

# Report on Municipal Waste 2022

Summary data

RACCOLTA SOLIDI  
URBANI

RACCOLTA CARTA  
• E CARTONE

RACCOLTA PLASTICA

# Report on Municipal Waste 2022

Summary data

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The Report confirms ISPRA's commitment to ensure that information and knowledge relating to an important sector, such as that of waste, are available to all.

Because of this commitment, ISPRA considered it essential that the process for preparing the Municipal Waste Report, starting from the acquisition of data from specific sources, through to their processing and presentation, is planned and controlled at each stage. The Quality Management System implemented also ensures that all activities are supported by documents (procedures and forms) that guarantee the traceability of the information and processing carried out. In 2021 ISPRA obtained certification of the process of preparing the Municipal Waste Report in accordance with UNI EN ISO 9001:2015 by an internationally recognised independent third-party body.

We would like to thank the regional and provincial environmental protection agencies and all those organisations and institutions that made its publication possible.

The design, coordination and final drafting of this Report was carried out by Valeria FRITTELLONI, Director of the Department for Environmental Assessment, Monitoring and Sustainability.

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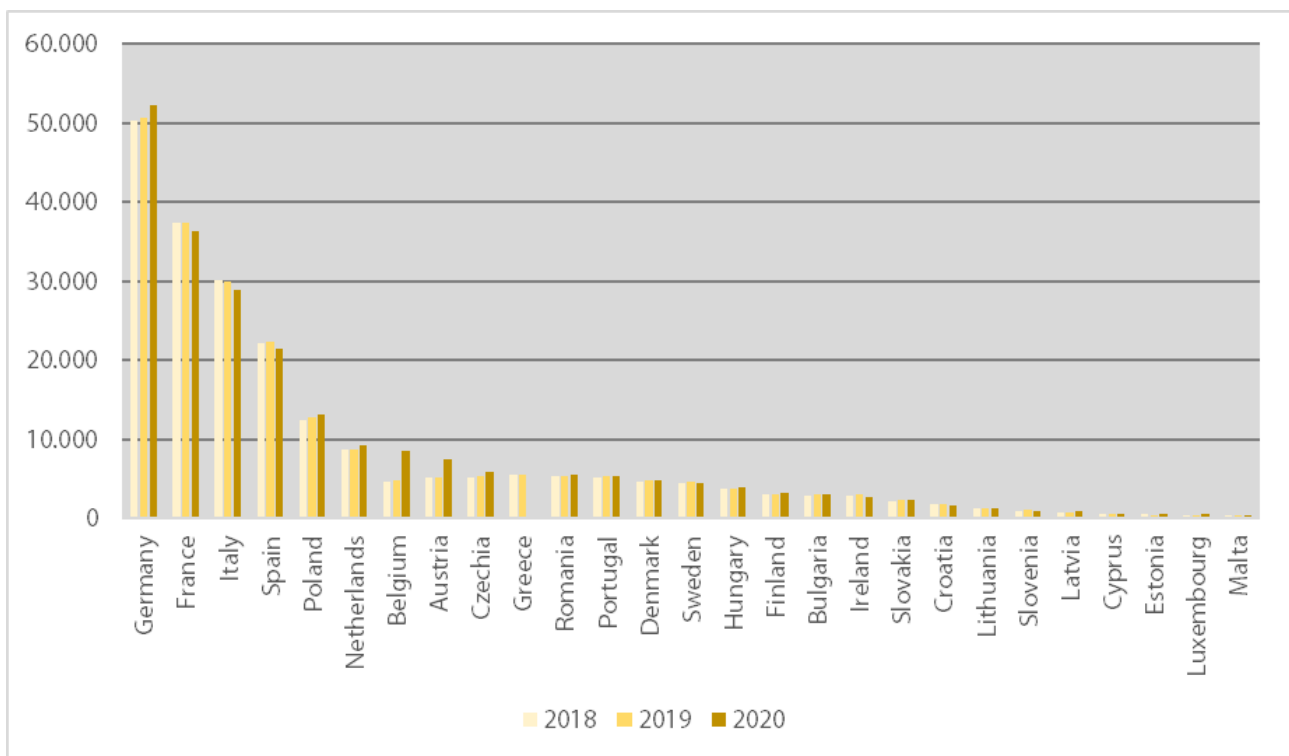
# 1. Municipal waste in Europe

## 1.1 Generation of municipal waste in Europe

In 2022, the historical series of Eurostat data on generation of municipal waste (MW) shows data up to 2020. Compared to 2019, total municipal waste generation in the EU27 shows an increase of 2.6%, from 225.3 million tonnes to approximately 231.3 million tonnes, instead if compared to 2018, the increase amounts to 3.7% (Figure 1.1). At EU country level, data comparison for the two-year period 2019 - 2020 reports negative decreases in Ireland (-10.3%) and Croatia (-6.6%), while shows the largest increases in Czechia and Latvia, amounting to 8.9% and 8.2%, respectively. For Italy, there was a decrease of -3.5% compared to 2019 and -4% compared to 2018.

The EU27 trend of the per capita value of generated municipal waste is increasing, from 500 kg/inhabitant per year in 2018, to 517 in 2020 (+3.4%). However, per capita generation values are characterised by high variability at country level. The most significant percentage decrease is recorded in Ireland (-11.2%) while the largest increase is in Latvia (+8.9%). Italy shows a decrease of -3.2% from 503 to 487 kg/inhabitant per year.

**Figure 1.1 – Total municipal waste generated in the EU27 (tonnes\*1,000), years 2018 - 2020.**



Source: ISPRA elaboration on Eurostat data

## 1.2 Management of municipal waste in Europe

In the EU27, the total amount of MW treated for 2020 is approximately 228 million tonnes, increased by 3.3% (+7.3 million tonnes) compared to 2019. For the three-year period 2020-2018, the increase is 9.7 million tonnes (+4.4%).

