in 2017 to 47.6% in 2021. Comparing the five main European countries, only Spain achieves a better result (56.4%). In third place is Germany with 48.4 percentage points. Poland (31.5% in 2019, the latest available year) and France (23.1%) report figures below the EU average and the lowest results among the countries examined here.

Recycling rate of WEEE collected separately [10]

The recycling of Waste from Electrical and Electronic Equipment (WEEE) has gained increasing prominence in recent years, not only due to the significant increase in the quantity of goods - such as cell phones, tablets, televisions, computers, and various other appliances - entering the market and reaching the end of their life cycle, but also because WEEE contains valuable and non-valuable materials, as well as critical raw materials, the sourcing of which is becoming increasingly complex and costly. It should be noted that the WEEE collection rate compared to the average placed on the market in the preceding three years remains very low relative to the EU target set at 65% by 2019. In fact, for Italy, this figure stood at 33.8% in 2021, while the EU27 average is 46.2%.

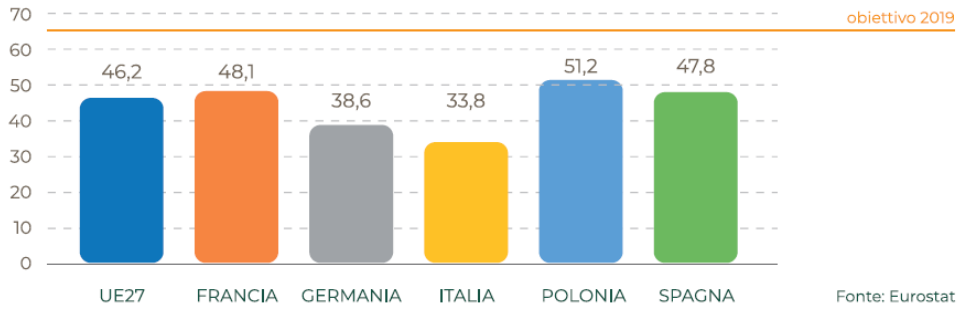


Figure 5 Rate of collection of RAEE waste with respect to the average consumption in the previous three-year period in the major five EU countries in 2021 (Eurostat)

Eurostat data shows that in 2021, Italy achieved a WEEE recycling rate of 87.1%, a slight decline of about two percentage points compared to the 2017 figure. This decrease is attributed to the disappointing performance during the 2017-2019 period, largely offset by the results achieved in the 2019-2021 period, which showed an increasing trend. In a European comparison, Italy's figure remains one of the highest, surpassing the EU27 average. Also, compared to the five main European countries, Italy regains the top position after the decline in the previous years.

[10] The calculation of the recycling rate of WEEE collected separately is measured based on the percentage of WEEE, by weight, sent for recycling/preparation for reuse compared to the total WEEE, also calculated by weight, collected separately.

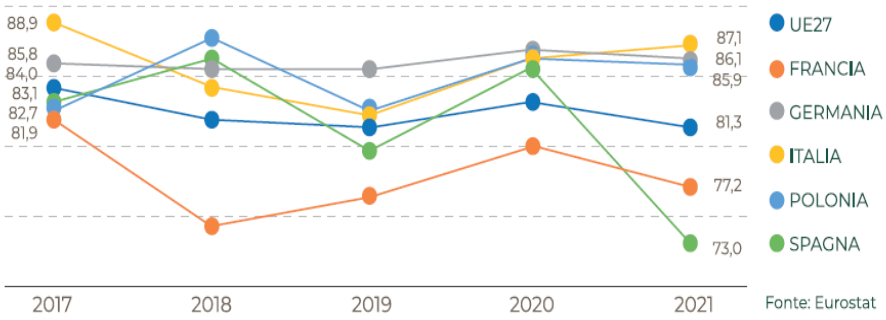


Figure 6 Recycling rate of RAEE waste subject to separate collection in the period 2017-2021 (in %) (Eurostat)

According to the dossier ***Comuni Ricicloni 2024***, in Italy in 2023 there will be 698 Waste Free Municipalities (i.e., those that contain the per capita production of undifferentiated waste sent for disposal below 75 kg/inhabitant/year) (69 more than in 2022, corresponding to about 11%), a not insignificant increase if compared to the data collected in the last 3 years, characterised by substantial stagnation. As a result, the percentage of waste-free citizens in relation to the total Italian population, which rose from 6% to 6.9%, also increased compared to the previous year, amounting in absolute terms to 539,590 more inhabitants served by an efficient waste management service. However, the incidence of Waste Free municipalities is in contrast to the number of inhabitants; in fact, the category of medium-sized municipalities (those with a population between 5,000 and 15,000 inhabitants) contributes 40%, those with more than 15,000 inhabitants 29%, and small municipalities 23%, with the capitals accounting for the remaining 8%. These figures show how crucial it is to invest even more in the most urbanised areas, where a large part of urban waste production is concentrated.

Table 2 Waste free municipalities according to territorial affiliation (years 2021, 2022, 2023, 2024)

Waste free municipalities according to territorial affiliation	2021	2022	2023	2024
North	423	391	423	434
Centre	38	32	30	33
South	162	167	167	231
Total	**623**	**590**	**629**	**698**

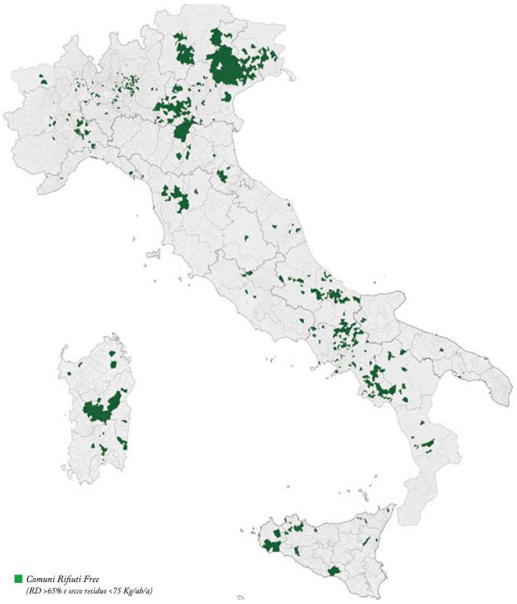


Figure 7 Map of waste-free municipalities in Italy in 2023

2.2. Separate waste collection system in the Veneto region

Regulatory framework

- Regional law 21 January 2000 n. 3 (BU4 n. 8/2000) "*Nuove norme in materia di gestione dei rifiuti*"
- D.G.R.V. n. 1773 of 28 August 2012 "*Modalità operative per la gestione dei rifiuti da attività di costruzione e demolizione*"
- D.G.R.V. n. 288 of 11 March 2014 "*Delibera approvazione metodo di calcolo della percentuale di raccolta differenziata ai fini del pagamento del tributo per il deposito in discarica dei rifiuti urbani*"
- D.G.R.V. n. 439 of 10 April 2018 "*Modalità operative per la gestione e l'utilizzo nel settore delle costruzioni di prodotti ottenuti dal recupero dei rifiuti inerti*"
- D.G.R.V. n. 336 of 23 March 2021, through which the procedure and calculation methods for separate waste collection certifications issued by municipalities, substituting D.G.R. n. 288 dell'11.03.2014
- D.G.R.V. n. 988 of 9 August 2022 Approval of the Updating the Regional Urban and special waste management plan
- D.G.R.V. n. 544 of 26 May 2023 "*Modifica degli obblighi amministrativi elencati al punto 6 dall'Allegato A della DGR n. 336/2021*"

- D.G.R.V. n. 1294 of 30 October 2023 "*Iniziative per la riduzione della produzione di rifiuti. Linee guida per la realizzazione e la gestione dei Centri del Riuso ai sensi dell'art. 181 del D.Lgs. 152/06 e s.m.i. e DGR n. 988/2022*"

Regional Urban and special waste management plan (2015)[11]

With D.G.R. n. 264 of 05/03/2013 - Bur. n. 25 del 15/03/2013, the Regional Council of the Veneto Region adopted the Plan for the management of urban and special waste, including hazardous waste, which, in compliance with the provisions of Article 199 of Legislative Decree no. 152/2006, was intended to update the previous planning instruments on environmental matters.
Following the consultation process, the Regional Plan for the management of urban and special waste was definitively approved with D.C.R. no. 30 of 29/04/2015 - Bur. no. 55 of 01/06/2015.

Table 3 Regional Urban and special waste management plan (2015)

Indicator	Type of data	Baseline year	Initial value	Target year	Target value
Urban waste sent to landfills Goal: minimize landfill's use - Management	T	2010	230.000	2020	0
Percentage of recycled waste Goal: encourage the recovery of material - Production	%	2010	58	2020	76
Urban waste production per person Goal: reduction of urban waste production	Kg/ab	2010	488	2020	420

Update of the Regional Municipal and Special Waste Management Plan (2022)

With DGR no. 988 of 09/08/2022 - Bur. no. 107 of 02/09/2022 the Update of the Regional Urban and Special Waste Management Plan was approved, containing:

- norms and regulations of the plan
- the assessment of the implementation of the 2015 plan, the update of the plan objectives and actions and the description of the new plan scenarios, with regard to urban waste.
- the assessment of the implementation of the 2015 plan, the update of the plan objectives and actions and the 5 in-depth focuses prepared for specific critical issues and themes emerging in the Veneto region, with regard to special waste

[11] Piano Regionale di gestione dei rifiuti urbani e speciali (2015) and Aggiornamento del Piano regionale di gestione dei rifiuti urbani e speciali (2022): https://www.regione.veneto.it/web/ambiente-e-territorio/piano-di-gestione-rifiuti-e-aggiornamento

- the updating of the criteria for defining unsuitable areas.
- the updating of the Plan for the reclamation of polluted areas in which the state of affairs, the assessment of intervention priorities, updating the criteria with respect to previous planning, and the Plan actions were reported.

The update of the Plan also led to updates of the following programmes:

- programme for the reduction of biodegradable waste to landfill (RUB);
- regional programme for the management of packaging and packaging waste;
- programme for the reduction of waste production;
- programme for the decontamination and disposal of equipment subject to inventory according to art. 4 of legislative decree 209/99.

Table 4 Update of the Regional Municipal and Special Waste Management Plan (2022)

Indicator	Type of data	Baseline year	Initial value	Target year	Target value
Urban waste sent to landfills Goal: minimize landfill's use - Management	T	2019	66.000	2030	0
Percentage of recycled waste Goal: encourage the recovery of material - Production	%	2019	74,7	2030	84
Urban waste production per person Goal: reduction of urban waste production	Kg/ab	2019	471	2030	420

Relevant actors of reference at regional level

In implementation of SNPA Guidelines no. 41/2022, in Veneto the public reference body for the waste collection and management system is **ARPAV (Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto).**

According to the founding regional law no. 32/1996 and the law establishing the National System for the Protection of the Environment (SNPA), Arpav works for the protection, control, and recovery of the environment and for the prevention and promotion of collective health.

The agency pursues two closely related objectives:

- protection, through environmental controls that protect the health of the population and the safety of the territory;
- prevention, through research, training, information and environmental education.

The founding law regulates the manner in which Arpav provides services to the Region, Provinces, Municipalities, Mountain Communities, Local Health and Social Units, other public bodies and private

individuals, entrusting the Agency with the performance of technical-scientific activities connected with the exercise of public functions for the protection of the environment.

Collection system in Veneto Region[12]

The collection system, i.e. the way in which waste is intercepted, is strategic for achieving the separate collection targets set by legislation because it conditions the quantity and quality of waste.
Therefore, in order to be efficient, the system must take into account not only the heterogeneity of the materials, but also the different territorial, urban and socio-economic factors, and not least the plant situation and the agreements stipulated with CONAI and the chain consortia. In Veneto, these consortia in fact guarantee take-back and only pay an economic consideration for particular categories (e.g. packaging).
Clear, correct and constant information involving all users of the service is also crucial in order to specify what and how to separate waste.

In Veneto, the collection system that affects more than 90% of citizens is the so-called dry-moist collection. Urban waste is separated into 3 main streams:

- wet
- recoverable dry fractions (paper, glass, plastic, metal packaging, etc.)
- non-recyclable dry residue.

Collection systems are then further classified into:

- Street collection: waste collection using containers placed on roads or public areas. Access to the street containers is free and not subject to any type of control, with no obligation on the user to comply with pre-determined times and dates for collection.
- Home collection or door-to-door collection: collection of waste from each individual user using special containers provided to them. Waste collection takes place at predetermined times and dates, when users display the containers outside their homes. When all of the above fractions are collected door-to-door, the collection system is referred to as pushed home collection.

Collection centre

The collection centre, also known as 'ecocentre', is an area intended only for the reception of municipal waste and its fractions, as well as waste assimilated to them, produced by domestic and non-domestic users, coming from the area of competence, and delivered directly by private individuals and/or by separate collection operators and public service managers.

[12] https://www.arpa.veneto.it/temi-ambientali/rifiuti/rifiuti-urbani/i-sistemi-di-raccolta

The ecocentre is an area that does not provide for the installation of technological facilities or treatment processes, where only citizens residing in the municipality can deliver waste, subject to possible agreements between neighbouring municipalities.
According to ARPAV data, in Veneto more than 85% of the population is served by a collection centre.

Municipal waste collection system[13]

The collection system that determines the real quantum leap in waste management is the separation of the organic fraction through dry-wet collection. For this reason, the per capita amount of organic waste intercepted can be considered an important reference value (Italian average of 121 kg/inhabitant*year in 2020 - Urban Waste Report Edition 2021 - ISPRA).
The number of municipalities carrying out separate collection of the organic fraction, so-called dry-wet collection, in 2021 is 560 out of 563, covering 99% of the population. Among these, the door-to-door mode continues to be the most widespread,
As regards the interception of the organic fraction in 2021, Veneto is among the first regions nationwide, with 145 kg/inhabitant*year.
The time trend confirms the tendency towards the widespread diffusion of dry-moist collection as opposed to undifferentiated collection. In particular, the door-to-door collection system is the one that is becoming more established at a regional level, progressively replacing roadside collection and especially that of undifferentiated waste.

2.2.1. Categories, quantity and type of separated and collected waste at regional level

Waste production and management[14]
The indicators presented are organised in two groups: the first concerns the issue of municipal and special waste generation (“pressure” indicator), while the second focuses on management systems (“response” indicators).

Waste production[15]
Waste production is to be considered as a negative aspect that must however be evaluated with respect to the answers and targets achieved.

[13] https://www.arpa.veneto.it/arpavinforma/indicatori-ambientali/indicatori_ambientali/rifiuti/gestione-dei-rifiuti-1/sistemi-di-raccolta-dei-rifiuti-urbani/2021
[14] https://www.catasto-rifiuti.isprambiente.it/index.php?pg=regione
[15] https://www.arpa.veneto.it/arpavinforma/indicatori-ambientali/indicatori_ambientali/rifiuti/produzione-di-rifiuti/produzione-di-rifiuti-urbani/2022

Municipal waste production is analysed at a regional and provincial level and refers to each inhabitant (per capita data) to highlight any differences between the Veneto provinces and thus obtain more information on the territory.
In the absence of legislation indicating a threshold value of urban waste production per capita, the national average figure of 502 kg is taken as a reference, which in 2021 is lower than the average value recorded in the northern Italian regions of 517 kg (Urban Waste Report Edition 2022 - ISPRA).
The 2022 data show a reduction in waste production compared to 2021 mainly attributable to higher energy and raw material costs with obvious effects on inflation rates due to the Russian-Ukrainian war. This was reflected in line with the contraction of consumption, particularly food. Also not to be underestimated is the decrease in green waste attributable to the very dry weather conditions.
On the one hand, this trend was mitigated by a high flow of tourists, which in 2022 was a particularly influential element in the waste production dynamics of certain areas of the region.

In 2022, total waste amounted to 2,207,328 tonnes, a decrease of -2.9% compared to 2021, and the per capita of 453 kg (1.24 kg/day) also decreased by -2.4%.
A comparison of Veneto's per capita production figure with the national average shows an overall positive situation as Veneto is well below the national value.
In 2022 the indicator underlines how Veneto citizens produce a reduced amount of urban waste (453 kg) and how most of this (76.3%) is collected separately.

In summary, with regard to waste generation, the Veneto region is characterized for:

- total municipal waste production of 2,207 thousand tonnes, down (-2.9%) compared to 2021;
- per capita production 453 kg (1.24 kg/inhabitant*day) down (-2.4%) compared to 2021, remains among the lowest nationwide;
- production of separately collected waste decreasing (-2.9%);
- per capita production of residual urban waste of 110 kg, slightly down on the previous year (-0.7%);
- separate collection percentage of 76.3% (+0.1 compared to 2021) determined in accordance with the methodology set out in the Ministerial Decree of 26 May 2016, which includes separate collections gross of waste, plus a per capita share of inert waste from households (maximum 15 kg/inhabitant) and one relating to home composting (80 kg/inhabitant).

For what concerns provinces, per capita production ranges between the lowest value in the province of Treviso (361 kg) and the highest in Venice (558 kg).

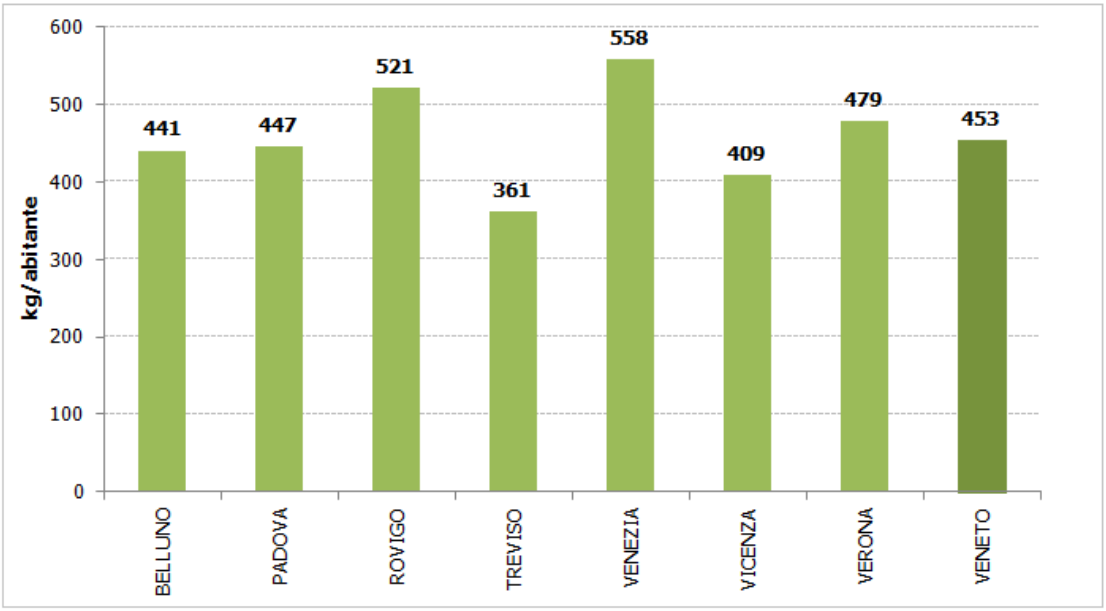


Figure 8 Per capita waste production in 2022 in Veneto region, divided by Province

The indicator trend from 1997 to 2013 shows a slight but progressive increase in the per capita production of municipal waste until 2010 and a decrease in the following years. Compared to 2021, a decrease of -2.4 % is noted in 2022.

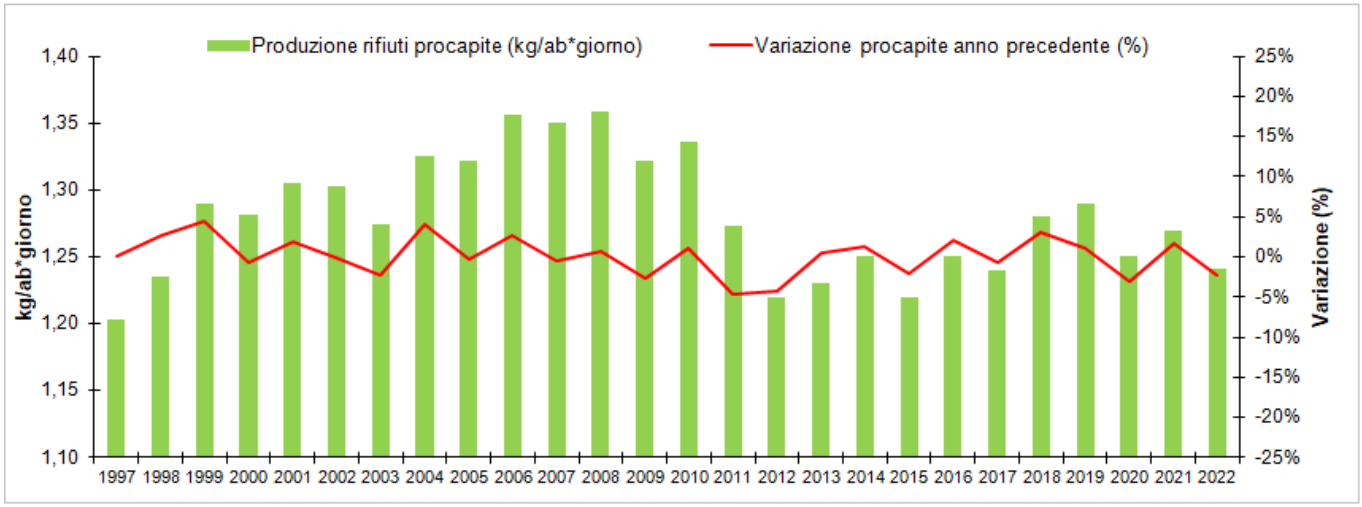


Figure 9 Per capita and variation in the production of municipal waste, period 1997-2022

To summarise, the best results can be highlighted at different levels:

- provincial with Treviso reaching the highest value of separate waste collection, with 86.8%, followed by Belluno with 86.3%;

- municipal with 541 municipalities (equal to 84% of the population) that have exceeded the 2012 national target of 65%, and 192 (equal to 31% of the population) that have already reached the 84% target set by the update of the Regional Waste Plan approved by DGRV 988/2022;
- there is a high diffusion of the dry-moist collection system involving 559 municipalities out of 563;
- almost all of the fractions collected separately sent for material recovery.

Waste management

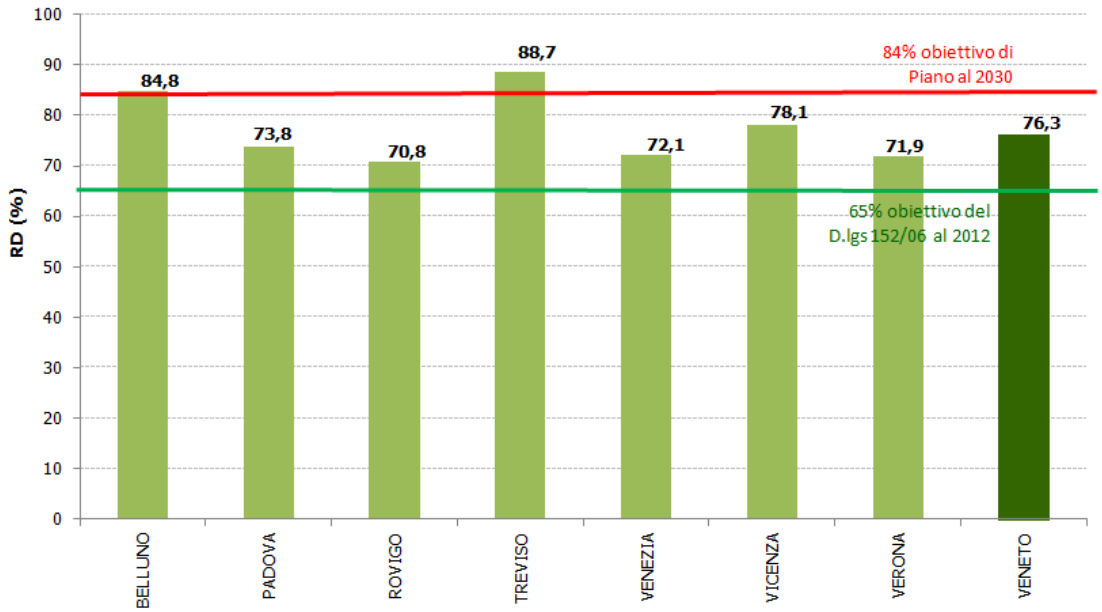
Overall, in Veneto in 2022, it can be seen that the selected response indicators show a progressive improvement in management capacities aimed at maximising recovery as opposed to disposal in general, and landfilling in particular.

- Quantity of separately collected municipal waste [16]

The percentage of separate collection represents the result of the measures implemented by local administrations for the management of municipal waste, in order to collect the greatest amount of waste to be sent for recovery, minimising the use of disposal plants, and to intercept the types of waste that are potentially harmful to the environment.
Until 2019, the Veneto region used a method for calculating % RD that excluded waste from the treatment of some fractions (DGRV 288/14), while in 2020, with DGRV 336/2021, the same method used at national level by ISPRA was adopted gross of waste (DM 26/05/2016).
The reference value for evaluating the indicator is established both by national legislation and by the Regional Urban Waste Management Plan, which in 2022 was updated with DGRV no. 988 of 9 August 2022.
In regional detail, the Regional Waste Plan envisages reaching 84% by 2030.
The quantity of municipal waste collected separately in Veneto in 2022 shows a decrease of -2.9% compared to 2021 and amounts to 1,658,733 tonnes.
The percentage of separate collection calculated using the national method is 76.3%. This value allows Veneto to exceed the 65% target set by national legislation for many years now, placing it first among Italian regions. All provinces exceed the 65% separate waste collection target foreseen by the legislative decree 152/06 for 2012 and Treviso with 88,7% and Belluno with 84,8% exceed also the target of the Regional Waste Plan foreseen for 2030.

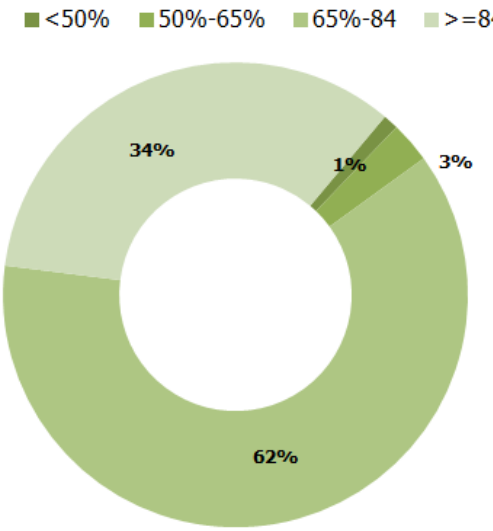
[16] Dati riferiti al 2022, saranno aggiornati a ottobre 2024 https://www.arpa.veneto.it/arpavinforma/indicatori-ambientali/indicatori_ambientali/rifiuti/gestione-dei-rifiuti-1/quantita-di-rifiuti-urbani-raccolti-in-modo-differenziato/2022

Figure 10 Quantity of urban waste (in tonnes) and percentage of separate collection by province and in Veneto (2022)



The indicator shows how the Veneto provinces are committed to differentiating increasing amounts of waste, achieving excellent separate collection percentages that will allow Veneto to reach 76.3% in 2022, the highest value at national level.

Figure 11 Percentage of municipalities in Veneto by class of separate waste collection. Year 2022



The number of municipalities that exceeded the maximum target of 65% increased to 541 (83% of the population). Of these, 192 exceeded the Plan's 84% target by 2030.

Waste management[17]

Also in the area of waste management in Veneto, very positive results are confirmed for 2022 with reference to the national panorama and in line with the objectives imposed by Italian legislation and those set by Directive 851/98/EC.
In particular, in Veneto **76% of the separately collected fractions**[18] (with the exception of a negligible amount of special municipal waste such as pharmaceuticals and hazardous substances which is necessarily sent for disposal/incineration) are sent for recovery.
In this sense it is useful to compare the regional figure of waste disposed of in landfills (6% of waste produced in 2022) with the national average (19% of waste produced in 2021 - Urban Waste Report Edition 2022 - ISPRA).
In 2022, municipal waste management, in line with previous years, the high quantity (76%) of waste sent for material recovery (organic, recoverable dry fractions - paper, glass, plastic, wood, WEEE, sweepings and bulky waste) allowed the valorization of the different materials as a new resource in the various industrial sectors as follows:

- 31%, approximately 680 thousand tons of collected organic fraction, collected through a widespread dry/wet collection system, is sent to a complex system of large, medium and small composting and anaerobic digestion plants. The total treatment capacity is about 1.5 million tons and is far greater than the regional demand. Approximately 223,000 tons of quality compost was produced and marketed in 2022, a figure down from 2021, mainly used in agriculture and horticulture. To the recovery of materials should be added the energy recovery carried out thanks to the biogas produced by anaerobic digestion, which is also used for the production of biomethane for motor vehicles;
- 33%, 731,000 tons of collected dry recyclable fractions (paper, glass and plastic and metal packaging) are sent to sorting and valorisation plants in the region for the production of secondary raw materials (EoW), which are then used in the production sector such as in paper mills, glassworks, plastic or synthetic fiber production industries, foundries, operating in the

[17] https://www.arpa.veneto.it/arpavinforma/indicatori-ambientali/indicatori_ambientali/rifiuti/gestione-dei-rifiuti-1/la-gestione-dei-rifiuti-urbani/2022

[18] A useful benchmark to assess the overall goodness of a municipal waste management system can be identified by the percentage of separate collection, which assesses the effectiveness of collection systems upstream, and by the destination of the waste collected.

Veneto region. Also in this sector, the overall recovery/recycling capacity is adequate to meet regional needs;

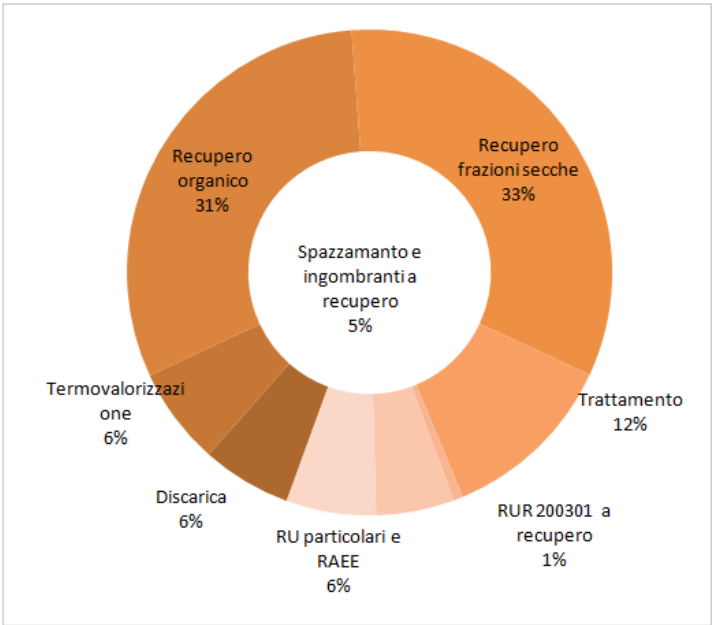
- 6%, i.e. 132,000 tons of sorted waste, is represented by other recoverable fractions such as WEEE (Waste Electrical and Electronic Equipment), wood and scrap, clothing and rags, including RUP. These fractions are delivered by citizens mainly through the dense network of collection centres spread throughout the region and from there sent for material recovery at specific treatment plants which then supply new materials to foundries, brush factories, etc;
- 5%, represented by 68,000 tons of bulky waste, about 48,000 tons of sweeping waste and about 14,000 tons of residual urban waste (EER 200301), fractions historically destined for landfills, was sent for material recovery and/or sorting in 2022, substantially in line with the provisions of Community and national regulations and the provisions of the Waste Management Plan.

For the other fractions of waste:

- 18% went to waste-to-energy plants of which
    - o 12%, or 261,000 tons, of which the residual urban waste amounts to 257,000 tons, was first sent to TMB plants. About 53,000 t of CSS were produced from 3 of these. 61% of the CSS produced was then sent to the waste-to-energy plant in Venice (Polo Ecoprogetto in Fusina), the remaining 39% was recycled outside Veneto;
    - o 6%, equal to 144 thousand tons of urban waste, of which about 98% is EER 200301 (141 thousand tons), was directly destined for energy recovery in the waste-to-energy plants operating in Veneto in Schio (VI) and Padua;
    - o 6%, equal to 132 thousand tons of urban waste (of which about 125 thousand of EER 200301) was directly disposed of in 7 landfills for non-hazardous waste operating in Veneto (historically dedicated to urban waste and forming part of the Plan plants referred to in the regional planning - DGRV 988 of 09/08/2022).

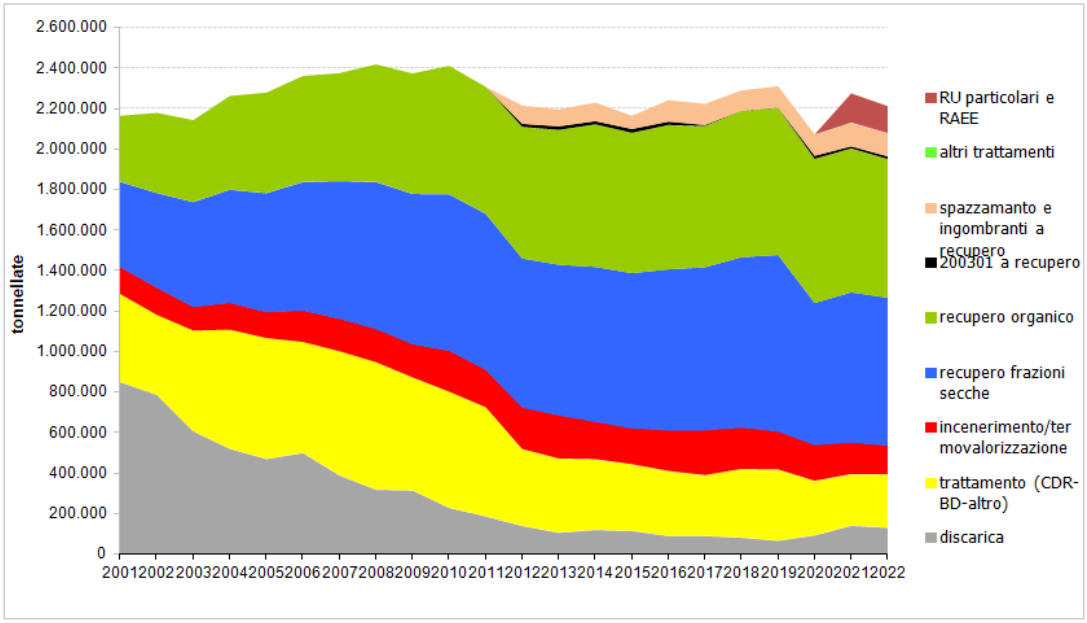
A residual portion of municipal waste (sweeping) amounting to about 300 tons was also allocated to other RNP landfills, disposed of or used for technical purposes. The share of waste resulting from the treatment of municipal waste and disposed of in the 7 landfills amounted to approximately 149,000 tonnes.

Figure 12 Destination of municipal waste produced in Veneto expressed as a percentage of the total produced - Year 2022



The indicator shows that in 2022 the share sent directly to landfill is now a marginal portion of the waste produced (6%), which has decreased by -5.3% compared to the previous year.

Figure 13 Destination of municipal waste produced in Veneto in tonnes. Years 2001-2022



Over the years, this indicator has shown how urban waste recovery and treatment systems have been increasingly favored over landfilling in management choices.

- Urban residual waste[19]

Urban residual waste, which represents that portion of waste that can no longer be recovered, is fundamental for regional planning and final disposal plant requirements.
RUR production is analyzed at a regional and provincial level and is referred to each inhabitant (per capita data) to highlight any differences between the Veneto provinces and thus have more information on the territory. The indicators considered are measured in kg per inhabitant/year.
The reference value is that envisaged by the Waste Plan update (DGRV 988 /2022) to 2030 equal to 80 kg/inhabitant.
Over the years it can be seen that per capita RUR has decreased to the benefit of an increase in separate waste collection (everything collected separately, gross of waste), a trend that is also confirmed in 2022 with a value of 110 kg/inhabitant.

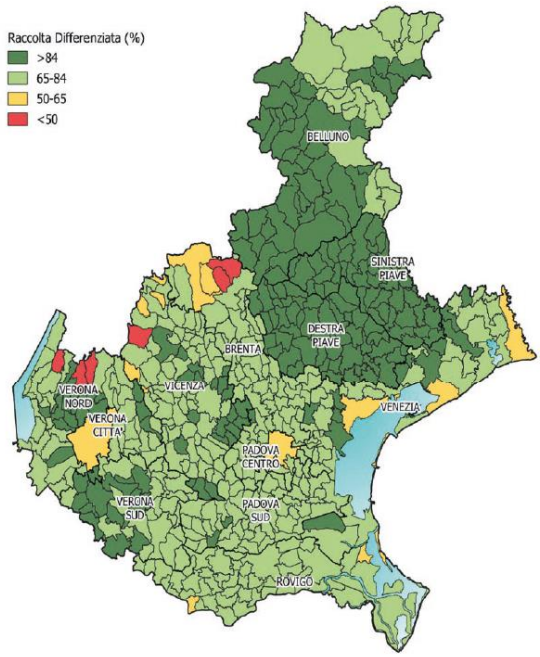
[19] https://www.arpa.veneto.it/arpavinforma/indicatori-ambientali/indicatori_ambientali/rifiuti/gestione-dei-rifiuti-1/il-rifiuto-urbano-residuo/2022

Comparing Veneto's RUR per capita figure with the national average, an overall positive situation emerges as Veneto is well below the national value (181 kg in 2021). Compared to the Plan's 2030 target, it is higher at the regional level.

The analysis waste per capita shows 3 provinces (Belluno and Treviso and Vicenza) with values lower than the regional average, of which only 2 (Belluno and Treviso) are also below the Plan's 2030 target (80 kg/inhabitant).
The indicator's trend from 2000 to 2022 shows a progressive decrease in the per capita production of urban residual waste. The RUR in 2022 is 110 kg/inhabitant, a slight decrease of -0.7% compared to the previous year.
In 2022 the indicator underlines how the Veneto Region's citizens produce a reduced amount of residual urban waste (110 kg), far below the national average value (181 kg).

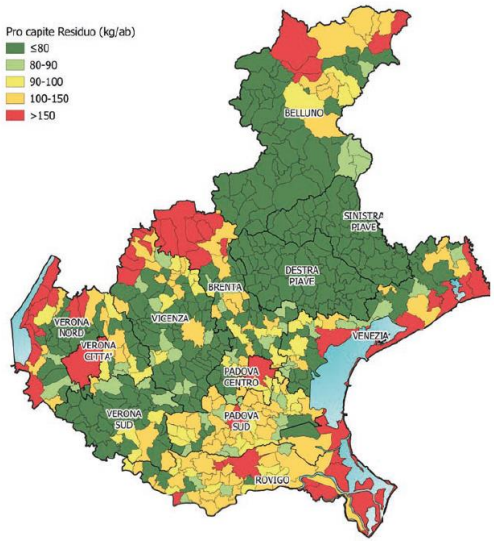
As highlighted in the report from Legambiente[20], in 2022 the positive results already achieved in previous years, also in line with EU targets, can be confirmed.

Figure 14 Distribution of municipalities according to separate waste collection (Method DM 26/05/2016) in 2022



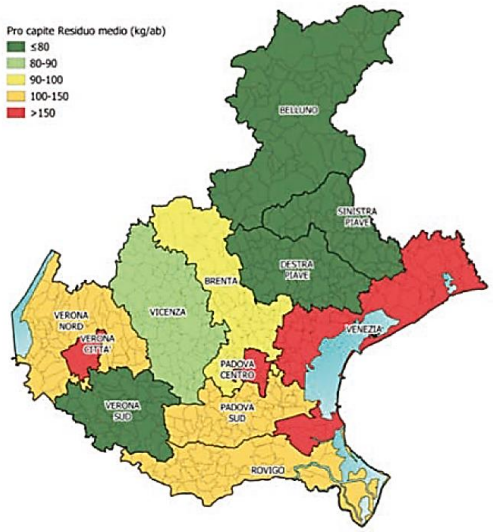
[20] Rapporto Legambiente Comuni Ricicloni Veneto 2023, https://www.ricicloni.it/edizioni?region=veneto

Figure 15 Distribution of municipalities according to per capita municipal waste production in 2022



The Basin Councils are bodies that regulate, govern and control the integrated waste collection service in the Optimal Territorial Ambits (*Ambiti Territoriali Ottimali*), as defined by regional regulations. Their objectives are to structure a transparent tariff system through synergies between the municipalities that result in economies of scale and unit costs in the management of collection services.

Figure 16 Categorization of Basin Councils according to per capita waste production in 2022



The Plan scenario, approved by DGR no. 988/2022, envisages a general target of 80 kg/inhabitant*year by 2030, differentiated according to the territorial complexity of the various basins, as shown in the table below.

Figure 17 Target for the residual municipal waste by 2030, differentiated according to the various basins

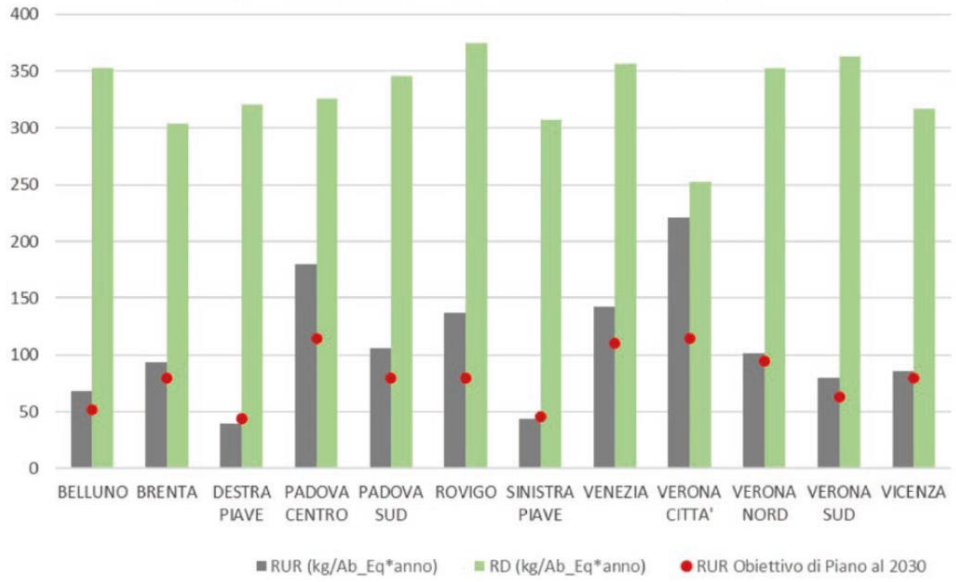
Obiettivo di RUR pro capite al 2030	BELLUNO	BRENTA	DESTRA PIAVE	PADOVA CENTRO	PADOVA SUD	ROVIGO
kg/ ab*anno	52	80	44	115	80	80
Obiettivo di RUR pro capite al 2030	**SINISTRA PIAVE**	**VENEZIA**	**VERONA CITTA'**	**VERONA NORD**	**VERONA SUD**	**VICENZA**
kg/ ab*anno	46	110	115	95	63	80

Figure 18 Comparison between 2022 data of the quantity of residual municipal waste and separate waste collection, and targets for 2030, differentiated according to the various basins

BACINO	RUR (kg/Ab_ Eq*anno)	RD (kg/Ab_ Eq*anno)	RUR Obiettivo di Piano al 2030
BELLUNO	68	353	52
BRENTA	94	304	80
DESTRA PIAVE	40	320	44
PADOVA CENTRO	180	325	115
PADOVA SUD	106	346	80
ROVIGO	137	375	80
SINISTRA PIAVE	44	307	46
VENEZIA	142	356	110
VERONA CITTÀ	221	252	115
VERONA NORD	102	352	95
VERONA SUD	80	363	63
VICENZA	86	317	80

The analysis for the year 2022 allows to verify the level of attainment with respect to the objectives of the Plan.
In the graph below it is reported in grey the quantity of production for the municipal residual waste, for the residual not recyclable, while in red it is highlighted the objective for 2030.
It can be noticed that the Right Basin of Piave and the Left Basin of Piave have already reached in 2022 the goal of the Plan for 2030, while Vicenza and Verona North are near to the same objective, followed by Verona South, Brenta and Belluno.
The basins of Padua South and Venice result more distant with respect to the attainment of the 2030 objective, while the path appears to be even longer for the Basins of Rovigo, Padova Centre and Verona city.

Figure 19 Per capita waste production divided by Basin Council in 2022


400
350
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250
200
150
100
50
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BELLUNO
BRENTA
DESTRA PIAVE
PADOVA CENTRO
PADOVA SUD
ROVIGO
SINISTRA PIAVE
VENEZIA
VERONA CITTA'
VERONA NORD
VERONA SUD
VICENZA
RUR (kg/Ab_Eq*anno)
RD (kg/Ab_Eq*anno)
RUR Obiettivo di Piano al 2030

3. Secondary raw material markets

3.1. Overview of the secondary raw material markets in the Italian Republic

Regulations

The rules regarding the recovery of residues, which are then transformed into secondary raw materials (so-called "MPS") or "End of waste" materials, are currently undergoing a legal evolution shifting from the historical discipline related to the production of "secondary raw materials" to the new European-based logic of "end of waste" (namely, the "cessation of waste qualification").