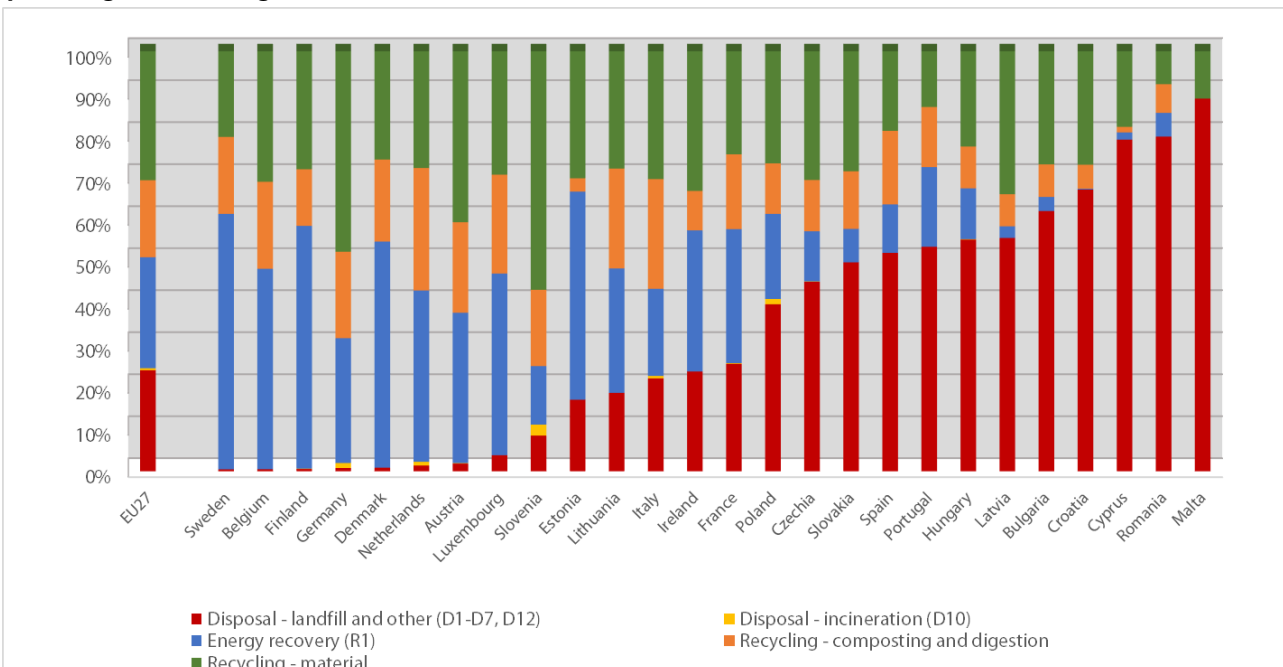
The largest percentage increases concern Czechia (+20%, approximately 1 million tonnes), the Netherlands (+5.7%, +498 thousand tonnes) and Finland (+5.5%, +173 thousand tonnes). However, in terms of quantity, the main increases, excluding those already analysed, were recorded in Germany (+1.6 million tonnes, +3.1%) and Poland (364 thousand tonnes, +2.9%).

The most significant percentage reductions in the two-year period 2020-2019 concern Malta with -12.5% (44 thousand tonnes) and Ireland with -10.3% (313 thousand tonnes). In terms of quantity, Italy records the main decrease with -1.3 million tonnes (-4.7%), followed by Spain with -733 thousand tonnes (-3.3%).

In the EU27, the average per-capita quantities of treated waste increased by 3.2% between 2019 and 2020, which rises to 4.3% compared to 2018. Significant rises in per capita treatment values are recorded between 2019 and 2020 for the Czech Republic (+19.7%), Finland (+5.3%) and the Netherlands (+4.9%), while the main decreases are observed for Malta (-14.4%), Ireland (-11.2%) and Slovenia (-7.5%). In Italy, per capita values decrease from 462 kg/inhabitant to 443 kg/inhabitant per year of treated municipal waste (-4.1%).

Figure 1.2 shows the extreme variability of municipal waste management approaches among different Member States. Sweden, Finland, Denmark, Estonia, Belgium, Luxembourg and the Netherlands prefer incineration with energy recovery (R1) to landfilling, with percentages ranging from 41% in the Netherlands to 61% in Sweden. Incineration without energy recovery (D10) is rarely used, with the highest percentage in Slovenia (3%). Some countries such as Malta, Romania, Cyprus, Croatia and Bulgaria show a significant prevalence of landfilling with percentage values above 60%. Countries with percentages of municipal waste sent to composting and anaerobic digestion exceeding 20% of the total treated MW are: Germany, Belgium and Austria (21%), Lithuania and Luxembourg (23%) Italy (26%) and the Netherlands (29%).

**Figure 1.2 – Percentage breakdown of municipal waste management in EU27, year 2020 (data sorted by increasing percentage of landfilling)**



Note: Data for Greece were not available.  
Source: ISPRA elaboration on Eurostat data



### 1.3 Recycling of municipal waste in Europe

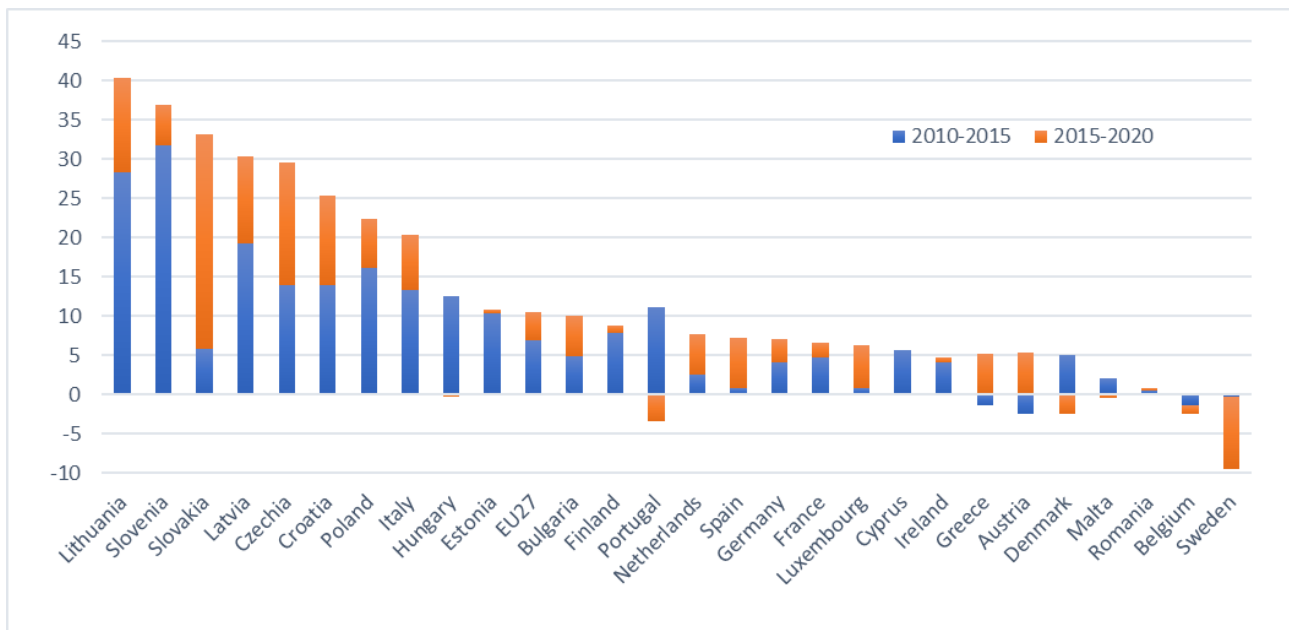
Percentages of at least 30% of municipal waste sent for material recycling, are found in only 9 out of 27 countries, with Slovenia (57%) and Germany (48%) leading the way. Italy sends 30.4% of municipal waste to recycling, and 26.1% to composting and anaerobic digestion, with a total share of waste sent to recycling operations of 56.5%.