- *End of Waste. SNPA Guidelines*. Guidelines No. 41/2022 provide indications for carrying out checks on recovery plants that produce materials that cease to qualify as waste (the so-called "End of Waste").
- The legislative decree 77/2021 converted into Law No. 108/2021 amended paragraph 3 of Article 184-ter and introduced in the procedure for issuing authorisation measures, as provided for in Articles 208, 209, and 211, and in Title III-bis of Part Two of Legislative Decree 152/06, "a mandatory and binding opinion of ISPRA or the regionally competent environmental protection agency."
- Additionally, Law No. 128 of 2 November 2019, published in GU No. 257 on 2/11/19, converting Legislative Decree 3 September 2019, No. 101 (urgent provisions for labor protection and the resolution of company crises), introduced a system of controls on plants carrying out waste recovery operations resulting in authorized end-of-waste on a case-by-case basis, with competence entrusted to SNPA. It represents the revision of the "Guidelines for the application of the End of Waste discipline referred to in Article 184-ter paragraph 3 ter of Legislative Decree 152/2006" published in February 2020 and aims to ensure harmonization, effectiveness, and consistency of the System's action throughout the national territory.
- Decree 22 September 2020, No. 188 *Regulation governing the cessation of waste status for paper and cardboard, under Article 184-ter, paragraph 2, of Legislative Decree 3 April 2006, No. 152*
- Decree 27 September 2022, No. 152 *Regulation governing the cessation of waste status for construction and demolition inert waste and other inert mineral waste, under Article 184-ter, paragraph 2, of Legislative Decree 3 April 2006, No. 152*

In Italy, Secondary Raw Materials (SRM) are expressly excluded from the waste regime, whether they derive from recovery activities identified by specific decrees (DM 5/2/1998, DM 161/2002, DM 269/2005) or whether they are identified through ordinary authorisation procedures. Also excluded from the waste regime are SRMs that are already such without the need for treatment (so-called SRMs at the source, as per Circular 28 June 1999 no. 3402/V/MIN, known as the Ronchi

Circular) up to 25 June 2011 (i.e., within six months from the entry into force of Legislative Decree no. 205/2010).
This is what the new paragraph 3 of article 184 ter provides regarding SRMs, or in the absence of community criteria, case by case for specific types of waste (paragraph 2 of article 184 ter). Therefore, a preliminary conclusion can be drawn. The national simplified procedures for SRMs can be updated both to take into account the community criteria for EOW and to simply adapt the simplified recovery procedures.
With reference to this last aspect, it is worth noting that Article 24 of Directive 98/2008 provides for the possibility of an exemption from the authorization requirement for entities and companies for the disposal of their non-hazardous waste at production sites and for waste recovery operations (both their own and third parties).

It is important to highlight that Italian SRMs are nothing but, in advance, an "end of waste" system. In fact, according to the procedures in place in Italy, a waste subjected to recovery activities becomes a secondary raw material for use in a specific industrial activity excluded from the waste regime. According to paragraph 1 of article 184 TER, waste ceases to be such when it has undergone a recovery operation, including recycling and preparation for reuse, and meets specific criteria, to be adopted in compliance with the following conditions:
a) the substance or object is commonly used for specific purposes; b) there is a market or demand for such substance or object; c) the substance or object meets the technical requirements for specific purposes and complies with existing regulations and standards applicable to products; d) the use of the substance or object will not lead to overall negative impacts on the environment or human health. Regarding condition 2, it is noted that the absence of economic value or triviality is certainly different from the existence of a market or demand.

When the Ronchi Circular was no longer officially in force, many Secondary Raw Materials (SRMs) "transitioned" into the by-product regime (referred to with the section dedicated to it). It is only worth bearing in mind the definition (also new) of by-product as introduced by article 12 with a new article 184 bis.
It stipulates that a by-product, and not waste as defined in article 183, paragraph 1, letter a), is any substance or object that meets all of the following conditions:

- the substance or object originates from a production process, of which it is an integral part, and whose primary purpose is not the production of that substance or object;
- it is certain that the substance or object will be used, in the course of the same or a subsequent production or utilization process, by the producer or third parties;

- the substance or object can be used directly without any further treatment other than normal industrial practice;
- further use is legal, meaning the substance or object meets, for the specific use, all relevant requirements concerning products and the protection of health and the environment and will not lead to overall negative impacts on the environment or human health.

According to the ***Circular Economy Report 2024***, in 2022 recycled materials only satisfied 11.5% of the overall materials demand in the EU27. In Italy, this figure stood at 18.7%, making the country achieve one of the best performances in Europe. However, for a significant number of materials, including many essential raw materials, the contribution of recycled materials to meeting the demand for raw materials is still not sufficient. For instance, for some rare earth metals, the end-of-life material recycling rate is around 1%, although it reaches 16% for nickel and 22% for cobalt.
Gli scambi di materie prime seconde (MPS) sia all'interno dell'UE sia con i paesi terzi sono in aumento. Nel 2021, l'UE27 è stata nel complesso un importatore netto di materie prime seconde: 41 milioni di tonnellate importate contro le 38 esportate.
The trade of Secondary Raw Materials (SRMs) both within the EU and with third countries is increasing. In 2021, the EU27 overall was a net importer of secondary raw materials: 41 million tonnes imported compared to 38 million tonnes exported.

The contribution of recycled materials to meeting the demand for raw materials is represented by the **Circular Material Use (CMU)** rate, defined as the ratio of the use of secondary raw materials generated through recycling to the total material consumption[21].
Italy, which has historically shown among the best performances in this indicator, confirmed its position in 2022 compared to 2018, albeit with a declining trend compared to subsequent years, with recycled secondary raw materials accounting for 18.7% of the total raw materials consumed. However, this indicator value has remained largely static in our country over the last five years, dropping by 0.1 percentage point compared to what was observed in 2018.

[21] The overall material usage is measured by adding the Domestic Material Consumption (DMC) and the Circular Material Use (U), representing the total quantity of material directly consumed at the national level as the sum of virgin raw materials extracted and recycled secondary raw materials reintroduced into production cycles. Circular Material Use (U) is determined by the quantity of waste recycled in recovery facilities within the national territory, minus imported waste destined for recycling, plus the quantity of waste exported for recycling abroad.

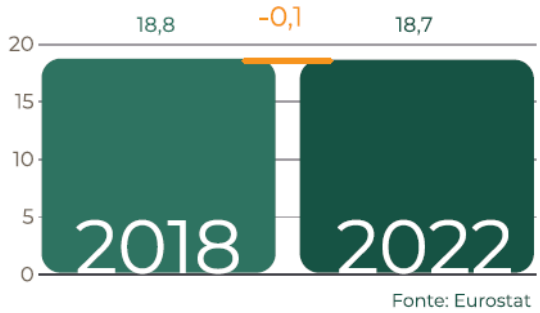


Figure 20 Circular use rate of material in Italy (2018-2022) (in %) (Eurostat)

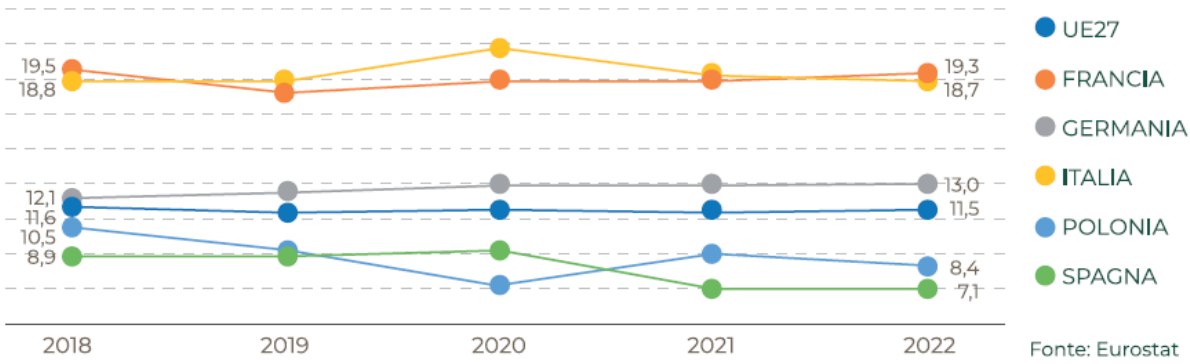


Figure 21 Circular use rate of materials in the five major EU countries (2018-2022) (in %) (Eurostat)

Trade of Secondary Raw Materials

In Italy, according to Eurostat[22] data, over the last five years, imports of secondary raw materials have grown by 6%, reaching 4 million tonnes in 2021. The most imported materials in Italy are organic and metallic types (iron and steel).

[22] Statistics from the International Trade in Goods Statistics (ITGS), published by Eurostat

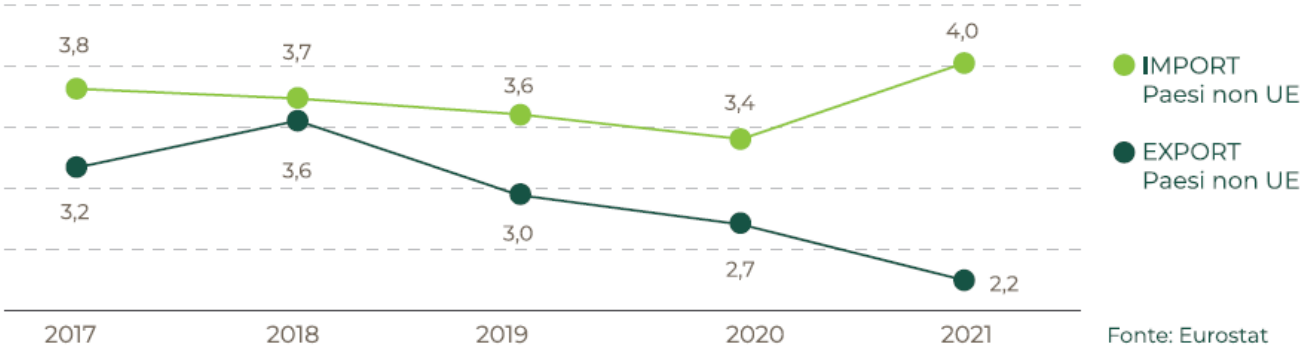


Figure 22 Import and export of Secondary Raw Material from and to outside-EU countries in Italy in the period 2017-2021 (in Mt) (Eurostat)

Conversely, exports to non-EU countries have declined since 2017 (with the exception of 2018), decreasing by approximately 30 percentage points in 2021 (2.2 million tonnes). Paper and cardboard materials are the most traded outside the EU, with their main destination being India and some countries in Southeast Asia.

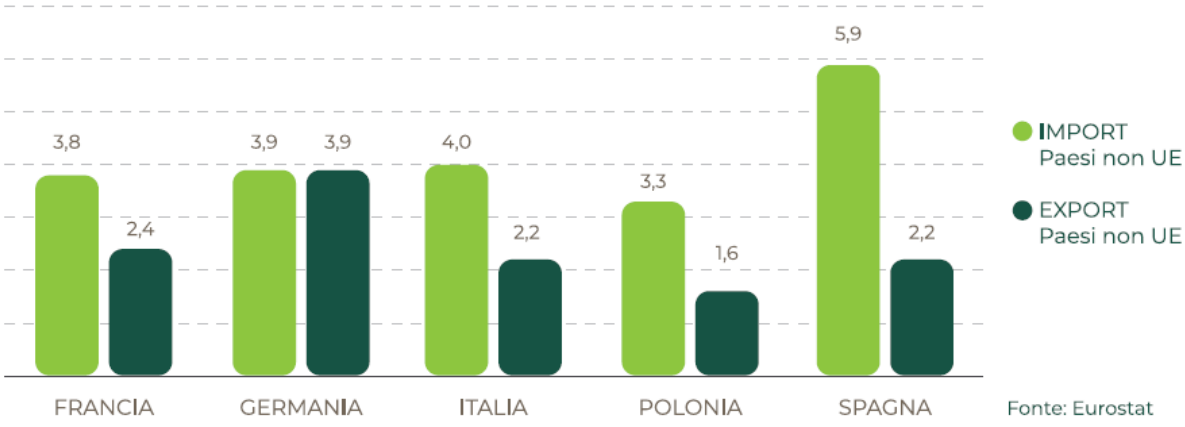


Figure 23 Trade of Secondary Raw Materials in the five major EU Countries in 2021 (in Mt) (Eurostat)

Intra-EU Trade of Secondary Raw Materials

Intra-EU imports of Secondary Raw Materials (SRMs) provide a good approximation of the market for these materials within the European Union. In the EU27, the exchange of secondary raw materials, calculated as imports between member countries, stood at around 92 million tonnes in 2021, an 8% growth compared to 2017. Italy's trend has shown a greater growth over the last five years compared to the EU27 average, increasing by over 10% to reach a value of 8.3 million tonnes of SRMs imported from EU countries. Particularly significant for Italy is the import of ferrous scrap (5.3 million tonnes):

in fact, our country is the European leader in electric arc furnace steel production, contributing to over 30% of the EU's electrosteel production.

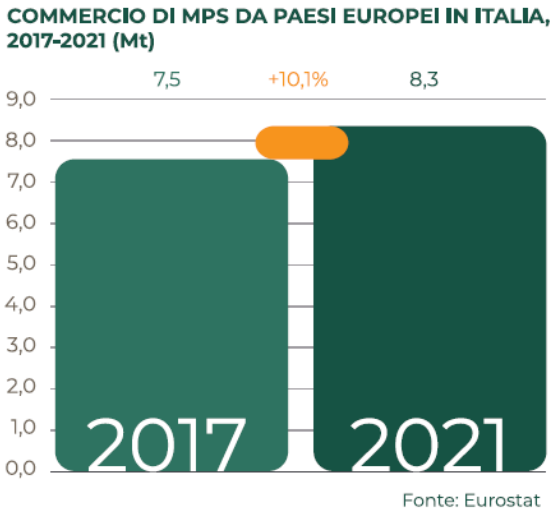


Figure 24 Trade of Secondary Raw Materials from EU countries in Italy in the period from 2017-2021 (in Mt) (Eurostat)

3.2. Secondary raw material system in the Veneto region

ARPAV does not rely on databases and systematized information related to secondary raw materials (formerly MPS, today EoW) used by companies or by the different production sectors: therefore, the Veneto region lacks overall information available on the supply or demand of recycled materials and consequently on the other aspects connected to this topic.

On the other hand, the Agency issues obligatory and binding opinions on the cessation of waste qualification where applicable on a "case by case" basis, i.e. in cases where the recovery activity does not correspond to the Community Regulations or the Ministerial Decrees issued to date.
However, with the aim of speeding up the timing of issuing opinions on a case-by-case basis and standardizing practices and approaches in the Veneto region, the following have been prepared:
- a dedicated page on the ARPAV's website[23]
- standard forms downloadable and editable by companies that make EoW requests on a case-by-case basis

[23] https://www.arpa.veneto.it/temi-ambientali/rifiuti/end-of-waste-1

- a series of standard opinions to which companies can directly refer.

Case-by-case binding opinion

Law 108 of 29 July 2021 introduced a mandatory and binding opinion of the territorially competent Environmental Agencies in the authorization procedures of waste recovery plants for the implementation of an EoW process (SNPA Guidelines n. 41/2022)

Based on these indications, in Veneto the company that intends to produce an EoW will have to submit a report to ARPAV on the basis of which the Agency will evaluate the suitability of carrying it out and the opinion will be included in the authorization document by the competent Authority.

In approximately two and a half years (2021- September 2023) ARPAV has released 230 opinions and approximately 69 are being processed, while new requests continue to arrive. Most of the opinions issued concerned inert matrices, metals, plastics, the chemical industry and compost.

In this context, the Circular Economy, Waste Cycle, End of Waste and By-Products structure of Arpav, in order to standardize procedures at regional level and speed up the issuing of opinions, has identified the elements useful for the creation of a common and homogeneous system for the preliminary evaluation for the purpose of issuing the "case by case" opinion referred to in the art. 184 ter paragraph 3 ter of the Legislative Decree. 152/06 and subsequent amendments.

For the authorizing bodies, a check list was created and shared with the minimum documentation to be provided to Arpav, while for the companies a format was drawn up and shared with all the information necessary for issuing the EoW opinion on a case-by-case basis.

Furthermore, the criteria for ceasing to qualify for some types of waste are made available in order to guarantee homogeneity at a regional level.

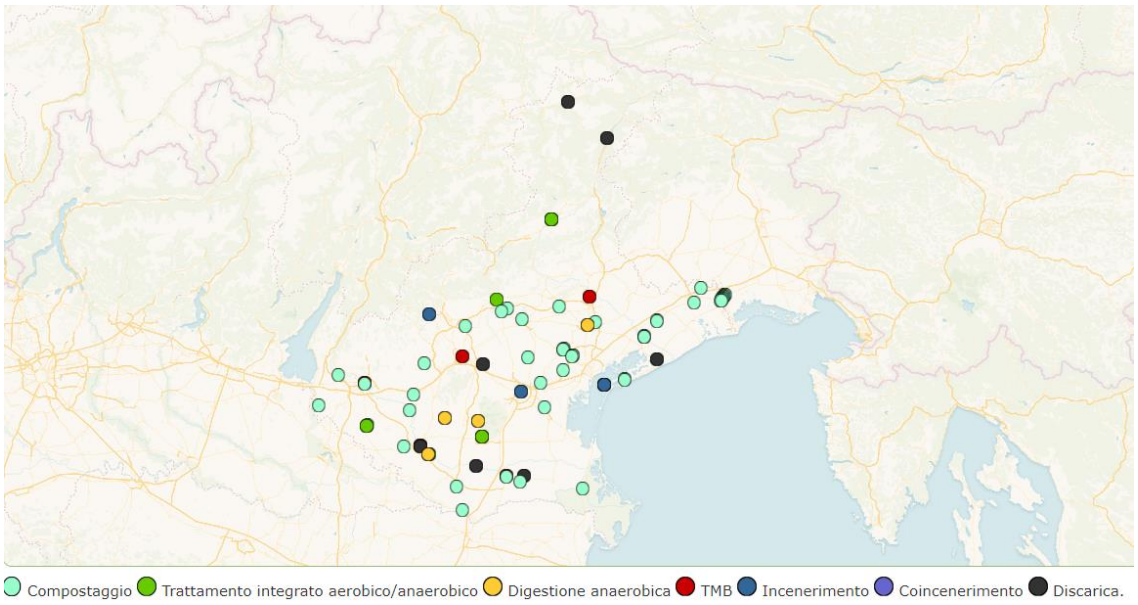
The "case by case" opinion is not required in the following cases:

- if EU Regulations or Ministerial Decrees have been issued for the cessation of waste status
- in simplified procedures
- in preparation activities for reuse or R12 and/or R13 recovery activities only
- in the case of semi-finished products, by-products and waste used directly in the manufacturing process
- in mobile campaigns
- in reclamation procedures.

3.2.1. Regional recycling facilities

Regional competence regarding the authorization of waste management plants is established by art. 4 of LR n. 3 of 21 January 2000[24].
The authorization for the definitive operation of the plants referred to in art. 208 of Legislative Decree no. 152/2006 not subject to Integrated Environmental Authorization is the responsibility of the Provinces pursuant to art. 6 of LR n. 3/2000, while for plants subject to Integrated Environmental Authorisation, the regional competences are established in Annex B to LR no. 4 of 18 February 2016.

Figure 25 Municipalities where urban waste treatment plants are located, year 2022



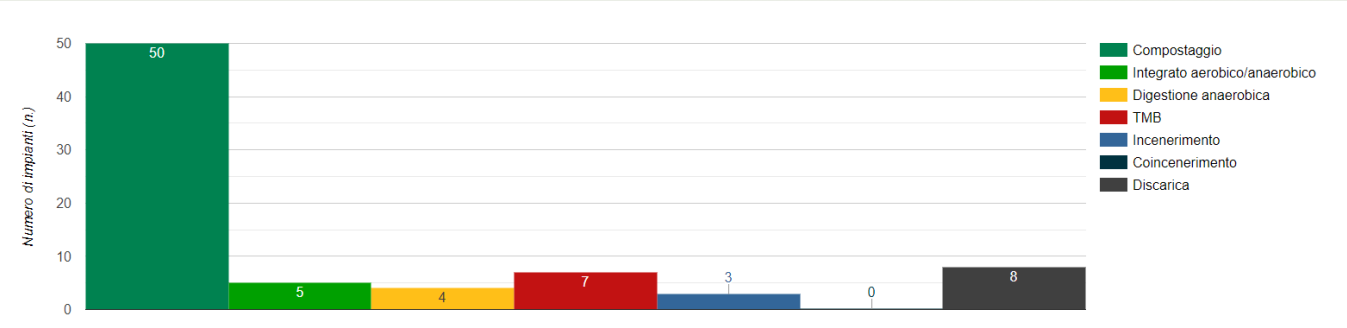
In Veneto, a variable number of plants[25] (depending on the type of treatment available) are present on the territory:

- Composting: 50 plants (for a total of 409,812 t of waste[26])
- Integrated aerobic and anaerobic treatment: 5 plants (for a total of 741,244 t of waste)
- Anaerobic digestion: 4 plants (for a total of 105,860 t of waste)
- Mechanical biological treatment (TMB): 7 plants (for a total of 17,859 t of waste)
- Incineration: 3 plants (for a total of 11,969 t of waste)

[24] https://www.regione.veneto.it/web/ambiente-e-territorio/impianti-gestione-rifiuti
[25] https://www.catasto-rifiuti.isprambiente.it/index.php?pg=gestimpianto&aa=2022&regid=1&impid=05&imp=Veneto&mappa=0
[26] Inclusive of municipal waste, mud and other waste

- Landfill disposal: 8 plants (for a total of 85,421 t of waste)

Figure 26 Number of waste treatment plants in the Veneto region according to the type of treatment available



4. Measures and initiatives for the development and improvement of secondary raw material markets

National level

- **NRRP investments**

A recent publication from the REF[27] Laboratory provides data on the implementation status of the National Recovery and Resilience Plan (NRRP) concerning waste management.
Regarding this, 2.1 billion euros have been allocated, involving two lines of intervention:

- The first one (Investment 1.1) has overall benefitted from 71% of the resources intended for the waste cycle and has been reserved for public entities and specifically to the Government Bodies of the Optimal Territorial Area (EGATO) operational by October 15, 2021, or alternatively to individual or associated municipalities.

- The second one (Investment 1.2), recipient of the remaining 29% of the funds, is instead aimed at private companies largely engaged in industrial activities aimed at producing goods or services or transport activities.