The recycling rate for municipal waste is one of Eurostat indicators measuring the progress of circular economy policies. It is also part of the EU Sustainable Development Goals (SDGs) set of indicators. The indicator measures the share of recycled municipal waste in relation to total municipal waste generation, and is therefore influenced by both the amount of waste sent to recycling and the increase/decrease in municipal waste generation. Recycling includes material recycling, composting and anaerobic digestion.

In 2020 the average recycling rate is 48.6% of the total waste generated in the EU27, an increase of 10.6 percentage points (pp) compared to 2010.

The countries with the most significant increases in percentages compared to 2010 are Lithuania (+40.4 pp), Slovenia (+36.9 pp), Slovakia (+33.1 pp). Italy shows an overall increase of +20.4 pp. There are also some overall decreases in Sweden (-9.5 pp) and Belgium (-2.5 pp) over the same period (Figure 1.3).

**Figura 1.3 – Changes in the recycling rate of municipal waste in the EU27, years 2010 – 2015 and 2015- 2020**



Source: ISPRA elaboration on Eurostat data

## 2. Municipal waste generation and separate collection in Italy

### 2.1 Municipal waste generation

In 2021, municipal waste generation in Italy was 29.6 million tonnes, higher than the 2020 value (28.9 million tonnes) (Figure 2.1).

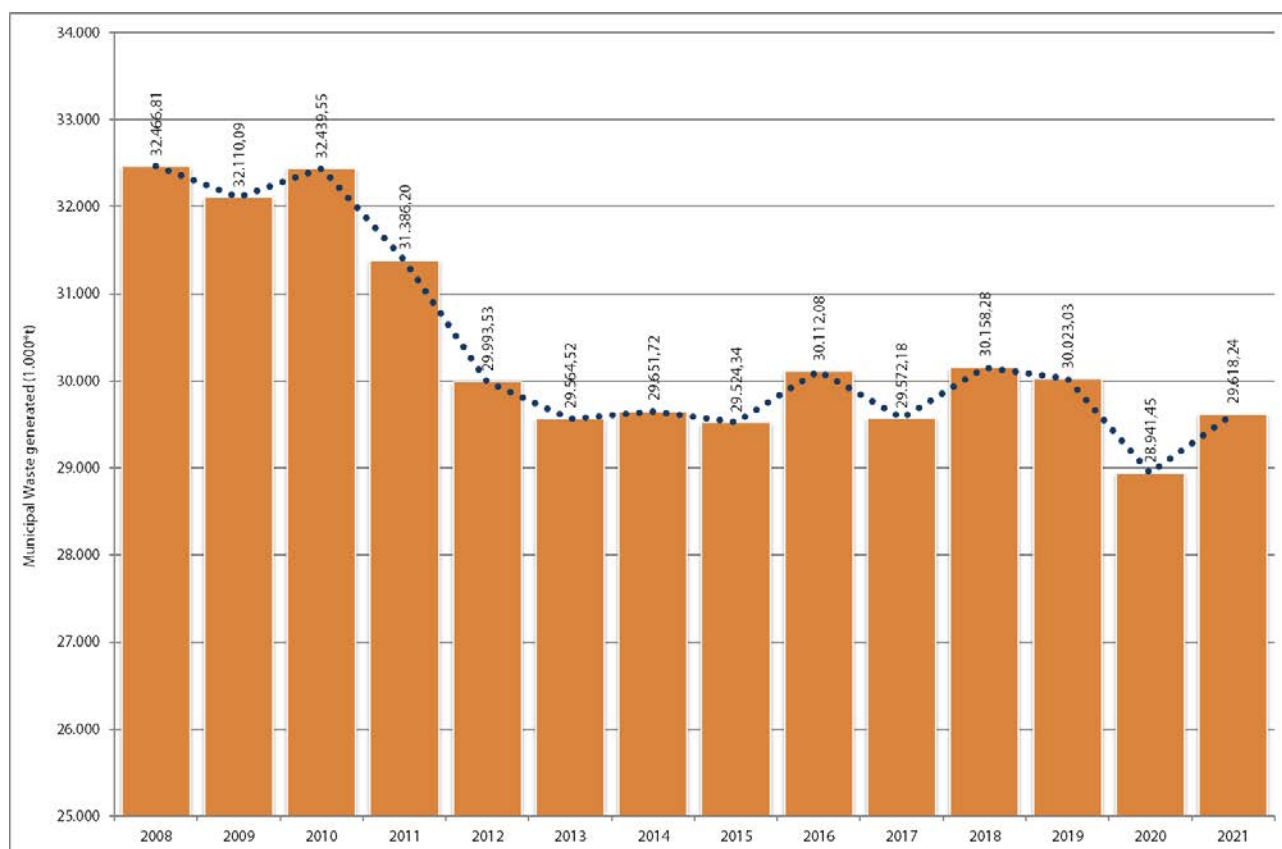
As a matter of fact, 2021 has been the year of economic rebound after the health emergency, which influenced the national socio-economic environment due to the restrictive measures taken and trade closures. Data on municipal waste reflect this rebound, but to a lesser extent than other socio-economic indicators such as gross domestic product and household expenditure. The growth of waste generation, which increases by 2.3% by 2020, is lower than the increases in GDP and household consumption of 6.7% and 5.3% respectively.