Regarding public initiatives, the allocations have been divided into 3 lines of intervention:

- Intervention Line A, dedicated to the improvement and mechanization of the separate collection of urban waste (600 million euros), which encompassed 991 interventions.
- Intervention Line B, aimed at the modernization and construction of new treatment/recycling plants for urban waste intercepted through separate collection (450 million euros), which solely for organic waste treatment involved 18 interventions.
- Intervention Line C, for the modernization and construction of innovative treatment/recycling plants for absorbents, sewage sludge, leather, and textile waste (450 million euros, of which half were related to sludge treatment plants), involving 16 interventions.

The resources allocated to the private sector are those provided under the title Investment 1.2 ("Flagship Circular Economy Projects"), intended to finance the realization of innovative projects for the treatment and recycling of waste from the four strategic sectors identified by the EU-promoted Circular Economy Action Plan, namely plastics, paper and cardboard, WEEE (including photovoltaic panels and wind turbine blades), and textiles. The amount of resources for these projects is

[27] "PNRR e rifiuti: dal PNGR alla strategia nazionale". Laboratorio REF ricerche. Rifiuti n. 262, febbraio 2024.

quantified at 600 million euros, divided among four different lines of intervention, with 150 million euros each, subsequently revised allocation.
In general, the total amount of allocated resources amounted to 580.8 million euros out of the expected 600 million euros. With the reallocation of funds, the distribution is no longer uniform across investment lines, particularly favouring initiatives for plastic recycling, which receive 45.8% of the total resources.
Regarding the flagship projects, the distribution predominantly sees funding for plastic waste treatment facilities (264.9 million euros, only those related to chemical recycling 100.3 million euros, more than twice the amount for mechanical recycling), followed by projects for paper and cardboard waste (134.7 million euros) and WEEE treatment (120.6 million euros), and lastly, textile waste (60.6 million euros).

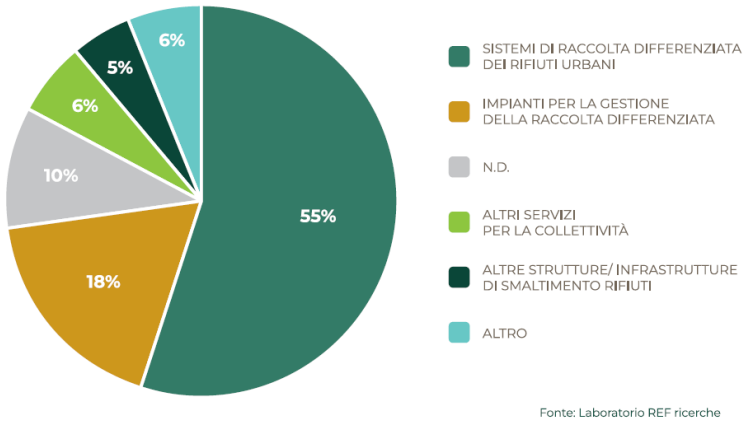
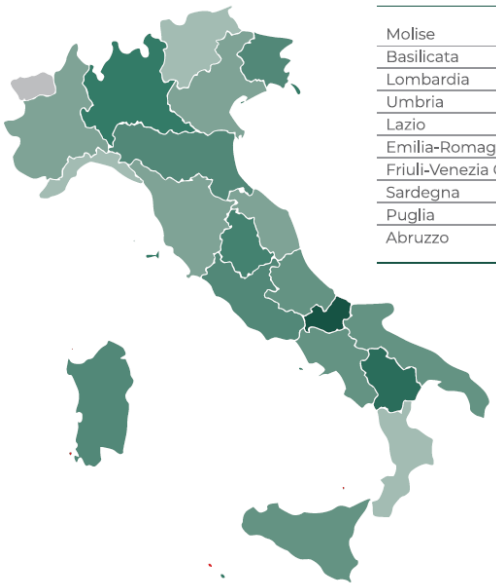
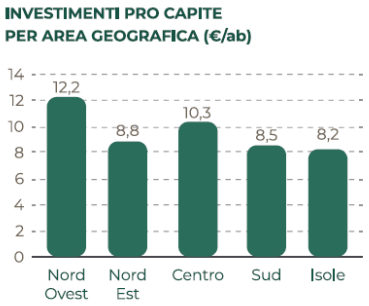


Figure 27 Assignment of NRRP for waste collection divided by activity typology (in % of the total of resources form intervention line A1.1)

Analysing the territorial distribution of funds, it is observed that the majority of resources went to the North-West regions (33.1%) and those in the Centre (20.4%). The South had access to 19.7% of the allocations, the North-East to 17.7%, and the islands to 9%.



Molise	33,1	Campania	7,7
Basilicata	24,3	Sicilia	7,6
Lombardia	16,9	Veneto	6,6
Umbria	16,3	Toscana	5,1
Lazio	13,8	Piemonte	5,1
Emilia-Romagna	12,6	Marche	4,9
Friuli-Venezia Giulia	11,0	Trentino-Alto Adige	2,0
Sardegna	10,1	Liguria	1,8
Puglia	9,0	Calabria	1,3
Abruzzo	8,8	Valle d'Aosta	-



Fonte: Laboratorio REF ricerche

Figure 28 NRRP per capita investments to private recycling companies (euro/inhabitant)

The distribution of the funding is unbalanced and has not pursued the objectives set by the PNGR, in particular:

- Regions with even surplus plant capacity have benefited from the majority of funds;
- In this way, the funded projects do not bridge but rather increase the gap in plant capacity between the North and the South, risking exacerbating the existing disparity between regions with the highest recycling rates and those lagging behind, going against the objectives set by the National Waste Management Plan, which calls for a reduction of this gap;
- Some regions, such as Lazio and Campania, which have a significant shortage of organic waste treatment capacity, did not receive any funding in this regard.

- **Decree on incentives for recycling**

On February 5, 2024, the Ministry of Environment issued a decree listing the recognized applications deemed eligible (406) for funding (tax credit provided by decree no. 538 of December 14, 2021). The total benefit amounts to 6.7 million euros.

- **End of Waste for Inert Waste**

On December 14, 2023, the Ministry of Environment notified the European Commission of the draft National Regulation on the end-of-waste status for construction and demolition inert waste, which will replace Decree no. 152/2022. This draft regulation, prepared by the Ministry of Environment after consultation with all relevant stakeholders during the monitoring period as per current regulations, has been under evaluation by the European Commission and Member States until March 15, 2024.

- **Transition 5.0**

The Government presented a decree-law on February 26, 2024, to introduce financial incentives for companies investing in environmental sustainability (including the circular economy), complementing the already implemented tool known as Transition 4.0, with a total financial availability of nearly 13 billion euros. Transition 5.0 includes tax incentives for companies in the form of a tax credit to support investments in digital and energy transition. The plan is aimed at all companies making new investments in production facilities located in the national territory, within innovative projects that lead to a reduction in energy consumption, regardless of legal form, sector, size, or tax regime. These assets must be part of an innovation project resulting in reduced energy consumption. The reduction must be at least 3% of the energy consumption of the production facility or at least 5% of the energy consumption of the processes involved in the investment. If the energy reduction exceeds these thresholds, the incentive amount increases. The plan also includes two additional lines dedicated to energy self-generation and self-consumption systems and to training.

Therefore, tax credits are provided for companies that will invest in:

- Purchase of tangible or intangible capital goods;
- Purchase of goods necessary for self-generation and self-consumption of energy from renewable sources (excluding biomass);
- Expenditure for training staff in skills for ecological transition. The 6.3 billion euros are distributed as follows:
- 3.780 billion euros for capital goods;
- 1.890 billion euros for self-generation and self-consumption of energy;

- 630 million euros for training (up to a maximum of 10% of the total investment and up to a maximum of 300,000 euros). The incentive system includes 9 different tax rates, determined by the amount of the investment and the results in terms of energy savings.

Regional level

Some of the specific activities and efforts activated by the Veneto Region for the development and improvement of secondary raw material markets include:

- Advanced separate waste collection

Veneto is known for having one of the highest separate waste collection rates in Italy. This implies more efficient waste management and a greater quantity of recycled materials.

- Circular economy programs

The Veneto Region has promoted programs to stimulate the adoption of circular practices in various sectors, including agriculture and manufacturing. These programs promote the responsible use of resources and the reduction of waste.

- Development of circular technologies

Veneto is home to several companies and research centers involved in the development of innovative technologies for the recycling and reuse of materials, thus contributing to promoting innovation in the circular economy.

- Education and awareness

The Veneto Region has conducted public awareness campaigns to educate citizens and businesses on the opportunities related to the circular economy and sustainable practices.

- Regional laws and regulations

Veneto has adopted specific regional laws and regulations to promote the circular economy, including the promotion of recycling and support for businesses and projects that embrace this model. First of all, the update of the Regional Waste Plan of the Veneto Region must be mentioned.

- **Technical table on circular economy**

With DGR n. 1257 of 17/10/2023 - BUR n.146 of 03/11/2023 the draft "Memorandum of Understanding for the definition of operational proposals for the implementation of the circular economy in the production sectors of Veneto" was approved between Veneto Region, A.R.P.A.V., Ca' Foscari University, University of Padua and University of Verona, with the aim of activating shared and complementary strategies that favor the application of the circular economy in the various production sectors, in particular by promoting:

- reducing the consumption of natural resources through greater efficiency of production processes and the use of recycled materials to replace similar virgin materials;
- the use of renewable natural resources;

- the development of a high-quality and competitive recovery industry that orients the market towards greater and established confidence in the quality of the recovered material;
- analytical reading of the current regulatory framework in force, identifying the related critical issues and possible initiatives aimed at overcoming them;
- the analysis of the design and implementation process of the production process, from design to product release, in different production sectors, to verify whether what is left over from one production sector can become a resource for a different sector, in a strategic vision based on the optimization of processes and circular economy;
- the promotion of operational technical tools to promote the achievement of circularity objectives, through an effective "Life-Cycle Assessment";
- the possibility of developing a web platform, aimed at collecting and sharing the activities carried out by individual subscribers, to be made available to operators in the sector if necessary;
- the promotion, development and support of circular business models also based on the principles of circular design;la promozione, lo sviluppo e il sostegno di modelli di business che prevedano l'affermazione e il potenziamento delle catene di valore in senso circolare;
- the study and development of enabling technological tools with a view to which digitalisation and innovation are effective and efficient tools for overcoming the linear model and affirming the circular model.

The Memorandum of Understanding establishes, in order to achieve the aforementioned objective, the Roundtable for the circular economy, coordinated by the Veneto Region, in which the representatives designated for each individual signatory to the protocol participate.

With regard to actions to promote the reuse of industrial waste in the production sector, the Update of the Regional Waste Management Plan (DGRV 988/2022), includes a focus dedicated to these issues, named "Circular resources for the production sector: incentive of By-Products and End Of Waste", which includes 2 coordination and support tables for local companies, one dedicated to by-products and one to EoW.

1. **Regional Coordination Technical Table for By-Products**

As part of the actions aimed at implementing the circular economy, the update of the regional urban and special waste management plan, Bur. n. 107 of 02/09/2022, aims to incentivize and support the production sector for the valorization of:
- by-products and industrial symbiosis;
- waste with specific characteristics, directly reusable as materials in production chains, according to the provisions of the contents of the art. 216-septies of Legislative Decree 152/06;

- materials coming from the recycling/recovery of waste which have ceased to qualify as waste (End of Waste).

In this regard, the Veneto Region, with DGR n. 448 of 04/18/2023 (BUR no. 63 of 05/12/2023), established the Regional Coordination for the Circular Economy and Development (CRESC), aimed at achieving the strategic objectives of regional policies related to the economy circular provided for by the Update of the Plan with the support of the Technical Secretariat, established with DGR n. 1495 of 11/29/2022 - BUR n. 153 of 12/16/2022. CRESC works through technical tables that will discuss and explore individual issues in depth, including the Regional Coordination Technical Table for By-Products.

The Regional Coordination Technical Table has the task of evaluating the requests coming from the production chains or individual companies and defining good technical and management practices which, in compliance with current legislation, can allow the identification and "validation", case by case, of certain by-products within different production cycles. At the end of the investigation carried out on the by-product covered by the request, the Coordination issues a document identifying the by-product and this by-product can be registered in the Regional List of By-Products managed by ARPAV.

2. Technical reference table for End of Waste

As part of the actions aimed at implementing the circular economy, the Update of the Regional Urban and Special Waste Management Plan, Bur. n. 107 of 02/09/2022, aims to incentivize and support the production sector for the valorization of:

- by-products and industrial symbiosis;
- waste with specific characteristics, directly reusable as materials in production chains, according to the provisions of the contents of the art. 216-septies of Legislative Decree 152/06;
- materials coming from the recycling/recovery of waste which have ceased to be waste (End of Waste).

For such a purpose the Veneto Region, with DGR n. 448 of 18/04/2023 (BUR n. 63 of 12/05/2023), has established the **Regional Coordination for the Economy and Circular Development (CRESC),** finalizing the formulation of the strategic objectives of regional policy on the economy circular provided by the Piano arrangement with the support of the Technical Secretariat, costituita with DGR n. 1495 of 11/29/2022 - BUR no. 153 of 16/12/2 CRESC works across technical tables that deal with and delve into single topics, including the Technical Table referred to as End of Waste.

The End of Waste Technical Reference Table is responsible for developing and approving technical reference documents for specific EoW product types (providing greater consolidation and recurrence), containing the information required to define the qualification criteria the refiuto eye sensi dell'art. 184-ter of the D.Lgs. 152/2006 and s.m.i.. These documents show the production and

validation of a second approved procedure in accordance with the Decree of the Directorate of the Environment and Ecological Transition. 184-ter and from the competent authority in the field of architecture returns to the relationship of authorizations in accordance with the specific EoW.
With DDR 221 of 07/11/2023 the state defines the mode of operation of the activity of the Technical Table referred to as End of Waste.

- **Projects in the circular bioeconomy**

The initiative of the circular bioeconomy of the Biorefinery of Arborea transforms residual biomass (cereal grains, sugarcane beans) into biofuels and bioproducts. The project has created new jobs and contributed to the diversification of the local economy.
Research in the circular bioeconomy presents an important advantage for the sustainable development of the territory, as it has created new economic opportunities and has enhanced local resources, while contributing to decarbonize the energy system.

- **PR Veneto FESR 2021-2027, Priority 2, OS "Promoting the transition towards a circular and efficient resource profile (FESR)", Azione 2.6.1**

The Circular Economy 2024 call, promoted by the Veneto Region, aims to sustain the micro, small and medium printed with the aim of:

- undergo organizational changes favoring the adoption of new production processes (raw materials and technology);
- improve the efficiency of production by dealing with the reduction or elimination of consumption and laughter, with the consequent change in demand and minor danger;
- sustain the resources of secondary raw materials, including products derived from the recovery of refuse, to stimulate demand for sustainable and circular products, and reduce the production of waste or the valorization of industrial by-products and re-immission into the value chain.

The application is open to local SMEs and micro-businesses.

- **Veneto Green Cluster**

Veneto Green Cluster is a Regional Innovative Group that combines excellence in the field of environmental values, involves industrial sectors oriented towards the provision of environmental benefits and services (green business) and is committed to reducing the environmental impact of its own productive processes their own products (green production).
In addition to sustaining and supporting research and innovation projects, Veneto Green Cluster will promote internationalization activity which its partner RIR intends to divide: market study and

research, proud international participation, incoming events, productive and commercial partner research.
The Veneto Regional Innovative Green Cluster is recognized by the Veneto Region with DGR n. 54 of 27/01/2017, is presented by Green Tech Italy – press.
The members are:

- businesses (production and manufacturing but also services, multisectoral and multidisciplinary);
- research bodies, in particular university departments and multidisciplinary interdepartmental research centres;
- trade associations; and
- private and public bodies.

5. Conclusion

From the data presented it can be deduced that Veneto maintains its leading role at a national level in the management of urban waste, continuing to interpret a virtuous management model for both other Italian and international realities.
Municipalities and Consortia, through public service managers, have continued to manage urban waste efficiently and effectively even in the most complicated periods, allowing the results achieved to be maintained and, in some ways, anticipating the objectives of the European Directives of the Circular Economy Package.

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7. List of figures

8. List of tables

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AWASTER

INTERREG ITALY-CROATIA
PROGRAMME 2021 – 2027

AWASTER – Adopting WASTE as Resource

D.1.1.3 Regional secondary market report – Apulia Region

Version: Final
Distribution: Public
Date: 8/2024

Interreg Co-funded by the European Union

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AWASTER

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

Work Package:	WP1 – Circular economy – current state analysis
Activity:	A.1.1 – Regional background analysis
WP coordinator:	LP – IRENA – Istrian Regional Energy Agency Ltd.
Deliverable:	D.1.1.3 Regional secondary market report

Version:	Draft	**Date:**	9/2024
Type:	Report/Study/Tool etc.		
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1. Introduction

The present deliverable is one of the five regional reports foreseen by Activity 1.1 Regional background analysis, which is part of the WP1 Circular economy – current state analysis of the Interreg IT-HR AWASTER project.

The report assesses the functionality of secondary raw material (SRM) market in the Apulia region and contains information on the supply and demand side of the market.

The findings and challenges detected will be used to develop subsequent project activities, in particular A.1.2 Sustainable resources use guidelines and A.1.3 Joint Strategy and Action Plan development.

Together with D.1.1.2 Regional waste management report, the present deliverable represents a high-quality database on which stakeholders can base their requests for financing the measures provided for in the Joint Action Plan from EU funds and other sources.

Moreover, it will be used by the PP and AP in their daily work to reinforce the use of the circular economy principles also after the project end.

2. Separate waste collection system

2.1. Separate waste collection system in the Italian Republic/Republic of Croatia (national level)

Regulatory framework

- Legislative Decree No. 152 of 3 April 2006, *Consolidated Environmental Act* (Part IV)
- Law No. 60 of 17 May 2022, *Provisions for the Recovery of Waste in the Sea and Inland Waters and for the Promotion of the Circular Economy* ("Save the Sea" Law)
- Legislative Decree No. 196 of 8 November 2021, *Implementation of Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the Reduction of the Impact of Certain Plastic Products on the Environment*
- Legislative Decree No. 197 of 8 November 2021, *Transposition of Directive (EU) 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 that Amends Directive 2010/65/EU and Repeals Directive 2000/59/EC*
- *Classification of Waste. SNPA Guidelines* No. 24/20: the documents provide a methodological approach for the agency system to classify waste according to procedural schemes by phases, operational indications, and useful examples for identifying the code and assessing the hazardousness of waste
- Ministerial Decree of the Ministry for the Environment, Land and Sea Protection No. 264 of 13 October 2016, *Regulation Laying Down Indicative Criteria to Facilitate the Demonstration of the Requirements for the Qualification of Production Residues as By-Products and not as Waste*
- Law No. 166 of 19 August 2016, *Provisions Concerning the Donation and Distribution of Food and Pharmaceutical Products for Social Solidarity Purposes and to Limit Waste*
- Prime Ministerial Decree of 10 August 2016, *Identification of the Overall Treatment Capacity of Urban Waste Incineration Facilities in Operation or Authorised at the National Level, as well as Identification of the Residual Need to be Covered by the Construction of Urban Waste Incineration Facilities with Recovery*
- Decree of the Ministry for the Environment, Land and Sea Protection of 26 May 2016, *Guidelines for Calculating the Percentage of Separate Collection of Municipal Waste*
- Decree of the Ministry for the Environment, Land and Sea Protection No. 134 of 19 May 2016, *Regulation Concerning the Application of the Climate Factor (CFF) to the Formula for the Efficiency of Energy Recovery from Waste in Incineration Plants*
- Decree of the Ministry for the Environment, Land and Sea Protection No. 101 of 12 May 2016, *Regulation Laying Down the Identification of Methods for the Collection, Disposal and*

Destruction of Explosive Products, Including Expired Ones, and Waste Produced by the Ignition of Pyrotechnic Articles of Any Kind, Including Those for Rescue Needs, Pursuant to Article 34 of Legislative Decree No. 123 of 29 July 2015

- Decree of the Ministry for the Environment, Land and Sea Protection No. 121 of 31 May 2016, *Regulation Laying Down Simplified Procedures for Carrying out Free Collection Activities by Distributors of Very Small WEEE (Waste Electrical and Electronic Equipment), as well as Technical Requirements for Carrying Out Preliminary Collection Storage Activities at Distributors and for Transport*
- Ministry of Environment Decree No. 132 of 2 April 2024 *Criteria and Methods for the Application of the Tax Credit for Enterprises that Purchase Recycled Materials Derived from Separate Collection* - Implementation of Article 1, Paragraph 690, of Law No. 197/2022 - Indication of Technical Requirements and Certifications Suitable for Documenting the Eco-Sustainable Nature of Products and Packaging

National Strategy for the Circular Economy[1]

In 2017, following a wide public consultation, the document ***Towards a circular economy model in Italy. Document of framework and strategic positioning*** has been published, with the purpose of providing a general overview of the circular economy as well as defining the strategic positioning of Italy on this matter, in consistency with the commitments adopted under the Paris Agreement on climate change, the United Nations 2030 Agenda on sustainable development, the G7 and the European Union. Also, on 2017 the context changed highlighting the urgency of an intervention in order to reduce gas emissions and tackle the effects of climate change. Thus, new Plans and Programs have been provided at European level in order to support the transition towards circular models. Moreover, a fast technological development allowed the identification of new production sectors which are capable of generating new value chains instead of the traditional ones maximizing the recovery and recycling of the waste. Also, recent circumstances such as the pandemic and the Ukranian crisis pointed out the need to turn to a national supply chain of energy and raw materials. **The transition to a complete circular economy represents a strategic goal for Italy which is deficient of raw materials and geographically marginal compared to the large markets of central Europe**, in order to deal with the major transformations that are affecting the global economy such as:

- the review of the globalization process which is causing new protectionisms aimed at the strengthening of the industrial bases of individual countries or geographical areas;
- the spreading of the effects of the new digital revolution;
- the environmental emergency and the need to start a green transformation process of the economy with the purpose to reduce gas emissions and the use of natural resources.

Therefore, it is necessary to update the strategic lines identified in 2017 to make them consistent with the new global challenges. For these reasons the "National strategy for the circular economy" is

a programmatic document providing actions, objectives and measures that are intended to be pursued as institutional policies with the purpose to ensure an effective transition towards a circular economy.
In particular, the *National strategy for the circular economy* intends to define new administrative and fiscal tools in order to strengthen the market of secondary raw materials with the purpose to make them competitive in terms of availability, performance and costs compared to virgin raw materials. To this end, the National Strategy produces its effects on the material purchase chain (Minimum Environmental Criteria for green purchases in the Public Administration), on the criteria on the basis of which a waste shall cease to be a waste (End of Waste), on the extended producer responsibility, on the role of the consumer and on the widespread of sharing practices and "product as a service". Furthermore, the Strategy represents an essential 12 tool in order to achieve the climate neutrality objectives and to define a roadmap of actions and measurable targets from now until 2035. On 30 September 2021, the Ministry for the Ecological Transition launched a public consultation on the "National Strategy for the Circular Economy: Programmatic Guidelines for Upgrading" which is a document structured in five main sections:

1. Reference framework of the national strategy for the circular economy
2. The national context
3. The Italian strategy
4. Measurement and monitoring of circularity
5. Strategic guidelines, areas of intervention and tools.

The public consultation expired on 30 November 2021 and allowed the Ministry for the Ecological Transition to gather over 100 contributions related to the five sections.
These contributions, where considered relevant, have been included in the text of this document.
In particular, the following topics have been introduced or implemented in the original text:

- eco-design;
- reuse and repair;
- end of waste;
- critical raw materials and development of a secondary raw materials market;
- green public procurement and minimum environmental criteria;
- strategic industrial supply chains;
- industrial symbiosis;
- extended producer responsibility;
- digitization.

In particular, the Strategy aims to achieve certain quantitative targets in terms of recycling for the following types of waste:

- 55% municipal waste

- 65 packaging waste
- 25% wood packaging
- 70 ferrous packaging
- 50% plastic packaging
- 50% aluminium packaging
- 70% glass packaging
- 75% paper and cardboard.

The National Waste Management Programme[2]

The *National Waste Management Programme (PNGR)* is the strategic guidance tool for the Italian Regions and Autonomous Provinces, setting macro-objectives, defining criteria, and outlining the strategic directions for the formulation of regional waste management plans. The PNGR, alongside the National Waste Prevention Programme, is one of the strategic and operational pillars of the National Strategy for the Circular Economy. It aims to ensure that planning criteria meet the objectives of EU legislation to prevent disputes and promote sustainability, efficiency, effectiveness, and cost-efficiency across waste management systems nationwide, in line with territorial cohesion objectives. Overcoming the gap in waste management facilities between regions is thus a priority. This objective is crucial to ensuring integrated waste management across the entire nation and complying with European targets on reducing final disposal. The National Waste Management Programme is one of the reforms under the NRRP (National Recovery and Resilience Plan), Mission 2 "Green Revolution and Ecological Transition", Component 1 "Sustainable Agriculture and Circular Economy". Component 1 addresses several topics, including the national programme for waste management, the establishment of new waste management facilities, and the modernisation of existing ones. The overall objectives of the National Waste Management Programme (PNGR), in adherence to the purposes, principles, and priority criteria defined respectively by Articles 177, 178, and 179 of Legislative Decree No. 152/2006, are as follows:

- to reduce the planning and facility gap between different regions, pursuing progressive socio-economic rebalancing and rationalisation of the facility and infrastructural system according to criteria of sustainability, efficiency, effectiveness, and cost-efficiency, in line with the principles of self-sufficiency and proximity;
- to ensure the achievement of objectives related to prevention, preparation for reuse, recycling and recovery of waste, and reduction of disposal, also considering producer responsibility regimes (EPR) for the waste produced;
- to rationalise and optimise the facility and infrastructural system through regional planning based on complete waste traceability and identification of pathways leading to the short-term bridging of the facility gap by describing existing systems and analysing flows; supporting the concurrent reduction of potential environmental impacts, which should also be assessed through the adoption of life cycle assessment (LCA) of integrated waste management systems;

- to ensure facility endowment with high-quality standards in both management and technology;
- to promote a waste cycle management approach that substantially contributes to achieving climate neutrality objectives;
- to define priority actions to enhance communication and environmental awareness regarding waste and circular economy.

National Waste Prevention Programme (NWPP)
Adopted and approved with DD of 7/10/13, based on EU Directive 2008/98, it must be updated every 6 years and can be included within the Waste Management Plan or be a standalone plan. The Programme sets prevention targets for 2020 compared to the values recorded in 2010:

- 5% reduction in municipal waste per unit of GDP;
- 10% reduction in hazardous special waste per unit of GDP;
- 5% reduction in non-hazardous special waste per unit of GDP.

Decree on Preparation for Reuse
The decree of 10 July 2023, No. 119 *Regulation laying down the conditions for exercising preparations for reuse in a simplified form, pursuant to Article 214-ter of Legislative Decree No. 152 of 3 April 2006* was published in the Official Gazette on 1 September 2023. The decree defines the operational methods, technical and structural equipment, and minimum qualification requirements of operators necessary to carry out such operations, the maximum quantities that can be used, the origin, types and characteristics of the waste, as well as the specific conditions of use under which products or components of products that have become waste are subject to preparation for reuse operations. To this end, the annexes to the Regulation specify the characteristics and technical equipment required for a preparation for reuse centre, the catalogue of acceptable waste, and the maximum quantities that can be used. The regulatory intervention, by allowing the opening of preparation for reuse centres through a simplified procedure, represents a tool that enables greater interception of those waste streams (e.g. WEEE) which, through repair operations, can regain market value, with the same functions and safety guarantees as the original product.

2.1.1. Categories, quantity and type of separated and collected waste at national level

According to the 4th ***SNPA Environmental Report 2023***[3], in Italy, the **amount of waste disposed of in landfills has been steadily declining**, with the percentage dropping from 63.1% in 2002 to 17.8% in 2022, although still far from the European targets (which propose reducing to below 10% by 2035). In parallel, in 2022, the trend of increasing separate waste collection continued, with a rise of 1 percentage point compared to 2021, reaching 65% at the national level. Regionally, in 2022, the lowest percentage of municipal waste disposed of in landfill was achieved by the Campania region

(1.1%), followed by Lombardy, Friuli-Venezia Giulia, Emilia-Romagna, and Trentino-Alto Adige, while the remaining Italian regions recorded percentages above the 10% threshold. The number of operational landfills in Italy, totalling 117 facilities in 2022, distributed across the North (50), Centre (25), and South (42), decreased compared to the previous year. In 2022, the highest percentage of separate waste collection was achieved by the Veneto region, with 76.2%, followed by Sardinia, with 75.9%.

The 2023 edition of the ***Urban Waste Report***[4], presented by ISPRA, also highlights that, despite the increase in GDP and household spending, **national municipal waste production decreased by 1.8% in 2022 compared to 2021**, while the percentage of separate waste collection increased (65.2% of total production). According to the data, Italy produces 29.1 million tonnes of municipal waste; this figure decreased by 544,000 tonnes (-1.8%) compared to 2021. According to ISPRA, the fluctuating trend in waste production can be attributed to various factors, including the introduction of new legislative provisions or health or socio-economic reasons, such as the 2020 pandemic and the 2022 international crisis. Except for 14 municipalities with a resident population over 200,000 inhabitants, where there was a slight increase (0.4%) between 2021 and 2022, the report highlights that waste production decreased in all major Italian geographical areas, specifically by 2.2% in the North and by 1.5% in the Centre and South. In absolute terms, Northern Italy produces over 13.8 million tonnes of waste, the Centre 6.2 million tonnes, and the South almost 9 million tonnes. In 2022, each Italian citizen produced an average of 494 kg of waste, with an average annual cost per inhabitant of €192.3 (it was €194.5 in 2021). According to the ISPRA Report, in 2022, separate waste collection increased (+1.2 points compared to 2021), accounting for 65.5% of total production. In quantitative terms, the dimension of separate waste collection remained stable (18.9 million tonnes), as did the existing gap between Northern and Southern Italy. In 2022, the recycling rate of municipal waste stood at 49.2%, an increase compared to 2021 (48.1%) but still insufficient to reach the target of 65% by 2030 set by the regulations. The waste management facilities operating in 2022 totalled 654. Over half of these are dedicated to the treatment of the organic fraction of separate collection, although not all regions yet have sufficient structures to handle the quantities produced. Regarding packaging and packaging waste, all the commodity fractions have already largely achieved the European targets set for 2025, except for plastic, which is nevertheless close to the target (48.9% against a target of 50%). Among separately collected waste, the organic fraction remains the most collected in Italy (38.3% of the total), followed by paper and cardboard with 19.3% of the total, glass (12.3%), and plastic (9%). The recovery of the organic fraction is mainly carried out in integrated anaerobic-aerobic treatment plants (50.8% of the quantities sent to organic fraction management facilities), followed by composting plants (44.4%); the remaining 4.8% is managed in anaerobic digestion plants.

Together with the annual Urban Waste Report by ISPRA, the ***Report on Energy Recovery*** from Waste in Italy was also published. According to the study, the number of facilities in Italy in 2022 totalled

188, including incinerators and anaerobic digestion plants for the organic fraction and sewage sludge, which produced approximately 7 million MWh of energy, enough to meet the needs of around 2.6 million households. The report also highlights a shortage of facilities in Southern Italy.

According to the 2023 ***Recycling Report in Italy***[5], the prices in the respective markets for secondary raw materials heavily influence the economic balance of companies, which have to navigate a climate of profound political and economic instability, complicating investments and future prospects. Despite this scenario, **Italy continues to be one of the European Union countries with the best recycling performance, reaching 72% in 2020**, **against a European average of 53%,** with peaks of excellence in packaging.

For Italy, according to the Foundation for Sustainable Development, the production of wastepaper (amounting to almost 7 Mt) saw a 6% decrease in 2022 compared to the previous year, mainly due to increased energy costs and geopolitical issues. This decline did not, however, dampen exports, with about 1.5 Mt of paper being sent abroad (nearly 10% more than in 2021). Asia remains the primary market, accounting for 55% of the total. Regarding plastic materials, the mechanical recycling market experienced a slight downturn in 2022 due to rising energy costs, fierce competition from virgin materials, and imports of polymers at competitive prices from Asian countries. Although separate collections are steadily improving, ensuring a good supply of recycled materials, the real challenge lies in the demand for recycled polymers. The significant increase in the selling prices of recycled materials has forced many sectors to resort to virgin polymers to stay competitive. This is particularly true for lower-added-value recycled polymers, for which the final markets would not be sufficient to absorb the quantities produced. In the glass sector, the production of bottles and jars increased in 2022 to meet consumer demands for safety and environmental sustainability. However, the price of glass cullet has risen to the point where many glassworks are returning to virgin raw materials. This discrepancy needs to be addressed, primarily by enhancing the demand for recycled glass. Overall, the amount of recycled glass used in the glass industry was 3.5 Mt, over 60% of the glass produced.

Italy is almost entirely dependent on foreign sources for both aluminium and copper and produce only secondary recycled aluminium. In 2022, Italy remained the leading European producer of electric arc furnace steel (with 85% of steel from scrap), contributing more than 30% to the EU's electric steel production. Due to the heavy reliance of the Italian manufacturing industry on metal imports, improving the collection of this fraction is increasingly strategic for our economy. For wood, energy recovery and recycling are in strong competition: out of the 50 Mt of wood waste generated in the European Union in 2020, 20 Mt were recycled, and the rest was incinerated. In Italy, 97% of recycled wood material is transformed into particle boards used by the furniture and furnishing industry. Today, panel manufacturers mainly use wood from the post-consumer recovery

chain. Regarding organic waste, over 2 Mt of compost was produced in 2021 from the transformation of organic matrix waste treated by composting plants and integrated anaerobic digestion facilities. The integration of composting with the anaerobic digestion process also made it possible to obtain over 400 million m³ of biogas, partly used for electricity production (around 440 GWh) and thermal energy (over 120 GWh), with a portion used to produce biomethane, which reached 136 million m³.

Regarding the textile sector, analysis by the Foundation for Sustainable Development shows that the only segment that has worked so far has been reuse, thanks in part to social cooperatives, generating a very active second-hand market, while textile waste recycling is still a challenge to be developed. As for recycled aggregates produced from construction and demolition (C&D) waste, experts from the Foundation suggest policy recommendations, such as using Minimum Environmental Criteria in public tenders to encourage their use, improving the performance of materials through new facilities, and streamlining the end-of-waste criteria to allow classification as secondary raw materials rather than waste.

According to the ***Circular economy report Italy 2024,*** the overall situation in Italy can be described according to some key numbers and a diagram of the materials flow.

Table 1 Key numbers of circular economy in Italy in 2023 in comparison to EU

Indicator	Italy	EU average
Overall recycling percentage (%)	52	58
Circular use of material rate (%)	18,7	11,5
PIL in relation to every kg of consumed resources (%)	3,7	2,5
Per capita use consumption of materials (t)	12,8	14,9

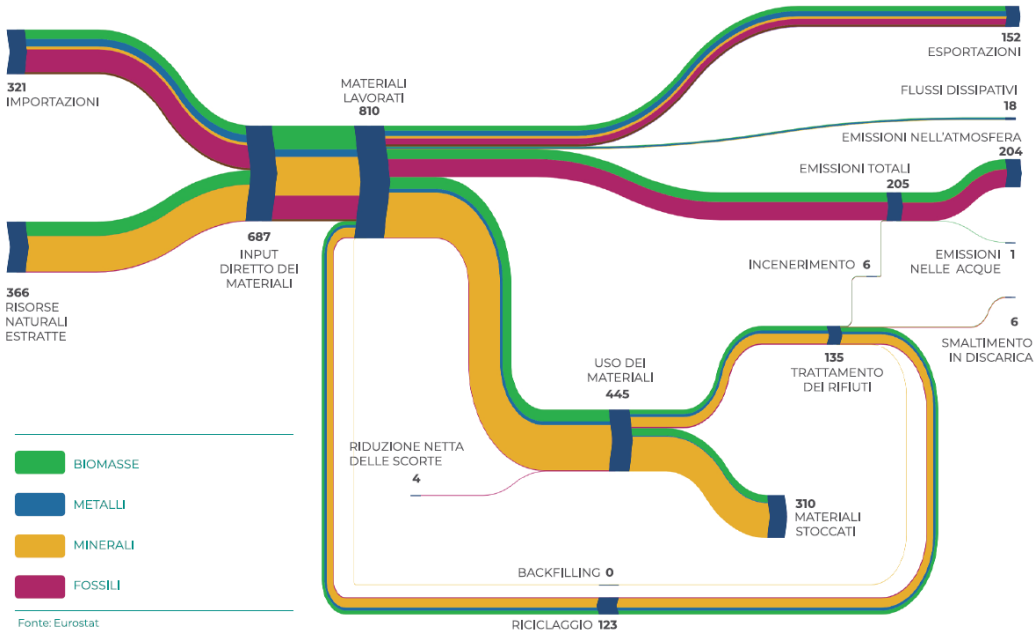

Figure 1 Flow diagram of materials in Italy in 2022 (Eurostat)

According to the latest data**, Italy has increased its municipal waste recycling rate from 37.6% to 49.2% over a decade** and is part of the group of 9 countries in line with European targets[a]. Even more positive data, both for the EU27 and especially for Italy, relate to the recycling rate of all waste, both special and municipal. The indicator shows a constant growth in our country, with an increase of 8 percentage points and a recycling rate of 72% for all waste, special and municipal, in 2020.

Also highly positive is the recycling rate of packaging which, in comparison at the European level, shows Italy achieving the best performance, with an overall packaging recycling rate of 71.7% compared to the EU average of 64%.

Finally, the issue of waste management must consider the WEEE (Waste Electrical and Electronic Equipment) sector, whose quantity is steadily increasing. The recycling of electronic and electrical waste allows for the recovery of various precious metals, including critical raw materials. Despite the high recycling rates of collected WEEE, the WEEE collection rate, compared to the average placed on the market in the preceding three years, remains very low relative to the EU target set at 65% since

[a] La normativa europea ha fissato specifici obiettivi per la preparazione per il riutilizzo e il riciclo dei rifiuti urbani (55% entro il 2025, 60% entro il 2030 e 65% entro il 2035) ed alcuni tra gli Stati membri sono vicini a raggiungere - o addirittura già hanno raggiunto - tali target. (Early Warning Report, European Commission, 2023)

2019. In Italy, the WEEE collection rate in 2021 was only 33.8%, significantly lower than the EU average, which is also low and far from the target but still at 46.2%.

Recycling rate of municipal waste[b]

The trend in the municipal waste recycling rate in Italy over the last available five-year period has grown by 3.4 percentage points. According to ISPRA[c] data, the recycling rate in 2022 stood at 49.2%, which is essentially in line with the target set by the Waste Framework Directive for 2020 (50%) and which must be increased to meet the further targets established by Directive 2018/851/EU.

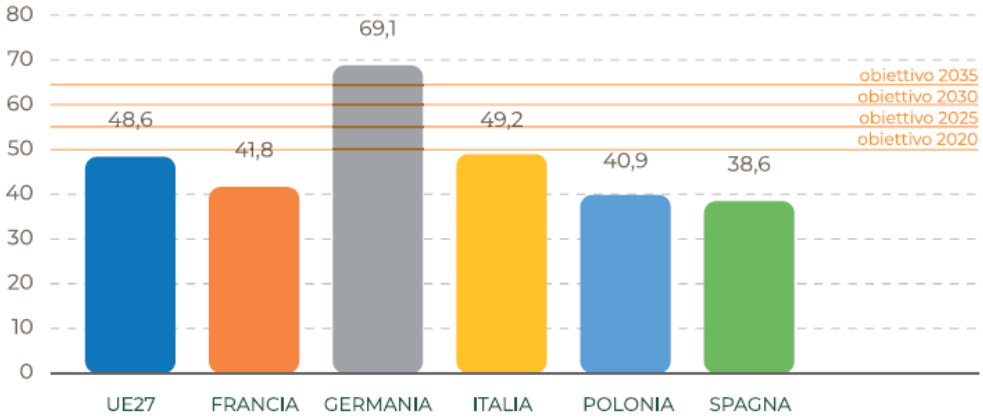

Figure 2 Recycling rate of municipal waste in five major EU countries in 2022 (in %) (Eurostat)

Rate of urban waste recycling[d]

Examining the five main countries of the European Union, Italy, with a 72% recycling rate, firmly remains at the top, while the other countries record performances below the EU average (58%).

[b] The indicator measures the proportion of urban waste recycled out of total urban waste production. Recycling includes material recycling, composting, and anaerobic digestion.

[c] For monitoring the indicator related to urban waste recycling, since last year ISPRA has been applying the new criteria established by Directive 2018/851/EU and the related implementing decision 2019/1004/EU. The new methodologies for accounting are more stringent for the new targets and have been designed to ensure that the calculated percentages are truly representative of the actual recycling capacity.

[d] The indicator measures the proportion of recycled waste (excluding landfill, energy recovery operations, and the category of inert waste) compared to the total quantity of waste treated. The recycling percentage allows monitoring the amount of material reintroduced into the economy derived from waste generated by households and businesses. The indicator covers both hazardous and non-hazardous waste.

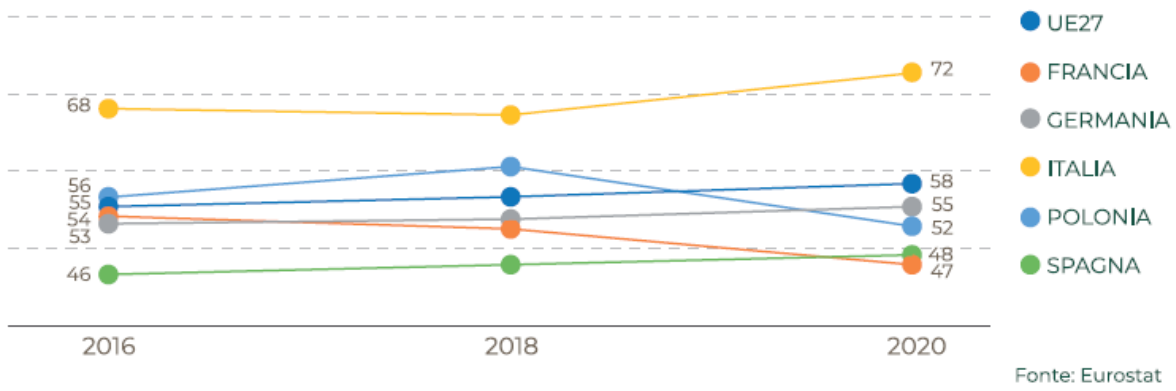

Figure 3 Waste recycling rate in the five major EU countries in the period 2016-2020 (in %) (Eurostat)

Recycling Rate of Specific Waste

- **Paper and cardboard, glass, steel, and wood**

Considering the Eurostat data for 2021, the latest available year, a diverse picture emerges. Italy is currently in an advanced stage of the journey towards achieving the European Union's packaging waste recycling targets, having already reached the 2025 targets in all five examined sectors. Particularly commendable are the results achieved in the recycling of glass, aluminium, and wood packaging waste, where the minimum recycling rate set as a target for 2030 has already been exceeded. The paper and cardboard packaging sectors are also very close to this target. Finally, regarding the recycling of steel packaging waste, our country records a recycling rate that surpasses the 2025 target.

- **Total packaging waste recycling rate**

Italy, which in 2017 recorded a figure below the European average, reached a recycling rate of 71.7% in 2021, almost 8 percentage points higher than the EU27 average (64%). In 2021, Italy achieved the highest recycling rate for all packaging waste among the five main European countries.

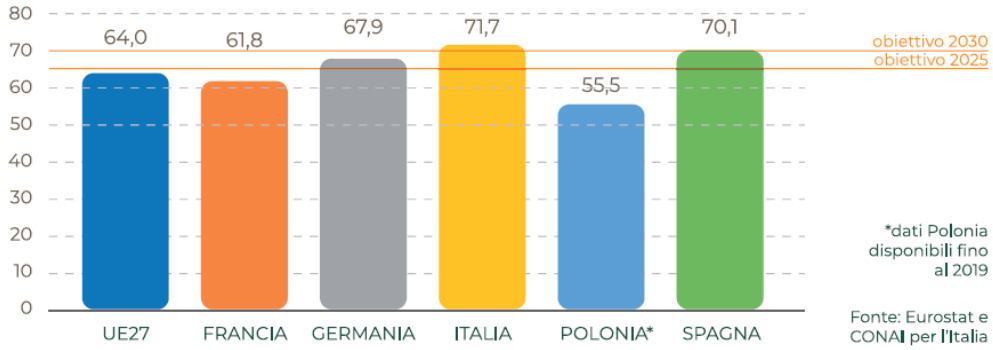

Figure 4 Packaging waste recycling rate in the five major EU countries in 2021 (in %)

- **Recycling rate of plastic packaging waste**

The European Union has set two minimum recycling targets for plastic packaging waste: 50% by 2025 and 55% by 2030. Over the past five years, Italy has achieved a 6-percentage point increase, raising its recycling rate from 41.8% in 2017 to 47.6% in 2021. Comparing the five main European countries, only Spain achieves a better result (56.4%). In third place is Germany with 48.4 percentage points. Poland (31.5% in 2019, the latest available year) and France (23.1%) report figures below the EU average and the lowest results among the countries examined here.