Generation of municipal waste have increased in all geographical macro-areas of Italy: South regions recorded the largest percentage growth (+2.9%), followed by the regions of the Centre (+2.5%) and those of the North (+1.9%).

In quantitative terms, northern Italy produced almost 14.2 million tonnes, central Italy over 6.3 million tonnes and the southern Italy over 9.1 million tonnes.

The average per capita value has realigned with the pre-pandemic values, with an average MW generation per capita of 502 kilograms. As in previous years, the highest values were observed in central Italy with 538 kilograms per inhabitant. The average value for northern Italy was around 517 kilograms per inhabitant, with an increase of 10 kilograms per inhabitant compared to 2020, while for the south Italy was 461 kilograms per inhabitant (+18 kilograms per inhabitant).

Figure 2.1 – Trends in municipal waste generation, years 2008 - 2021

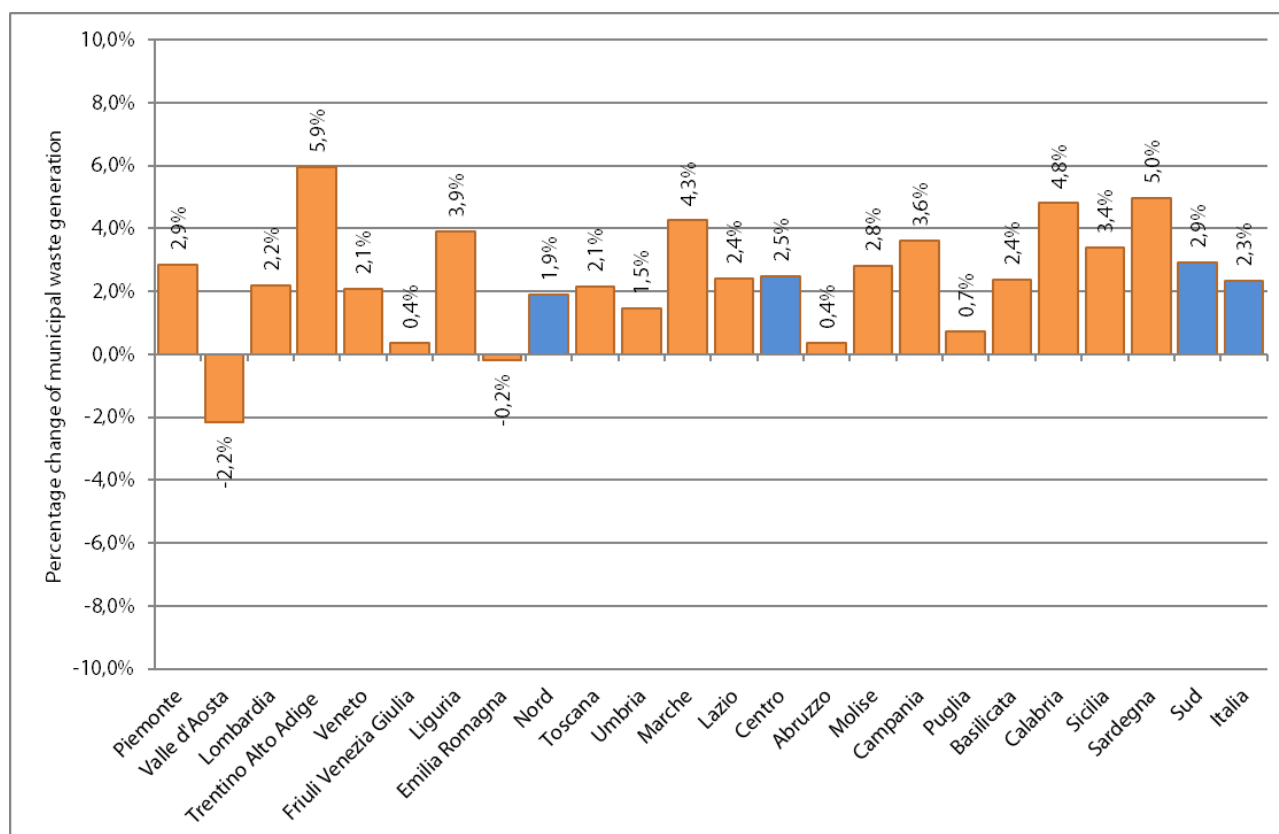


Source: ISPRA

All Italian regions showed an increase in the amount of waste produced, except for Valle d'Aosta and Emilia-Romagna, whose production remained stable (Figure 2.2). Among the northern regions, the greatest increases were observed for Trentino-Alto Adige (+5.9%), Liguria (+3.9%) and Piemonte (+2.9%); in the Centre, for Marche (+4.3%), Lazio (+2.4%) and Toscana (+2.1%) and in the South for Sardegna (+5%), Calabria (+4.8%) and Campania (+3.6%).

Among the regions, Emilia-Romagna had the highest per capita value with 641 kilograms/inhabitant per year. Next is Valle d'Aosta, with 602 kg/inhabitant, followed by Toscana with an increase of 11 kilograms, reaching 598 kg/inhabitant. The other regions with per capita values above the national average were Liguria, Marche, Umbria, Lazio and Trentino-Alto Adige. The lowest per capita values were recorded for Basilicata (358 kg per inhabitant), Molise (386 kg per inhabitant) and Calabria (411 kg per inhabitant).

**Figure 2.2 - Percentage change, from 2020 to 2021, of municipal waste generation on a regional scale**



Source: ISPRA

The three provinces that produce the highest amount of waste are in Emilia-Romagna: Reggio Emilia with 763 kilograms per inhabitant per year, Ravenna with 735 kg/inhabitant per year and Piacenza with 720 kg/inhabitant per year. Provinces with per capita production between 600 and 700 kg/inhabitant per year include three other provinces in Emilia-Romagna (Rimini, Modena and Ferrara), four Toscana provinces (Livorno, Grosseto, Lucca and Prato) and the province of Aosta.

Lowest per capita values (less than 400 kg/inhabitant per year) were found in several southern Italian provinces and in two provinces in the Centre, Rieti and Frosinone. In particular, Potenza and Enna were below 350 kg/inhabitant per year.