Recycling rate of WEEE collected separately [e]

The recycling of Waste from Electrical and Electronic Equipment (WEEE) has gained increasing prominence in recent years, not only due to the significant increase in the quantity of goods - such as cell phones, tablets, televisions, computers, and various other appliances - entering the market and reaching the end of their life cycle, but also because WEEE contains valuable and non-valuable materials, as well as critical raw materials, the sourcing of which is becoming increasingly complex and costly. It should be noted that the WEEE collection rate compared to the average placed on the market in the preceding three years remains very low relative to the EU target set at 65% by 2019. In fact, for Italy, this figure stood at 33.8% in 2021, while the EU27 average is 46.2%.

[e] The calculation of the recycling rate of WEEE collected separately is measured based on the percentage of WEEE, by weight, sent for recycling/preparation for reuse compared to the total WEEE, also calculated by weight, collected separately.

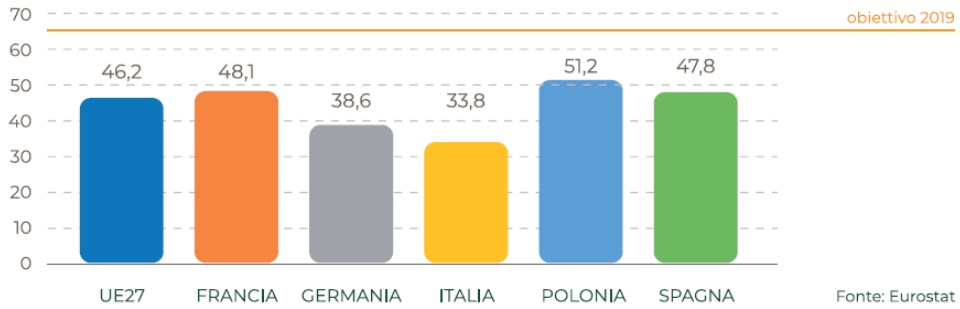

Figure 5 Rate of collection of RAEE waste with respect to the average consumption in the previous three-year period in the major five EU countries in 2021 (Eurostat)

Eurostat data shows that in 2021, Italy achieved a WEEE recycling rate of 87.1%, a slight decline of about two percentage points compared to the 2017 figure. This decrease is attributed to the disappointing performance during the 2017-2019 period, largely offset by the results achieved in the 2019-2021 period, which showed an increasing trend. In a European comparison, Italy's figure remains one of the highest, surpassing the EU27 average. Also, compared to the five main European countries, Italy regains the top position after the decline in the previous years.

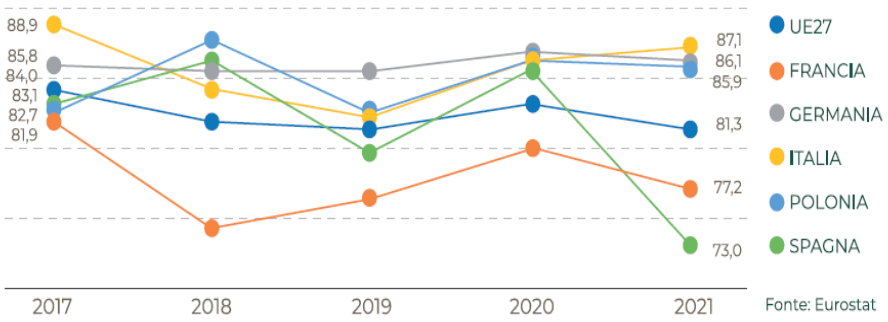

Figure 6 Recycling rate of RAEE waste subject to separate collection in the period 2017-2021 (in %) (Eurostat)

According to the dossier ***Comuni Ricicloni 2024***, in Italy in 2023 there will be 698 Waste Free Municipalities (i.e., those that contain the per capita production of undifferentiated waste sent for disposal below 75 kg/inhabitant/year) (69 more than in 2022, corresponding to about 11%), a not insignificant increase if compared to the data collected in the last 3 years, characterised by substantial stagnation. As a result, the percentage of waste-free citizens in relation to the total Italian population, which rose from 6% to 6.9%, also increased compared to the previous year, amounting in absolute terms to 539,590 more inhabitants served by an efficient waste management service. However, the incidence of Waste Free municipalities is in contrast to the number of inhabitants; in fact, the category of medium-sized municipalities (those with a population between 5,000 and 15,000

inhabitants) contributes 40%, those with more than 15,000 inhabitants 29%, and small municipalities 23%, with the capitals accounting for the remaining 8%. These figures show how crucial it is to invest even more in the most urbanised areas, where a large part of urban waste production is concentrated.

Table 2 Waste free municipalities according to territorial affiliation (years 2021, 2022, 2023, 2024)

Waste free municipalities according to territorial affiliation	2021	2022	2023	2024
North	423	391	423	434
Centre	38	32	30	33
South	162	167	167	231
Total	**623**	**590**	**629**	**698**

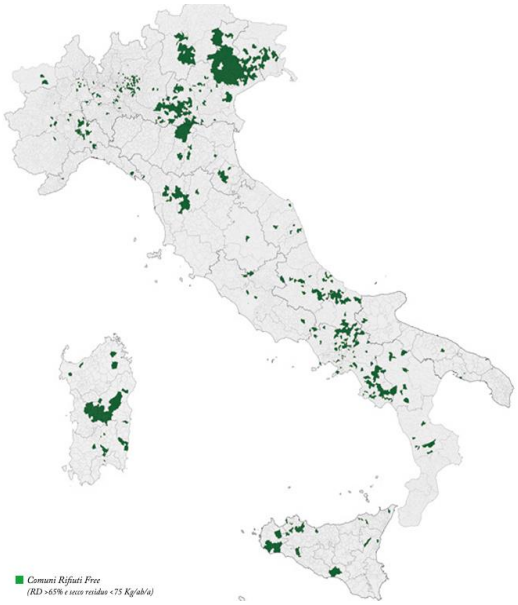

Figure 7 Map of waste-free municipalities in Italy in 2023

2.2. Separate waste collection system in the Apulia region

With D.G.R. 15/10/2021 no. 1651 the Regional Council of the Apulia Region adopted the Plan for the management of urban waste. The planning basis comes from the principles inspired

by the European “package of measures on the circular economy” and declines it by adapting it to regional needs.

The plan, in addition to being a programming tool, allows the Regional Waste Agency “AGER” - established by regional law no. 20 of 4 August 2016 - to achieve in an optimal way the objectives and activities set out in the regional law no. 20 of 4 August 2016. The aim of the plan is to ensure the active participation of trade associations and stakeholders with the method of co-planning and the consultation of subjects with environmental expertise within the framework of the strategic environmental assessment procedure.
European and National waste management policies have focused on respecting the "hierarchy of actions", which aims to promote, in order of priority, prevention, preparation for reuse, recycling, other types of recovery and disposal. The Urban Waste Management Plan of the Apulia Region is rooted in the conviction of strengthening the effort adopted by European policies, reflecting on the term “waste” itself, which is characterized by a negative connotation and leads to rejection.[6]

2.2.1. Categories, quantity and type of separated and collected waste at regional level

The waste separation system in the Apulia region has seen significant developments in recent years, aimed at improving waste management and promoting environmental sustainability. Recently, the region signed an important agreement with CONAI (National Consortium for packaging recovery) and ANCI Apulia (Apulian referent for the National Assosiation of Italian Municipalities) to strengthen the infrastructure needed to close the waste cycle and improve the quality of waste separation. This agreement includes the introduction of innovative waste tracking systems and the promotion of pay-as-you-throw schemes, which encourage citizens to better separate their waste in order to pay less, based on the amount of waste they produce.[7] In Apulia, some municipalities stand out for the effectiveness of their waste separation systems, with eight municipalities recognized by Legambiente as "waste-free," having exceeded the 65% waste separation target and showing a very low per capita waste production rate. However, the results are still uneven across provincial capitals, with some failing to reach the same efficiency.[8]

At the same time, the Apulia region has launched an initiative to upgrade municipal waste collection centers, with funding of 13 million euros. These centers are essential for the proper disposal of waste that cannot be managed through household collection, such as

pruning waste, textiles, and bulky waste, thereby further increasing waste separation percentages[9].

The Regional Plan for urban waste management provides that all the municipalities of Apulia adopt systems of differentiated collection at least of the following fractions: organic waste, paper and cardboard packaging, metal packaging, plastic packaging, glass packaging, wood packaging and textiles. The ISPRA Institute provides data about waste production originated both from domestic users (families) and non-domestic users (restaurants, supermarkets, cinemas, shops, museums, hotels, etc.) in Apulia Region in 2022. The following table provides the detail of the composition of separated waste by categories and by provinces in Apulia Region.[4]

Table 3 Detail of the composition of the separated waste by categories in Apulia Region Provinces - 2022 (ISPRA)

Detail of the composition of the separated waste by categories in Apulia Region Provinces - 2022 (ISPRA)												
Province	**Food Waste (tons)**	**Paper (tons)**	**Plastic (tons)**	**Metals (tons)**	**Glass (tons)**	**Wood (tons)**	**Furnitur esetc. (tons)**	**Electrica l Equipme nt (tons)**	**Clothing (tons)**	**Waste from construc tion (tons)**	**Street Sweepin g to recover (tons)**	**Others (separate d waste) (tons)**
Foggia	44.175,44	16.401,74	9.397,89	1.246,677	11.904,17	3.246,03	7.466,12	987,89	1.442,10	968,98	18.095,61	1.351,58
Bari	130.382,9	73.604,93	31.730,31	3.247,422	38.379,00	13.794,53	23.975,25	4.125,52	3.937,39	6.165,77	4.953,50	6.250,25
Taranto	58.469,56	24.182,72	12.837,01	1.459,514	16.273,40	3.912,63	14.509,94	1.666,48	1.071,17	3.125,65	7.338,54	3.494,50
Brindisi	50.768,83	20.206,19	13.476,75	1.296,934	8.453,38	4.216,18	7.026,54	1.437,79	1.246,62	3.278,25	387,16	2.721,29
Lecce	99.187,74	46.857,47	24.323,69	3.834,412	28.147,52	7.343,89	9.116,06	4.385,68	1.320,25	6.140,95	5.109,07	3.191,22
Barletta-Andria-Trani	49.491,32	18.061,00	9.077,94	679,728	11.220,23	6.183,230	7.045,080	935,87	1.611,46	2.894,24	1.774,60	1.568,75

3. Secondary raw material markets

3.1. Overview of the secondary raw material markets in the Italian Republic

Regulations

The rules regarding the recovery of residues, which are then transformed into secondary raw materials (so-called "MPS") or "End of waste" materials, are currently undergoing a legal evolution shifting from the historical discipline related to the production of "secondary raw materials" to the new European-based logic of "end of waste" (namely, the "cessation of waste qualification").

- *End of Waste. SNPA Guidelines*. Guidelines No. 41/2022 provide indications for carrying out checks on recovery plants that produce materials that cease to qualify as waste (the so-called "End of Waste").

- The legislative decree 77/2021 converted into Law No. 108/2021 amended paragraph 3 of Article 184-ter and introduced in the procedure for issuing authorisation measures, as provided for in Articles 208, 209, and 211, and in Title III-bis of Part Two of Legislative Decree 152/06, "a mandatory and binding opinion of ISPRA or the regionally competent environmental protection agency."
- Additionally, Law No. 128 of 2 November 2019, published in GU No. 257 on 2/11/19, converting Legislative Decree 3 September 2019, No. 101 (urgent provisions for labor protection and the resolution of company crises), introduced a system of controls on plants carrying out waste recovery operations resulting in authorized end-of-waste on a case-by-case basis, with competence entrusted to SNPA. It represents the revision of the "Guidelines for the application of the End of Waste discipline referred to in Article 184-ter paragraph 3 ter of Legislative Decree 152/2006" published in February 2020 and aims to ensure harmonization, effectiveness, and consistency of the System's action throughout the national territory.
- Decree 22 September 2020, No. 188 *Regulation governing the cessation of waste status for paper and cardboard, under Article 184-ter, paragraph 2, of Legislative Decree 3 April 2006, No. 152*
- Decree 27 September 2022, No. 152 *Regulation governing the cessation of waste status for construction and demolition inert waste and other inert mineral waste, under Article 184-ter, paragraph 2, of Legislative Decree 3 April 2006, No. 152*

In Italy, Secondary Raw Materials (SRM) are expressly excluded from the waste regime, whether they derive from recovery activities identified by specific decrees (DM 5/2/1998, DM 161/2002, DM 269/2005) or whether they are identified through ordinary authorisation procedures. Also excluded from the waste regime are SRMs that are already such without the need for treatment (so-called SRMs at the source, as per Circular 28 June 1999 no. 3402/V/MIN, known as the Ronchi Circular) up to 25 June 2011 (i.e., within six months from the entry into force of Legislative Decree no. 205/2010).
This is what the new paragraph 3 of article 184 ter provides regarding SRMs, or in the absence of community criteria, case by case for specific types of waste (paragraph 2 of article 184 ter). Therefore, a preliminary conclusion can be drawn. The national simplified procedures for SRMs can be updated both to take into account the community criteria for EOW and to simply adapt the simplified recovery procedures.
With reference to this last aspect, it is worth noting that Article 24 of Directive 98/2008 provides for the possibility of an exemption from the authorization requirement for entities and companies for the disposal of their non-hazardous waste at production sites and for waste recovery operations (both their own and third parties).

It is important to highlight that Italian SRMs are nothing but, in advance, an "end of waste" system. In fact, according to the procedures in place in Italy, a waste subjected to recovery activities becomes

a secondary raw material for use in a specific industrial activity excluded from the waste regime. According to paragraph 1 of article 184 TER, waste ceases to be such when it has undergone a recovery operation, including recycling and preparation for reuse, and meets specific criteria, to be adopted in compliance with the following conditions:
a) the substance or object is commonly used for specific purposes; b) there is a market or demand for such substance or object; c) the substance or object meets the technical requirements for specific purposes and complies with existing regulations and standards applicable to products; d) the use of the substance or object will not lead to overall negative impacts on the environment or human health. Regarding condition 2, it is noted that the absence of economic value or triviality is certainly different from the existence of a market or demand.

When the Ronchi Circular was no longer officially in force, many Secondary Raw Materials (SRMs) "transitioned" into the by-product regime (referred to with the section dedicated to it). It is only worth bearing in mind the definition (also new) of by-product as introduced by article 12 with a new article 184 bis.
It stipulates that a by-product, and not waste as defined in article 183, paragraph 1, letter a), is any substance or object that meets all of the following conditions:

- the substance or object originates from a production process, of which it is an integral part, and whose primary purpose is not the production of that substance or object;
- it is certain that the substance or object will be used, in the course of the same or a subsequent production or utilization process, by the producer or third parties;
- the substance or object can be used directly without any further treatment other than normal industrial practice;
- further use is legal, meaning the substance or object meets, for the specific use, all relevant requirements concerning products and the protection of health and the environment and will not lead to overall negative impacts on the environment or human health.

According to the ***Circular Economy Report 2024***, in 2022 recycled materials only satisfied 11.5% of the overall materials demand in the EU27. In Italy, this figure stood at 18.7%, making the country achieve one of the best performances in Europe. However, for a significant number of materials, including many essential raw materials, the contribution of recycled materials to meeting the demand for raw materials is still not sufficient. For instance, for some rare earth metals, the end-of-life material recycling rate is around 1%, although it reaches 16% for nickel and 22% for cobalt.
Gli scambi di materie prime seconde (MPS) sia all'interno dell'UE sia con i paesi terzi sono in aumento. Nel 2021, l'UE27 è stata nel complesso un importatore netto di materie prime seconde: 41 milioni di tonnellate importate contro le 38 esportate.
The trade of Secondary Raw Materials (SRMs) both within the EU and with third countries is

increasing. In 2021, the EU27 overall was a net importer of secondary raw materials: 41 million tonnes imported compared to 38 million tonnes exported.

The contribution of recycled materials to meeting the demand for raw materials is represented by the **Circular Material Use (CMU)** rate, defined as the ratio of the use of secondary raw materials generated through recycling to the total material consumption[f].
Italy, which has historically shown among the best performances in this indicator, confirmed its position in 2022 compared to 2018, albeit with a declining trend compared to subsequent years, with recycled secondary raw materials accounting for 18.7% of the total raw materials consumed. However, this indicator value has remained largely static in our country over the last five years, dropping by 0.1 percentage point compared to what was observed in 2018.

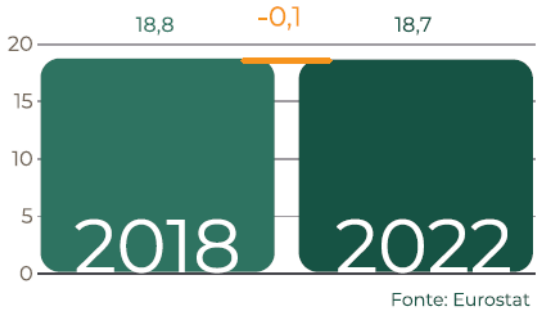

Figure 8 Circular use rate of material in Italy (2018-2022) (in %) (Eurostat)

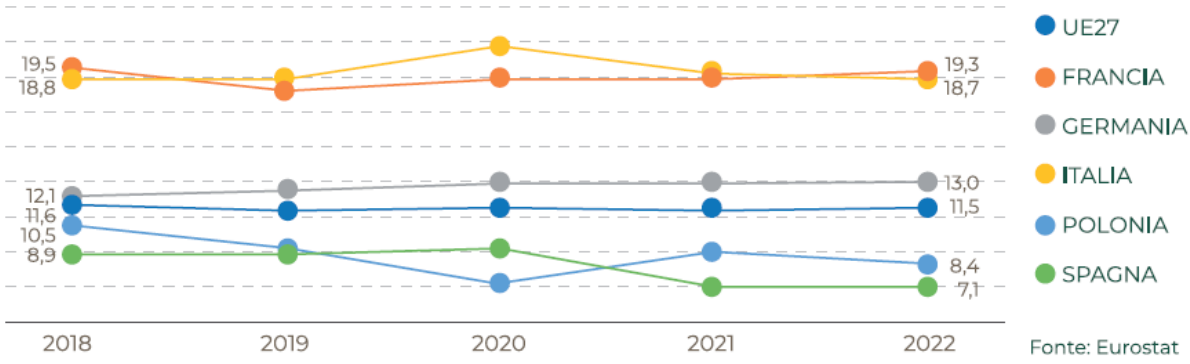

Figure 9 Circular use rate of materials in the five major EU countries (2018-2022) (in %) (Eurostat)

[f] The overall material usage is measured by adding the Domestic Material Consumption (DMC) and the Circular Material Use (U), representing the total quantity of material directly consumed at the national level as the sum of virgin raw materials extracted and recycled secondary raw materials reintroduced into production cycles. Circular Material Use (U) is determined by the quantity of waste recycled in recovery facilities within the national territory, minus imported waste destined for recycling, plus the quantity of waste exported for recycling abroad.

Trade of Secondary Raw Materials

In Italy, according to Eurostat[g] data, over the last five years, imports of secondary raw materials have grown by 6%, reaching 4 million tonnes in 2021. The most imported materials in Italy are organic and metallic types (iron and steel).

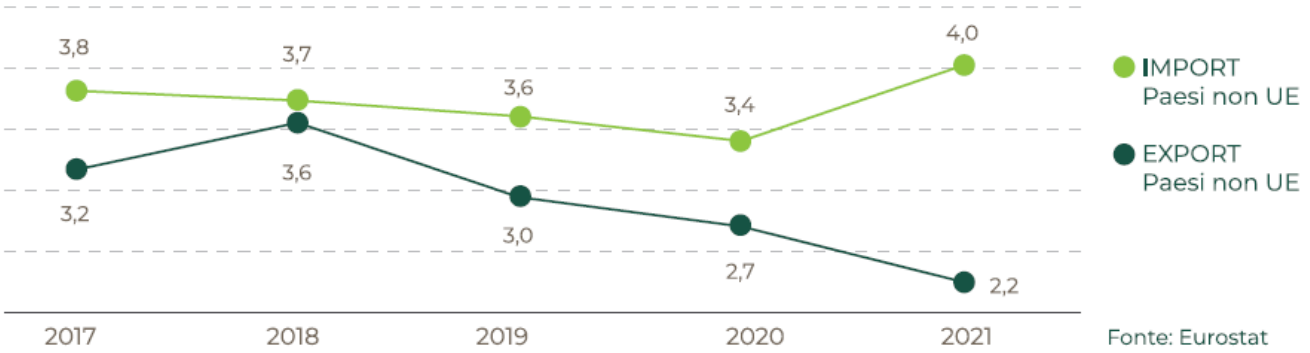

Figure 10 Import and export of Secondary Raw Material from and to outside-EU countries in Italy in the period 2017-2021 (in Mt) (Eurostat)

Conversely, exports to non-EU countries have declined since 2017 (with the exception of 2018), decreasing by approximately 30 percentage points in 2021 (2.2 million tonnes). Paper and cardboard materials are the most traded outside the EU, with their main destination being India and some countries in Southeast Asia.

[g] Statistics from the International Trade in Goods Statistics (ITGS), published by Eurostat

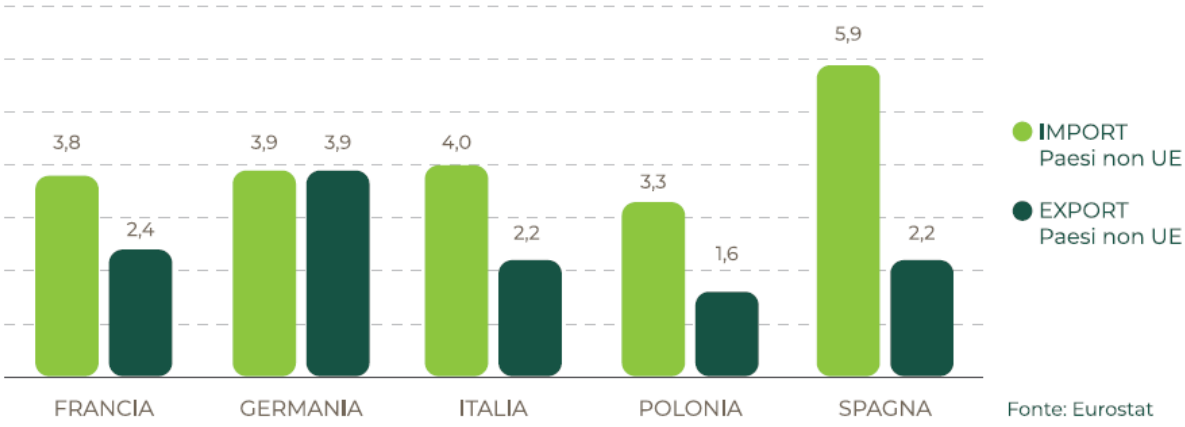

Figure 11 Trade of Secondary Raw Materials in the five major EU Countries in 2021 (in Mt) (Eurostat)

Intra-EU Trade of Secondary Raw Materials

Intra-EU imports of Secondary Raw Materials (SRMs) provide a good approximation of the market for these materials within the European Union. In the EU27, the exchange of secondary raw materials, calculated as imports between member countries, stood at around 92 million tonnes in 2021, an 8% growth compared to 2017. Italy's trend has shown a greater growth over the last five years compared to the EU27 average, increasing by over 10% to reach a value of 8.3 million tonnes of SRMs imported from EU countries. Particularly significant for Italy is the import of ferrous scrap (5.3 million tonnes): in fact, our country is the European leader in electric arc furnace steel production, contributing to over 30% of the EU's electrosteel production.