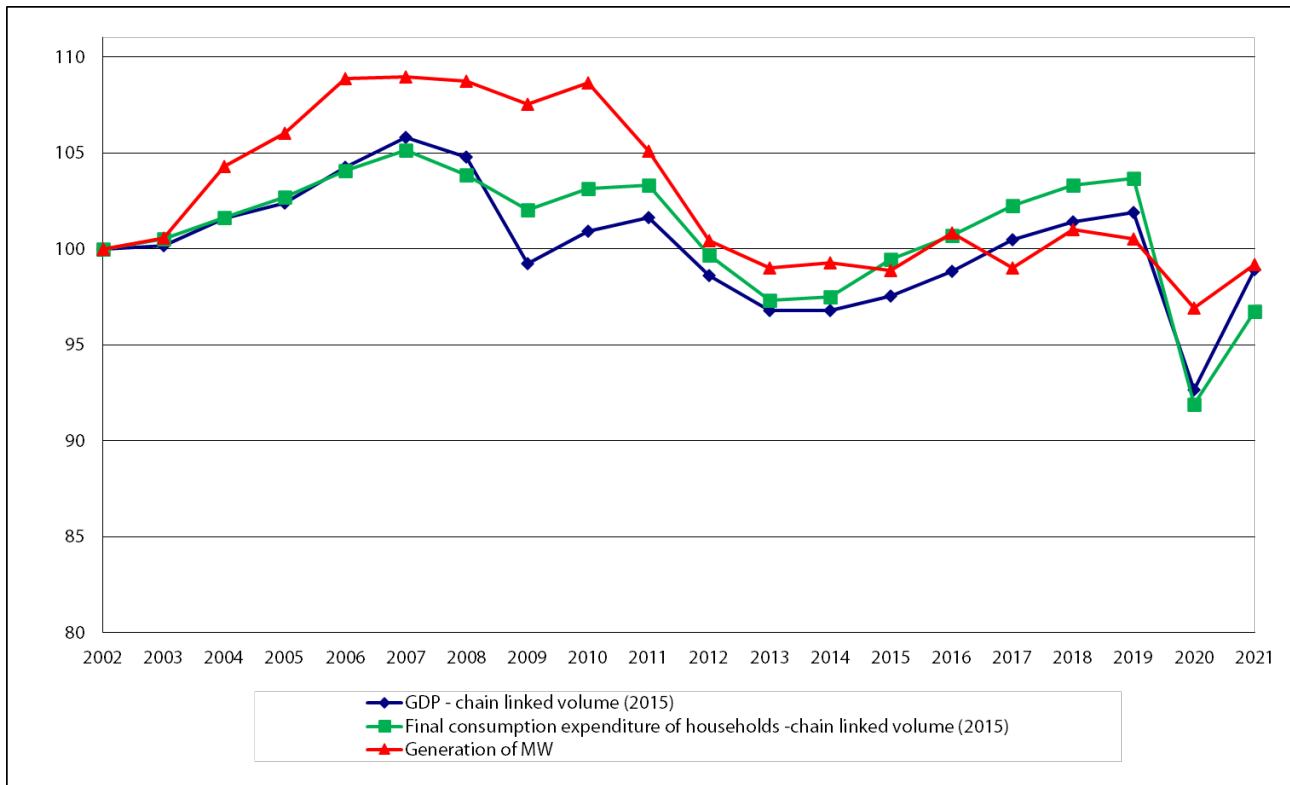
On a municipal scale, the trend of municipal waste generation in the 16 municipalities with resident population above 200,000 showed an increase of 2.8% between 2020 and 2021, linked to the post-pandemic effects. The upturn in commuter and tourist flows played a particularly significant role in the increase in waste generation, which was higher than the national value (+2.3%). Catania and Palermo showed increases of 5.8% and 5.1%

respectively, followed by Genova, Roma and Napoli with increases of 4.1%, 4% and 3.6%. Milan and Prato both showed an increase of 3.4%. Only Trieste, Bari and Bologna recorded decreases of 5%, 3.8% and 2% respectively. Verona remains substantially stable (-0.9%).

Compared to 2020, both waste generation and socio-economic indicators (GDP and households expenditure) were on the rise, the latter also being strongly influenced by the health emergency.

Regardless, a misalignment can be noted between the trend of waste generation and socioeconomic indicators, considering that there is a lower growth in waste production (+2.3% between 2020 and 2021), against increases in GDP and household expenditure of 6.7% and 5.3% respectively (Figure 2.3).

**Figure 2.3 - Trends in municipal waste generation and socio-economic indicators, years 2002 – 2021**



Source: ISPRA

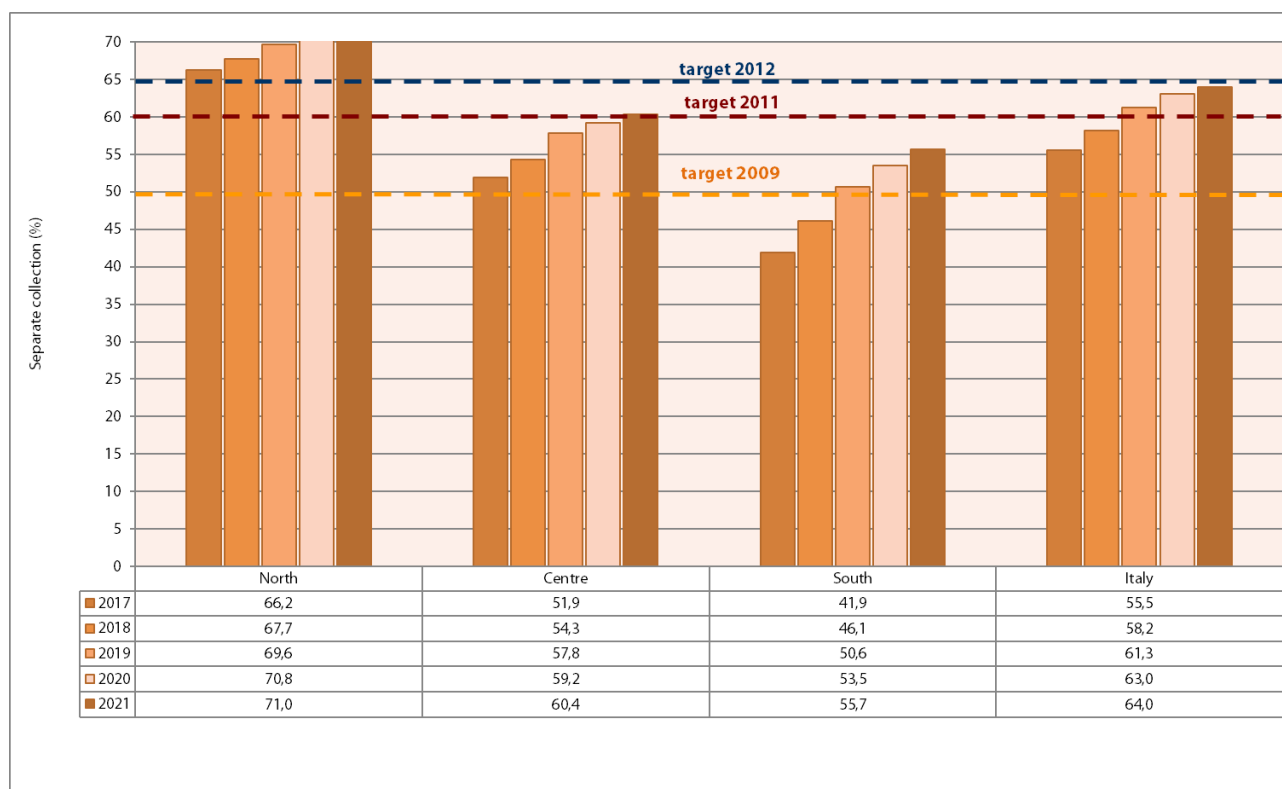
## 2.2 Separate collection of municipal waste