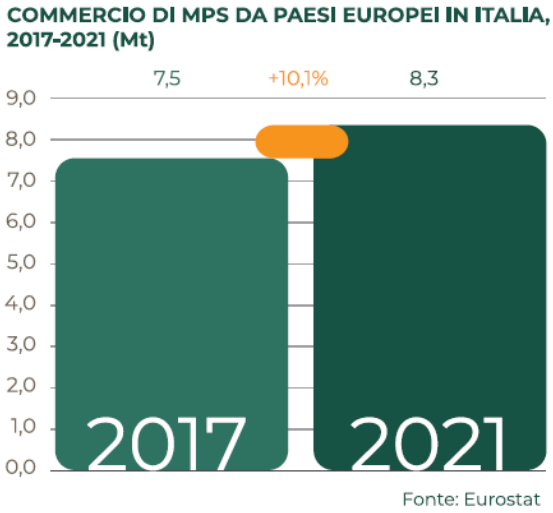

Figure 12 Trade of Secondary Raw Materials from EU countries in Italy in the period from 2017-2021 (in Mt) (Eurostat)

3.2. Secondary raw material system in the Apulia region

Differentiated waste sorting activities are only one of the multiple links in the recovery chains. All the chain's steps are closely interconnected and interdependent, each of them entailing costs and revenues so much that it is often more correct to assess the economic balance of the entire chain, rather than individual operations. The flow chart in Figure 1 below provides an idea of the factors that can affect the economic balance of a chain. Many of these factors also play a key role in the economic performance of the sorting plants.

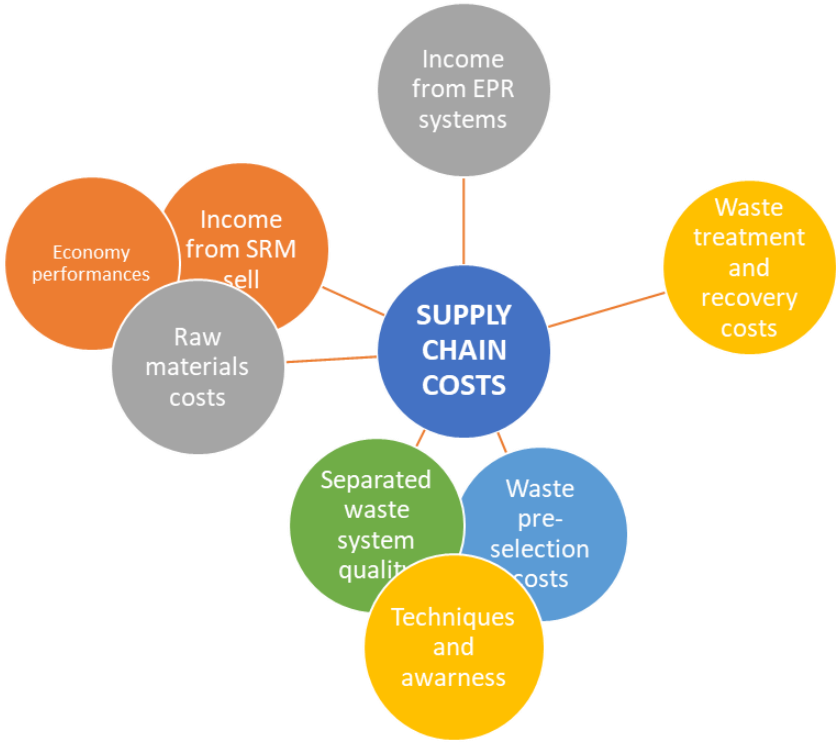

Figure 13 Main parameters affecting the cost/income supply chain in a waste recovery process

The management of secondary raw materials derived from waste in Apulia region is aligned with advanced principles of the circular economy, aiming to maximize resource efficiency and minimize environmental impact. The region's approach is outlined in several key documents, including the Special Waste Management Plan of the Apulia Region, which provides the framework for transforming waste into secondary raw materials.[11]

Key Aspects of the System:

1. Resource Recovery: Apulia has implemented strategies to recover valuable materials from waste streams, particularly from sectors such as electronics (WEEE), plastics, and organic waste. The region's facilities are equipped to handle complex waste types, extracting materials like precious metals, critical raw materials (e.g., cobalt, lithium), and high-quality polymers. These materials are then reintegrated into production cycles, reducing the need for virgin raw materials.

2. Technological Innovation: The region emphasizes the use of advanced technologies for waste processing. For example, hydrometallurgical processes are employed to recover metals from electronic waste, achieving high purity levels. This is particularly relevant given the increasing demand for metals like lithium and cobalt, driven by the growth of renewable energy and electric vehicles.[5]
3. Circular Economy Integration: The Apulia region's waste management policies are deeply integrated with circular economy principles. This involves not only recycling but also designing products and processes to minimize waste generation from the outset. The focus is on creating closed-loop systems where waste materials are continuously cycled back into production, reducing the environmental footprint and reliance on non-renewable resources.[1]
4. Sludge Management: A specific focus is placed on the management of sludge from wastewater treatment plants. The region has developed strategies to reuse this sludge, particularly in agriculture, thus converting waste into a resource. This aligns with the broader goals of reducing waste disposal in landfills and promoting sustainable practices in key regional industries.
5. Regulatory and Policy Framework: Apulia's system is supported by a strong regulatory framework that aligns with both national and EU directives on waste management and resource recovery. The region's policies encourage innovation and the adoption of best practices across all sectors involved in waste generation and processing.[1]

3.2.1. Recycling facilities (Apulia Region)

In the Apulia region, the infrastructure for recycling and processing waste has developed significantly to align with the broader goals of a circular economy and sustainable waste management. The region hosts a variety of advanced facilities that cater to different waste streams, including organic waste, recyclable materials, and special waste types like sludge from wastewater treatment.[10]

1. Organic Waste Treatment Facilities

Apulia has invested in facilities specifically designed to handle the Food Waste, which refers to the organic fraction of municipal solid waste. These facilities employ anaerobic digestion technology, a process in which organic waste is broken down by microorganisms in the absence of oxygen, producing biogas. This biogas can be converted into thermal or electrical energy, or further refined into biomethane, which is a renewable substitute for natural gas.

The region is actively expanding these anaerobic digestion facilities to both manage organic waste more effectively and contribute to renewable energy production. This approach is seen as essential in reducing the environmental impact of waste and supporting energy self-sufficiency.[10]

2. Material Recovery Facilities (MRF)

The Material Recovery Facilities (MRFs) in Apulia are crucial for the separation and processing of dry recyclable materials. These facilities use a combination of mechanical and manual sorting techniques to extract valuable materials such as plastics, metals, paper, and glass from the mixed waste stream. The recovered materials are then cleaned, sorted, and prepared for sale as secondary raw materials to manufacturers. Apulia has focused on upgrading these facilities to increase the efficiency and purity of the recovered materials, which is essential for maintaining the economic viability of recycling operations and ensuring that the materials meet market standards for reuse.

3. Waste-to-Energy Plants

Although waste-to-energy (WtE) plants are less prominent in Apulia compared to other waste management options, they play a role in dealing with non-recyclable waste. These plants incinerate waste to generate energy, which can be used to produce electricity or heat. The process also reduces the volume of waste, thus decreasing the need for landfill space. However, the expansion of WtE plants in Apulia is approached with caution due to concerns about air quality and potential health impacts, especially in regions already burdened by industrial pollution.

4. Sludge Treatment Facilities

A significant development in Apulia's waste management strategy is the inclusion of sludge treatment facilities that process sludge from wastewater treatment plants. These facilities have been authorized to recover and repurpose sludge under strict regulatory controls to avoid environmental contamination. The treated sludge can be used in various applications, including as a soil amendment in agriculture, provided it meets safety and quality standards. This initiative is part of a broader effort to integrate waste streams into the circular economy by finding productive uses for materials that were previously considered waste.

Despite these advancements, Apulia faces ongoing challenges, particularly in optimizing the cost-effectiveness of its waste management system and further reducing the amount of

waste sent to landfills. The region is actively working to address these issues by encouraging the development of additional recycling and recovery facilities, improving waste separation at the source, and enhancing public awareness of the importance of waste reduction and recycling. The goal is to achieve higher recycling rates and more sustainable waste management practices across all municipalities in the region.
The region's focus on developing a robust recycling infrastructure is essential not only for environmental sustainability but also for economic resilience, as it reduces dependency on external raw materials and creates local jobs in the recycling and waste management sectors.[10]

3.2.2. Users of the secondary raw material

In Puglia, several production facilities utilize recycled raw materials as part of their regular operations, aligning with the principles of the circular economy. These users can be broadly categorized into sectors such as manufacturing, construction, energy, and agriculture.

1. Manufacturing Sector
   - Plastic Recyclers: Facilities that produce plastic products often use recycled polymers sourced from local recycling plants. These materials include PET, HDPE, and LDPE, which are recycled into new products like packaging materials, containers, and other plastic goods. Companies in Puglia engage in closed-loop recycling, where waste plastic is reprocessed and reincorporated into production lines.
   - Metal Processors: Metal recycling facilities in Puglia recover ferrous and non-ferrous metals from waste, which are then supplied to manufacturing companies for use in producing new metal products. This sector includes companies that produce automotive parts, construction materials, and machinery.
2. Construction Industry
   - Construction Material Manufacturers: Companies in the construction industry utilize recycled aggregates from demolition waste, glass, and other inert materials in the production of new building materials, such as concrete and asphalt. This approach reduces the demand for virgin raw materials and lowers the environmental footprint of construction projects.
   - Green Building Materials: Some facilities in Puglia focus on producing eco-friendly building materials, including bricks and tiles made from recycled materials. These products are used in sustainable construction projects across the region.

3. Energy Sector
   - Biogas Plants: As part of the region's waste-to-energy initiatives, biogas plants use organic waste and sludge from wastewater treatment facilities to produce biogas. This biogas is either converted into electricity or purified into biomethane, which is used as a renewable energy source. The residual digestate from this process is sometimes used as a fertilizer in agriculture, closing the loop in organic waste management.

4. Agriculture
   - Organic Fertilizer Producers: Agricultural facilities in Puglia increasingly use organic compost derived from the processing of organic waste (FORSU) and treated sludge. These recycled materials are used to enhance soil fertility, contributing to sustainable agricultural practices in the region.
   - Sludge Utilization: Treated sludge from wastewater facilities, which meets strict safety and environmental regulations, is used as a soil conditioner or fertilizer, particularly in large-scale farming operations.

These production facilities not only help in reducing the environmental impact of waste but also contribute to the region's economic sustainability by creating new markets for recycled materials. The use of recycled raw materials is a growing trend in Apulia, supported by regional policies and investments aimed at enhancing the circular economy. The integration of these materials into production processes is essential for reducing dependency on virgin resources, lowering production costs, and minimizing waste sent to landfills.[10]

4. Measures and initiatives for the development and improvement of secondary raw material markets

The Apulia region has undertaken several initiatives aimed at developing or improving the market for secondary raw materials, focusing on enhancing recycling, promoting the circular economy, and supporting industrial innovation. Below is a list of some key initiatives:

1. Regional Plan for Waste Management
   - Objective: This comprehensive plan outlines the region's strategies for managing different types of waste, including promoting the use of secondary raw materials. The plan emphasizes reducing landfill use, increasing recycling rates, and developing markets for recycled materials.

- Initiatives: It includes investments in waste processing infrastructure, such as facilities for organic waste (FORSU) and material recovery facilities (MRFs), which are crucial for producing high-quality secondary raw materials.

2. Public-Private Partnerships
   - Objective: To foster collaboration between public authorities and private companies in developing recycling and material recovery facilities.
   - Initiatives: The region supports initiatives that bring together public and private entities to invest in recycling plants, particularly those focusing on high-value materials such as plastics, metals, and electronic waste (WEEE). These partnerships are designed to stimulate the market for recycled materials by ensuring a steady supply and demand chain.
3. Investment in Biogas and Biomethane Facilities
   - Objective: To convert organic waste into energy, thereby reducing waste and producing renewable energy sources.
   - Initiatives: The region is expanding its network of biogas plants that process organic waste into biogas, which is then used to generate electricity or refined into biomethane. This process creates secondary products, such as digestate, which can be used as a fertilizer in agriculture, promoting a circular approach to waste management.
4. Development of Green Procurement Policies
   - Objective: To encourage the use of products made from recycled materials in public procurement processes.
   - Initiatives: Apulia has been working on integrating green procurement policies that mandate the use of recycled materials in public infrastructure projects. This includes the use of recycled aggregates in construction and promoting the use of recycled content in products purchased by public institutions.
5. Support for Innovation in Recycling Technologies
   - Objective: To enhance the efficiency and effectiveness of recycling processes and the quality of secondary raw materials.
   - Initiatives: The region provides financial and technical support for research and development in new recycling technologies. This includes grants for startups and established companies that are innovating in areas such as plastic recycling, electronic waste processing, and the recovery of critical raw materials.
6. Educational and Awareness Campaigns

- Objective: To increase public and industrial awareness of the importance of secondary raw materials and encourage their use.
- Initiatives: The region has launched several campaigns to educate businesses and the general public about the benefits of using recycled materials. These campaigns also aim to improve waste separation at the source, which is crucial for producing high-quality secondary raw materials.

These initiatives reflect Apulia's commitment to fostering a robust market for secondary raw materials, contributing to both environmental sustainability and economic growth in the region.[10]

5. Conclusion

The secondary raw material (SRM) market in the Apulia region is an essential component of the region's circular economy, enabling the recovery and reuse of materials that would otherwise be wasted. The market for SRMs operates by reintegrating recycled materials into the production cycle, reducing the reliance on primary resources. However, the SRM market in Apulia faces both supply- and demand-side challenges that affect its functionality.

On the supply side, one of the key issues is the lack of consistent quality and availability of SRMs, which makes it difficult for industries to integrate these materials into their processes. In Apulia, as in other regions, technical specifications and the harmonization of "end-of-waste" criteria are needed to boost confidence in using recycled materials. The region has numerous recycling facilities, but there is a need for better coordination and standardization to ensure that SRMs meet industry standards consistently. This includes the recycling of materials such as paper, glass, wood, and biowaste, sectors where the circular economy has seen progress.

On the demand side, industries in sectors like construction, manufacturing, and agriculture are increasingly interested in incorporating SRMs into their production cycles. However, there is still a reluctance to invest in newer technologies that would allow for greater integration of recycled materials. This is exacerbated by uncertainties regarding the consistent supply of high-quality SRMs and economic drivers that do not always favor the use of recycled over primary materials.

To address these challenges, policies supporting market transparency, improving product design for recyclability, and introducing economic incentives (e.g., eco-modulated tariffs) are being considered both at the regional and EU levels. These measures aim to increase both

supply and demand, promoting a more efficient and competitive SRM market in the Apulia region.
The SRM market in Apulia, like elsewhere in Europe, is still evolving and can benefit from more robust governance structures, better market information, and increased confidence from industries to fully integrate SRMs into their processes.

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INTERREG ITALY-CROATIA
PROGRAMME 2021 – 2027

AWASTER – Adopting WASTE as Resource

D.1.1.3 Regional secondary market report – Dubrovnik-Neretva County

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INTERREG ITALY-CROATIA PROGRAMME 2021 – 2027
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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 Secondary Market Report – Dubrovnik-Neretva County" aims to provide a comprehensive overview of the current state and development of secondary raw material markets within the Dubrovnik-Neretva County. This report covers the framework and implementation of separate waste collection systems, assesses existing recycling facilities, and evaluates the effectiveness of local initiatives. Additionally, it explores potential measures for enhancing the secondary raw material market, with an emphasis on aligning local practices with national and EU waste management directives. The ultimate goal is to propose actionable strategies to improve recycling rates and reduce landfill dependency, contributing to a more sustainable regional waste management system.

The report begins with an introduction to the legislative context, highlighting Croatia's alignment with EU directives through the Waste Management Act (NN 84/2021). It outlines the national targets for recycling municipal waste, reducing landfill waste, and increasing biowaste treatment by 2035. The separate waste collection system's implementation in Dubrovnik-Neretva County is detailed, showing a significant increase in the use of advanced collection systems due to initiatives such as the national Fund for Environmental Protection and Energy Efficiency's distribution of waste collection bins.

Key sections of the report discuss the status of secondary raw material markets in Croatia, focusing on regional recycling facilities and their integration into local waste management systems. Notable examples include DS Smith Belišće factory and Kronospan's wood recycling facility. The report also covers local initiatives like the Dubrovnik Plastic Free Initiative, which significantly reduced plastic waste and increased public awareness.

The report identifies gaps in the market for secondary resources and suggests that future improvements could be driven by the national waste management plan, which is expected to introduce project funding to enhance recycling capacities

2. Separate waste collection system

2.1. Separate waste collection system in Republic of Croatia (national level)

Croatian legislation is aligned with the EU directives, and the Waste Management Act (NN 84/2021) prescribes measures to achieve the goals of the European Green Deal, particularly a 65% recycling rate for municipal waste and a reduction of waste disposal to 10% of the total amount of waste generated by 2035.

According to the Waste Management Act (2021), waste is any substance or object that the holder discards, intends to discard, or is required to discard. Waste management, therefore, is the process of conducting and directing activities to achieve set goals and relates to activities such as the collection, transportation, recovery including sorting, and disposal of waste, the supervision of these activities, as well as the monitoring and measures implemented at locations where waste has been disposed of. (Republic of Croatia, 2021)

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.

The goals of national waste management plan summarized all the obligations and goals set in primary and secondary national legislation and following table presents major waste stream goals:

Br.	Waste type	objective
1.	Municipal waste	Recover through recycling and preparation for reuse at least: • 55% of the mass of municipal waste by 2025, • 60% of the mass of municipal waste by 2030, and • 65% of the mass of municipal waste by 2035. To landfill less than 264.661 tonnes of biodegradable waste ; To landfill less than 10% of total waste mass produced by 2035;

		Increase the collection and treatment of biowaste
2.	Packaging waste	Separately collect and recover, materially or energetically, at least 60% of the total mass waste packaging produced in the territory of the Republic of Croatia. Recycle at least 70% of the mass of total waste packaging by December 31, 2030, at least the following mass of material in the recycling process: • 55% plastic • 30% wood • 80% of unpainted metals • 60% aluminum • 75% glass • 85% paper and cardboard

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

Collection of municipal solid waste in Croatia is not unified and municipalities in general have free choice to select the suitable collection system while the methodology for implementation of pay as you throw scheme is unified and prescribed by the national law. Major collection system in the inland (central and eastern Croatia) is door to door collection with very few streams collected with the street container system. On the contrast, majority of municipalities in Croatian coastal area rely on street container systems and limited application of the pay as you throw principle due to difficulties in its implementation through street container systems. Another major difference between north and south is the fact that southern part of Croatia rarely or do not collect biowaste at all and thus cannot achieve significant separated collection results. The collection in general is done with larger trucks 16-21 sqm, while some of the municipalities introduced lighter vehicles (7 sqm) in the last 10 years.

2.1.1. Categories, quantity and type of separated and collected waste at national level

Since 2011, the amounts of municipal waste generated have been continuously increasing, ranging between 1.6 million and 1.8 million tons. In 2020, as a consequence of the COVID-19 pandemic, which led to a significant reduction in the service sector (closure of hospitality establishments, a decrease in the number of tourist overnight stays), the amounts of municipal waste fell to the levels of 2014. With the increase in service sector activities (hospitality establishments, a significant increase in the number of tourist overnight stays, etc.) from 2021, the amount of municipal waste rose again, and in

2022, the total amount of municipal waste reached 1,844,382 tons, which is the highest value in the observed period from 1995 to 2022. (Ministry of Commerce and Sustainable Development, 2023) The same report also shows that total municipal solid waste originating from public service represents 1.270.429 tonnes and the rest originates from commercial activities.

Since 2010, the quantities of separately collected waste has 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 waste (35%). There is also a significant increase in the amount of separated collection for waste plastic (23%) and waste 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.

The following figure shows the amount of produced, separately collected and treated biowaste. In 2022. Croatia has produced 489.404 tonnes of municipal biowaste, out of which 118.806 tonnes (24%) was separately collected and 95.471 tonnes (19.5%) were treated by composting or anaerobic digestion.