In 2021 separate collection of municipal waste in Italy reached 64% of the national municipal waste generation, 1 percentage point higher than 2020 (Figure 2.4). In terms of quantity, after the slight decrease recorded in 2020 (-0.9%), separate collection started to grow again, increasing by about 720 thousand tonnes (from 18.2 million to almost 19 million tonnes).

This increase is more marked than the one recorded for the produced quantities: +4% for separate collection against +2.3% for municipal waste generation.

In the North, separate collection amounted to 10.1 million tonnes, in the Centre about 3.8 million tonnes and in the South almost 5.1 million tonnes. These quantities correspond in the northern regions to 71% of the total production, 60.4% in the Centre and 55.7% in the Southern regions.

**Figure 2.4 - Trend in the percentage of separate collection of municipal waste by macroarea, years 2017 - 2021**

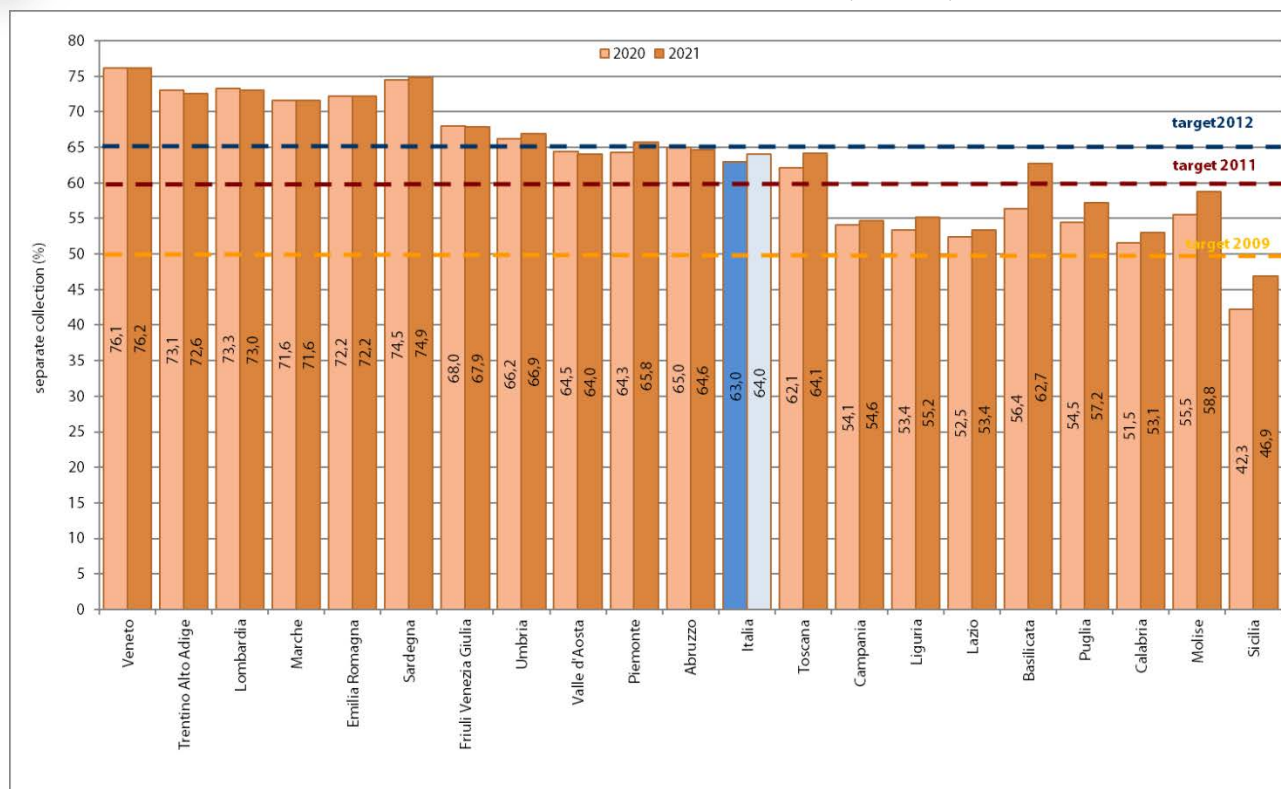


Source: ISPRA

Similarly to 2020, the highest percentage of separate collection was achieved by the Veneto region with 76.2%, followed by Sardegna (74.9%), Lombardia (73%), Trentino-Alto Adige (72.6%), Emilia-Romagna (72.2%), Marche (71.6%), Friuli-Venezia Giulia (67.9%), Umbria (66.9%) and Piemonte (65.8%). Close to the target of 65%, set by the legislation for 2012, were Abruzzo (64.6%), Toscana (64.1%) and Valle d'Aosta (64%). Basilicata, with an increase of over 6 points, reached a percentage of 62.7%, while Molise, Puglia and Liguria reached 58.8%, 57.2% and 55.2% respectively. Molise and Puglia increased their percentages by 3.3 and 2.7 points respectively. Campania reached 54.6%, Lazio 53.4% and Calabria, with a growth of 1.5 points, 53.1%.

Only Sicilia remained below the 50% mark (i.e. 46.9%), but nevertheless the percentage of separate collection increased by 4.7 points compared to 2020 (42.3%) (Figure 2.5). In this region, the percentage of separate collection is more than doubled in the five-year period 2017-2021.

**Figure 2.5 - Trend in the percentage of separate collection of municipal waste by region, years 2020 - 2021**



Source: ISPRA

On a provincial level, the highest percentages of separate collection were found, similarly to 2020, for Treviso, which stands at 88.6% in 2021, followed by Mantova (86.4%), Belluno (83.8%) and Reggio Emilia (82.1%). Also above or close to 80% were the rates of Pordenone (80.9%), Novara, Parma (both 79.5%) and Nuoro (79.1%). Separate collection rates below 40% are observed for the provinces of Palermo (33.3%) Crotona (35.5%) and Reggio di Calabria (38.4%).

Provinces or metropolitan cities with separate collection greater than or equal to 65% were 61 (4 more than in 2020) and those with collection between 60% and 65% were 15 (10 in 2020). Provinces with separate collection rates between 50% and 60% were 21 (25 in 2020). As a result, 91% of the provinces (97 out of 107 compared to 92 in 2020) have separately collected at least half of the amount of municipal waste produced on their territory. Out of the 61 provinces that have reached the 65% target, 37 are located in northern Italy, 11 in central Italy and 13 in the southern Italy.

Data at municipal level showed that 67% of the municipalities achieved a separate collection rate higher than 65% in 2021. This value was 64.8% in 2020 and 60.2% in 2019. Two thirds of the Italian municipalities were therefore above the separate collection target of 65%. At the same time, there is a gradual decrease in the number of municipalities with separate collection rates below 30% (from 7% in 2019 to 4.2% in 2021).

Overall, 85% of municipalities collect separately more than half of their municipal waste in the past year.

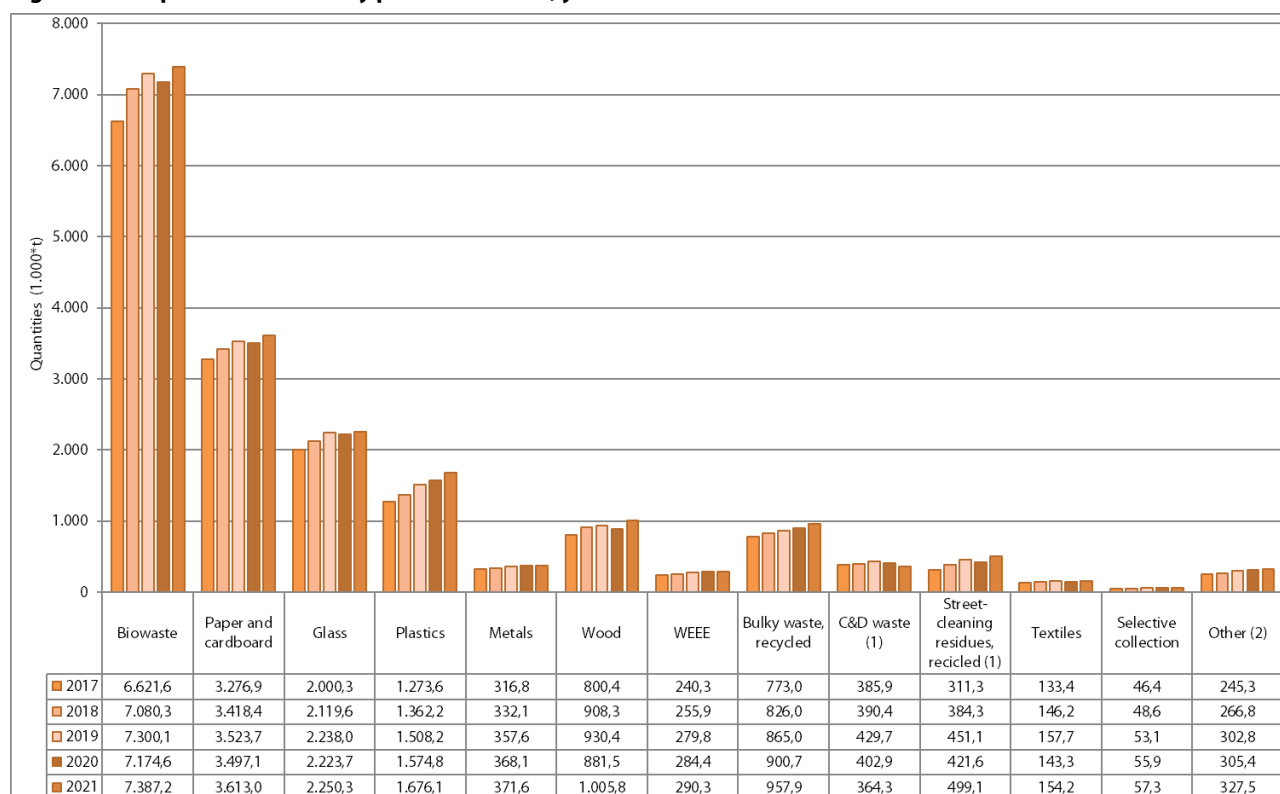
The highest levels of separate collection, for municipalities with a resident population of more than 200,000 inhabitants, were observed for Prato, Venice and Milan, with percentages of 72.6%, 65.2% and 62.5% respectively.

## Separately collected waste streams

Among the separately collected waste, bio-waste is the largest stream in Italy, representing, with 7.4 million tonnes collected, 39% of the total, with an increase of 3% compared to 2020. Approximately 69.6% of bio-waste are biodegradable kitchen and canteen waste (LoW 200108 -5.1 million tonnes), 26.1% are biodegradable waste from garden and park maintenance (LoW 200201 - 1.9 million tonnes), 3.6% are home composting waste (265 thousand tonnes) and 0.7% waste from markets (LoW 200302 - 51 thousand tonnes).