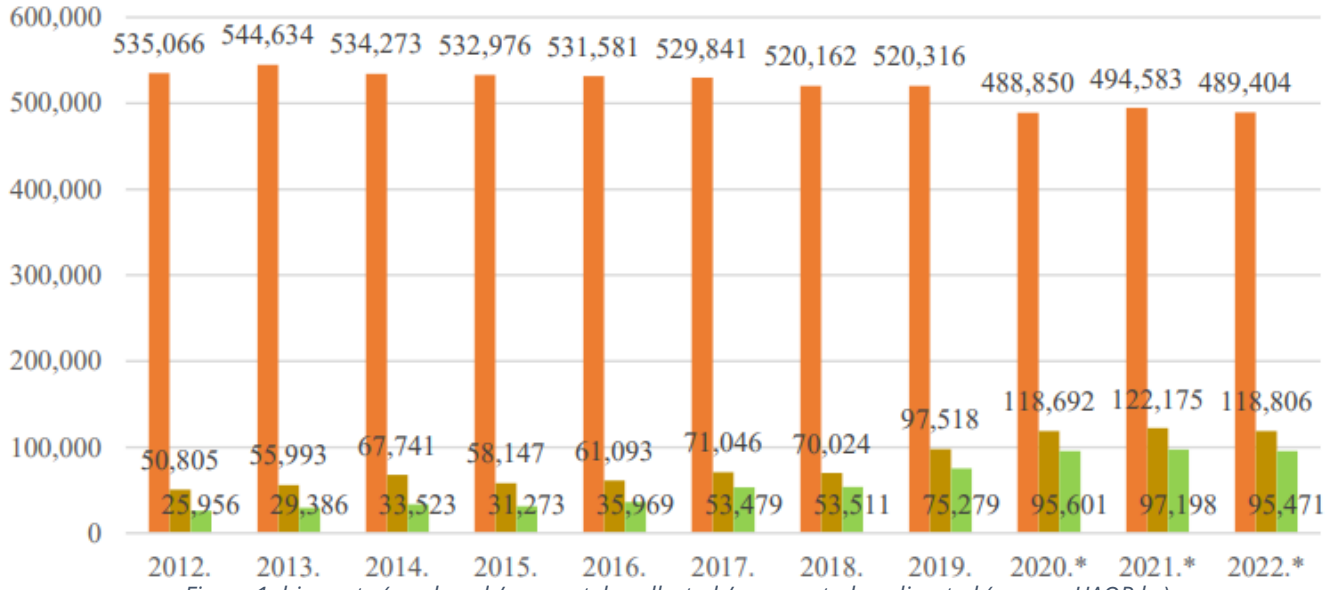

Figure 1. biowaste (produced / separately collected / composted or digested (source: HAOP.hr)

The total breakdown of separately collected waste in Republic of Croatia is shown in next figure, 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
Plastics	91.025	0,11
Glass	71.709	0,08
Wood	57.865	0,07
Metals	34.899	0,04
WEEE	29.917	0,04
Textiles	4.728	0,01
Batteries	416	0,00
Other	27.519	0,03
Total	844.387	1

Figure 2. separately collected waste in 2022 / tonne

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 plastics 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 do not exactly enter the market through the same channels as ones used by public service companies.

2.2. Separate waste collection system in the Dubrovnik-Neretva county

In 2022 the amount of municipal waste collected was 55.844,45 tonnes, out of which 48.901 t were collected from households, 6.381 tonnes from business sector (mostly mixed waste). Since by the time of creation of this report, the statistical data for 2023 for the county is still not completed, we present here the data from 2022. (Ministry of Commerce and Sustainable Development, 2023)

Total amount of waste generated as part of public service in DN County is 52.844,45 t of waste, out of which 48.901 t have been landfilled, which leaves the capacities for further landfilling for less than 3 years of operation. The total amount of separately collected waste through collection service was 3588 tonnes which is pitifully low. Since none of the cities or municipalities have reached the recycling

targets set by legislation (50% by 2020), all of them have to pay the national fee for landfilling for total of 20.759 tonnes resulting in damages in taxes worth approximately 551.038,55 EUR.

City/ Municipality	Total MSW collected / tonne	Mixed waste / tonne	Total separate collection	Collected through public service	Collected – mobile civic amenity site	Collected – stationary civic amenity site	separate collection efficiency
Orebić	2.488,90	1.570,90	918,00	918,00	0,00	0,00	37%
Lastovo	320,00	230,00	90,00	90,00	0,00	0,00	28%
Konavle	4.221,91	3.628,61	593,30	336,00	0,85	256,45	14%
Lumbarda	627,03	551,27	75,76	0,00	0,00	75,76	12%
Vela Luka	1.485,21	1.310,00	175,21	0,00	0,00	175,21	12%
Ploče	2.865,17	2.529,82	335,35	231,12	0,00	104,23	12%
Slivno	934,80	840,00	94,80	0,00	0,00	94,80	10%
Dubrovnik	19.656,39	18.237,74	1.418,65	1.148,14	141,96	128,54	7%
Blato	1.380,40	1.286,00	94,40	1,82	0,00	92,58	7%
Mljet	704,65	675,57	29,08	0,00	29,08	0,00	4%
Trpanj	418,92	406,22	12,70	12,70	0,00	0,00	3%
Dubrovačko primorje	1.025,28	998,56	26,72	0,00	0,00	26,72	3%
Smokvica	343,28	337,86	5,42	5,42	0,00	0,00	2%
Metković	4.582,83	4.522,37	60,46	50,00	0,00	10,46	1%
Opuzen	1.166,98	1.158,60	8,38	0,00	0,00	8,38	1%
Korčula	3.364,64	3.358,96	5,68	5,68	0,00	0,00	0,00
Župa dubrovačka	3.443,42	3.443,05	0,37	0,00	0,37	0,00	0,00
Janjina	420,00	420,00	0,00	0,00	0,00	0,00	0,00
Kula Norinska	201,29	201,29	0,00	0,00	0,00	0,00	0,00
Pojezerje	264,60	264,60	0,00	0,00	0,00	0,00	0,00
Ston	2.716,56	2.716,56	0,00	0,00	0,00	0,00	0,00
Zažablje	212,20	212,20	0,00	0,00	0,00	0,00	0,00
Total	**52.844,45**	**48.900,18**	**3.944,27**	**2.798,88**	**172,26**	**973,13**	**7%**

Figure 3. Separate collection per municipality in Dubrovnik-Neretva County

From statistical data, it is visible that majority of waste is still landfilled or treated with other option as 93% of collected waste is mixed municipal waste. The dominant method for collection of waste traditionally has been street container system which historically did not bring significant separate collection results- Total of 3.944.27 tonnes of waste have been separately collected leaving the County at 7% rate, which is significantly below national average and EU set targets.

2.2.1. Categories, quantity and type of separated and collected waste at regional level

Total quantities of separately collected waste from public service in Dubrovnik-Neretva county amount at 3.934,28 tonnes, which in context of market development does not represent significant mass for development of circular economy models.

Waste stream	From public service / tonnes
Biodegradable waste	80
Metal	137,69
Textile	6,84
Paper	392
Plastics	257,63
Glass	78,82
Other	2.981
Total	3934,28

Figure 4. quantities of collected MSW in 2022. (source: ROO public database compared with HAOP report)

According to the national waste report, the situation is even worse as municipal companies running the waste management systems heavily rely on landfilling – even for separately collected waste. The data from yearly statistical report shows that the majority of waste is sent to disposal options (50.388,67 tonnes or 95,42%) and only 2108,44 (4,38%) tonnes have been sent for recovery and can be viewed as marketable good. Unfortunately, the quantities are not significant for development of any market at this moment, however it is possible that the recycling potential can be increased in the future. (Ministry of Commerce and Sustainable Development, 2023)

Slightly better statistics arise when the other types of collections (EPR schemes) are added and Dubrovnik-Neretva county accounts for 23,9% of recovery, however it is still among the lowest performing counties in Croatia.

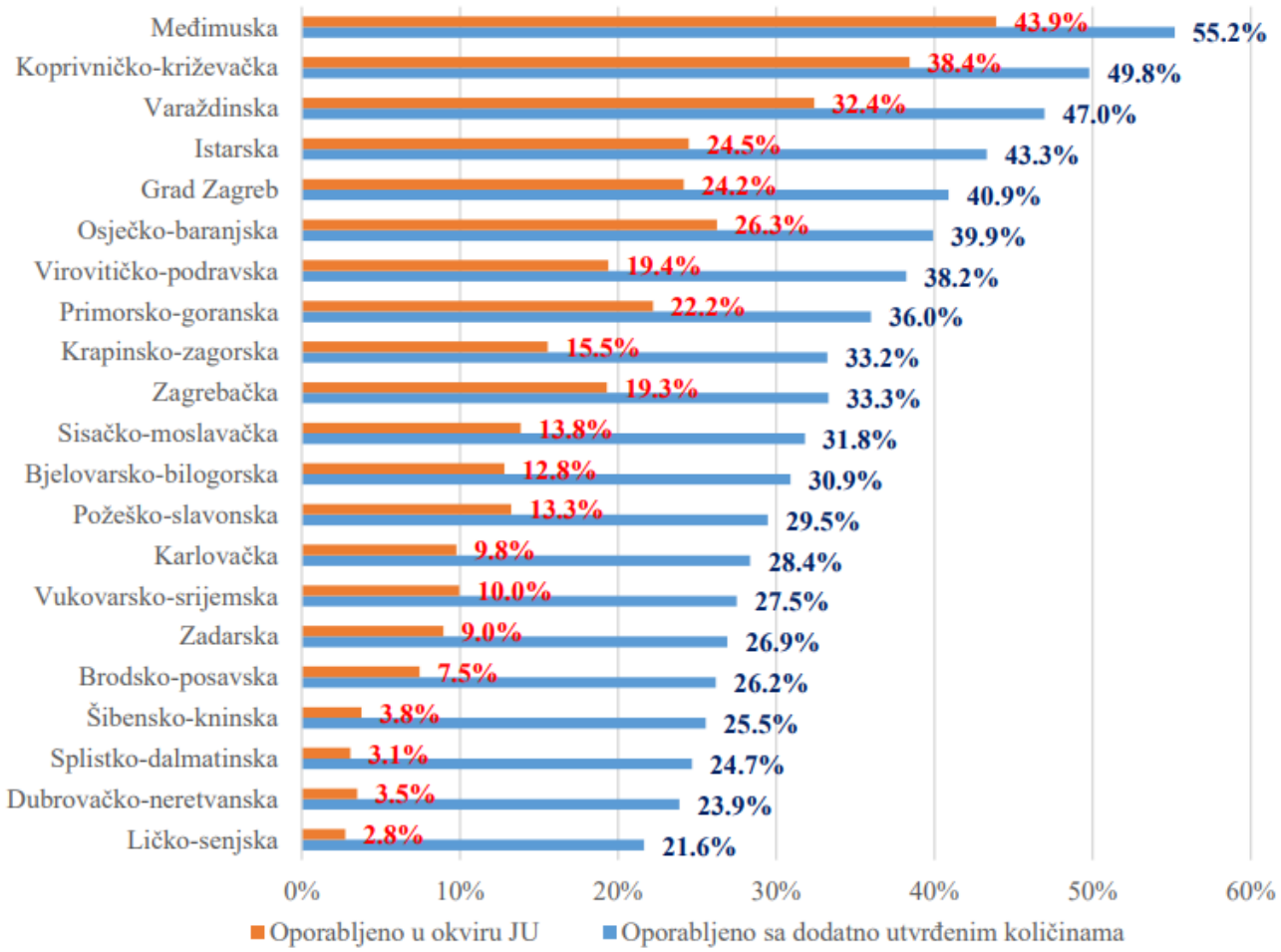

Figure 5. Conparison of recovery rate from public service with included other quantities

EWC CODE	Waste type	collected	temporary storage	landfill (D1-D7 + D12)	R2-R11 without composting	PP, R12 + R13
15 01 01	Paper and cardboard packaging	255,02	29,49		65,55	159,98
15 01 02	Plastic packaging	31,78	4,53		0	27,25
15 01 04	Metal packaging	10,73	1,41		0	9,32
15 01 05	multilayer packaging					
15 01 07	Glass packaging	30,45	3,92		17,57	8,96
15 01 10*	Packaging contaminated by hazardous substances	1,36	0,08		0	1,28
15 01 11*	Metallic packaging containing a hazardous solid porous matrix					
20 01 01	Paper and cardboard	136,94	44,74		0	92,2
20 01 02	Glass	48,37	18,11	1,96	0	27,3
20 01 08	Biodegradable kitchen and canteen waste					
20 01 10	Clothes	3,29	0,54	0,16	2,75	0
20 01 11	Textiles	3,55	1,39		2	0
20 01 13*	Solvents					
20 01 19*	Pesticides					
20 01 21*	Fluorescent tubes and other mercury-containing waste	0,01	0,01		0	0
20 01 23*	Discarded equipment containing chlorofluorocarbons	7,28	0,17		0	7,11
20 01 25	Edible oil and fat	5,38	1,69		3,16	0,47
20 01 26*	Other oil and fat	0,25	0,12		0	0,13

20 01 27*	Paint, inks, adhesives and resins containing hazardous substances	0,23	0,23		0	0
20 01 28	Paint, inks, adhesives and resins	0,37	0,37		0	0
20 01 30	Other detergents					
20 01 32	Medicines	0,03	0,01		0	0,02
20 01 33*	batteries and accumulators	0,14	0,09		0	0,05
20 01 34	other batteries and accumulators	0,86	0,29		0	0,57
20 01 35*	WEEE	125,77	1,02		10	114,75
20 01 36	other WEEE	13,59	0		0	13,59
20 01 37*	Wood containing hazardous substances					
20 01 38	Other wood	188,50	14,99		0	173,51
20 01 39	Plastics	225,85	135,31		0	84,54
20 01 40	Metals	126,96	1,91		19	106,05
20 02 01	Biodegradeable waste	80	0	80	0	0
20 03 01	Mixed municipal waste	48.901,18	10,25	48.850,29	0	0
20 03 07	Bulky waste	2.637,57	19,98	1.456,26	0	1.161,33
	Total	52.835,45	290,65	50.388,67	120,03	1.988,41

Temporary storage	**46,56**
Landfill D1 – D2	50.388,67t
R2-R11 without composting	120,03 t

Exchange of waste for submission to any of the operations numbered R 1 to R 11	1.988,41 t

3. Secondary raw material markets

3.1. Overview of the secondary raw material markets in Republic of Croatia

Secondary raw material is a material resulting from a recovery process that becomes an input in a new production. Secondary raw material (SRM) markets are crucial for a circular economy. This is because SRMs enable recyclables to re-enter the production value chain, which reduces dependency on primary resources as a result. This role is acknowledged in the EU circular economy action plan of 2020. However, if policy is to help establish or further develop such markets, we need to better understand the currently-fragmented SRM markets in the EU. (European Environment Agency, 2022)

The waste management market in Croatia is evolving, driven by EU regulations and national efforts to modernize waste handling and increase recycling rates. While significant progress has been made, challenges such as public awareness, illegal dumping, and financial constraints remain. Continued investment, education, and adherence to sustainable practices are crucial for Croatia to achieve its waste management goals and EU targets. Croatian waste market consists of following subjects, and the extensive list can be found on Croatian Ministry of Commerce website[1]:

	Type of operation	Number of active permits issued
1.	End of waste operators – produce new product from waste	135
2.	Waste transporters	1300
3.	By product producers	305 permits issued – 203 active
4.	Waste brokers	300 permits issued – 218 active
5.	Waste sellers	476 permits issued – 403 active
6.	Collectors and recovery operators – no permit required	52 permits issued – 36 active
7.	Collectors and recovery operators – permit required	89 permits issued – 75 active
8.	RE-use centres	8 pertmits – 7 active

Figure 6. waste market operators

[1] https://mingo.gov.hr/o-ministarstvu-1065/djelokrug/uprava-za-procjenu-utjecaja-na-okolis-i-odrzivo-gospodarenje-otpadom-1271/gospodarenje-otpadom/ocevidnici-7589/7589

In the field of waste management, C.I.O.S. group is the leader in the region, and in Croatia, connecting companies specialized in numerous waste recovery procedures, it is the largest group in the sector. It brings together several companies dealing with the recovery of collected waste such as CE-ZA-R, CIAL, EKO-FLOR Plus, Metis and others. Through more than forty business locations in Croatia and twenty in Bosnia and Herzegovina, it annually collects and processes more than one million and one hundred thousand tons of different types of waste. In 2022, they collected about 700,000 tons of metal waste, about 364,000 tons of non-metallic waste, 44,000 tons of scrap vehicles and 17,000 tons of electronic and electrical waste, with a consolidated business income of 389.5 million euros. (Dokonal, T., 2024,)

The company Hamburger Recycling Croatia is a part of an international group, and is focused primarily on paper and plastic. They believe that the secondary raw materials market in Croatia functions at a satisfactory level. According to CEO Jadranko Tomašević "The Croatian market is actually part of the regional, even world market, where the price of individual raw materials is adjusted to supply and demand. In the last 4-5 years, we have had extremes, which alternate, from very low prices to record highs. All this is a consequence of events at the world level. From the coronavirus, the war in Ukraine, and other disruptions in the markets".

According to DS Smith, multinational operator, „domestic collection meets less than 50 percent of the needs of the factory in Belišće. Rolls of paper, the final product of the paper mill, are delivered to domestic packaging factories in Belišće and Koprivnica, in order to provide sustainable packaging solutions on domestic and international markets."

The market itself is currently distorted as not all the materials collected are classified as marketable (especially plastics currently). The following market size estimation is based on the fact that all reported quantities are recycled.

Waste stream/material	Quantity	Share	Price	total
Paper and cardboard	270.666	0,32	28	7.578.648
Bulky waste	136.837	0,16	0	-
Biowaste	118.806	0,14	0	-
Plastics	91.025	0,11	89,64	8.159.481
Glass	71.709	0,08	65	4.661.085
Wood	57.865	0,07	0,5	28.933
Metals	34.899	0,04	170	5.932.830

WEEE	29.917	0,04	0	-
Textiles	4.728	0,01	120	567.360
Batteries	416	0,00	0	-
Other	27.519	0,03	0	-
Total	844.387	1		26.928.337

Figure 7. calculation of market value based on collected materials in 2022

The amounts of waste collected through the public service is estimated at almost 27m EUR, however it does not include the total amounts of waste collected in the country (end of waste materials and byproducts from industry and other waste types collected through national EPR schemes).

The third-party retailers/brokers and operators can gain additional 57.667.240 for further collection and treatment of the separately collected waste (mainly bulky and biowaste) from public sector (municipal waste). This part of the market value is distorted and for public service (municipal solid waste operators) presents costs not incomes.

3.2. Secondary raw material system in the Dubrovnik-Neretva County

Separately collected waste in Dubrovnik-Neretva County is mostly sent directly to third party brokers, as there are no recovery operators in the region, except Strabag d.o.o. which recovers construction waste – which is not part of this report.

3.2.1. Recycling facilities (regional if applicable, if not, then national)

Out of 135 recovery facilities in Croatia that treat municipal waste with R3 Code, none is located in Dubrovnik-Neretva County.

Total amount of plastics treated with R3 code in the Republic of Croatia is 48.608 tonnes which is 51% of total collected plastics, which means majority was exported. The most dominant company out of 21 operators is definitely DRAVA international which recovered 34.023 tonnes of plastics in 2022. The issue with the company is definitely the fire that broke in the October of 2023. The fight with the fire lasted for 11 days. The fire caught the storage with more than 3000 tonnes of PET which was valued at 1.2 million euros. (Bastalić, J., 2023). The work in factory was discontinued due to the fire and the consequences on the national market are still yet to be seen. The company incomes in 2022. were calculated at 55 m EUR.

Figure 8 fire broke in the Drava international factory in Osijek (picture: sib.net.hr)

The good example is newly established Croatian-Austrian company REKIS d.o.o. that owns a modern facility for the recovery of waste PET packaging from beverage bottles. The production facility is located in Donja Dubrava, Međimurje County. It uses "bottle to bottle" production technology, which includes efficient processes of sorting, grinding, washing and drying, produces crushed PET (transparent or colored) which is later used in the granulation process for the production of recycled PET granulate. In 2022. the factory has recycled 729,7 tonnes of waste. The company Pos Plast d.o.o. from Vrbovec recovered 2725 tonnes of various types of materials, mainly HDPE plastics.

DS Smith as multinational company has in 2015 bought the paper mill in Belišće where majority of their collected paper is recycled. In 2022. DS Smith's Belišće factory has recycled 244.257 tonnes of paper and cardboard which accounts for 90% of all collected paper in the entire Croatia. The rest of paper capacities are owned by Hartmann d.o.o. who recycled 25.441 tonnes of waste.

The recovery of wood in 2022 amounted at 98.800 tonnes, out of which 85.565 tonnes (87% of total R3 amounts) were recycled in Kronospan CRO d.o.o. factory in Bjelovar, where new wood boards are produced.

In 2022. Regeneracija d.o.o. from Zabok (RGNC grupa d.o.o. since 2023.), recycled 4599 tonnes of textile waste.

Additional significant recycling capacities are to be found for waste tyres where company Gumiimpex GPR recycled 25.077 tonnes of waste tyres, however this does not account as municipal solid waste.

3.2.2. Users of the secondary raw material

Most of the above-mentioned recyclers use the materials in their internal processes. This fact can be applied to factories such as DS Smith Belišće factory where entire national separate collection can be recycled and made into new paper and packaging products. Similar situation is also with the Kronospan recycling of wood which is entirely recycled in Croatian city Bjelovar. Gumiimpex and Regeneracija also recycle the product directly in their premises producing rubber surfaces products or fleece insulating materials. The only dispersed distribution material are plastics which are distributed to variety of producers.

4. Measures and initiatives for the development and improvement of secondary raw material markets

There are not many activities in the sector of secondary raw materials, however it is important to state that during 2020 the national Fund for Environmental Protection and Energy efficiency has distributed total of 1.230.695 units of different types of waste collection bins and containers for separate waste collection. This has so far resulted with significant increase of separate waste collection on national level. On Dubrovnik-Neretva County level, the initiative resulted in the increase of municipalities using advanced separate collection system. Although the results are not comparable as the containers were not in use during 2023, the significant increase will be shown on 2023 statistics. Compared to 2018 which was fully operational without obstacles, in 2022 Dubrovnik-Neretva County has landfilled 100 tonnes more which also means that decoupling phase in the waste management still didn't happen.

In May 2020, the City of Dubrovnik became the first Croatian coastal city to join the ***Plastic free initiative***, implementing project activities that reduced the plastic footprint in various segments of social life and the local community, while promoting alternative solutions for plastic waste. Part of the awareness campaign targeted both foreign and domestic tourists, as tourism is a key contributor to pollution. The city adopted the "Action Plan to Reduce Plastic Pollution in the City of Dubrovnik for the Period 2021-2026." On August 30, 2021, the Dubrovnik City Council decided to limit the use of single-use plastics for the City of Dubrovnik and its institutions and businesses. Two public events free of single-use plastics were held in 2021. Since its launch, the Dubrovnik Plastic Free Initiative has made significant strides in reducing plastic waste within the city. The visible reduction in plastic litter,

improved recycling rates, and increased public awareness are early indicators of success. The project itself was successfully implemented by association Sunce from Split in cooperation with WWF Mediterranean office.
However, none of the visible projects supported the development of the market for the secondary resources which could hopefully improve once the national waste management plan introduces project funding for development of waste management market, especially financing recycling capacities in the region.

5. Conclusion

The "Regional Secondary Market Report – Dubrovnik-Neretva County" highlights progress in waste management and recycling within the region, driven by both national policies and local initiatives. The successful implementation of advanced waste collection systems and public awareness campaigns, such as the Dubrovnik Plastic Free Initiative, demonstrate the region's commitment to reducing plastic waste and improving recycling rates. However, the report also identifies the need for further development of the secondary raw material market. To achieve long-term sustainability goals and meet EU waste management targets, future efforts should focus on securing funding for new recycling projects and facilities, as outlined in the national waste management plan.

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