Paper and cardboard waste ranks second in terms of collected quantity, with 19.1% of the total amount, over 3.6 million tonnes, increased by 3.3% compared to 2020. Glass waste are next with almost 2.3 million tonnes (11.9%), also up by 1.2%. Plastic waste, which accounts for 8.8% of the total amount, continues to show growth in the quantities collected separately (+6.4%), with a total amount collected nationwide of almost 1.7 million tonnes. About 95% of the plastic waste separately collected is packaging (Figure 2.6 and Figure 2.7).

**Figure 2.6 - Separate collection by product fraction, years 2017 - 2021**



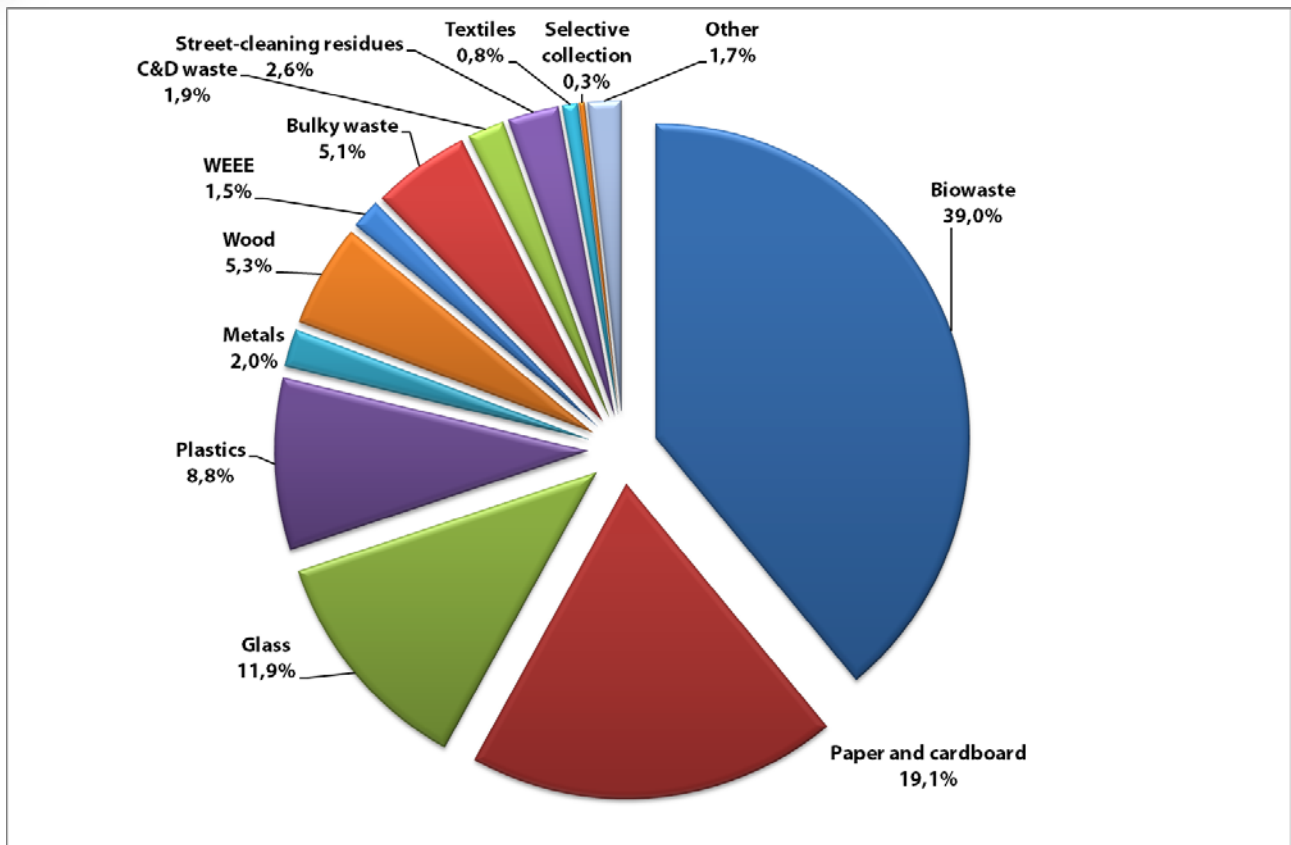
Note:

(1) Waste stream included starting from 2016 based on the criteria established by the Ministerial Decree of 26 May 2016.

(2) Starting from 2016, waste collected as multi-material is also included in the "Other" item. Based on the criteria established by the Ministerial Decree of 26 May 2016, the latter must, in fact, be fully calculated (gross of the share of waste) in the amount of Separate Collection. The quotas relating to the paper and cardboard, glass, plastic, metal, and wood fractions are given by the sum of the collected quantities of packaging and other types of waste made up of these materials.

Source: ISPRA

Figure 2.7 - Percentage breakdown of separate collection, year 2021



Source: ISPRA



### 3. Municipal waste management in Italy

In this analysis of data and information on the treated quantities and the forms of municipal waste management, it was decided to also include waste generated from the treatment of municipal waste. These wastes, identified by the LoW<sup>1</sup> codes 191212 (other wastes including mixed materials from mechanical treatment of waste), LoW 191210 (combustible wastes - RDF /SRF), LoW 190501 (non-composted fraction of municipal and similar wastes), LoW 190503 (off-specification compost) and LoW 190599 (wastes from aerobic treatment of waste not otherwise specified), although classified differently, since they are the product of treatment operations that change their nature and chemical composition, are nevertheless of municipal nature.

This choice is also justified by the provisions of Article 182-bis of Legislative Decree No 152/2006, which envisages the achievement of self-sufficiency in the disposal of non-hazardous municipal waste and waste produced by the mechanical treatment of waste, through the creation of an integrated plant network in a defined territory (optimal territorial area). The main critical issue in the analysis of these waste flows is their transport to extra-regional destinations, which makes it particularly complex to follow their path from production to final destination.

Municipal waste (MW) sent to intermediate forms of mechanical biological treatment before a final destination of recovery or disposal represent 30.6% of the municipal waste produced in 2021. It is therefore necessary to account for this waste in order to close the cycle of municipal waste management. Mechanical biological treatment is, as a matter of fact, widely used as a form of pre-treatment to landfilling or incineration. The aim is to guarantee the conditions of biological stability, by reducing the humidity and volume of the waste, but also of increasing its calorific value to make the combustion process more efficient.

As required by law, waste may be landfilled only after treatment<sup>2</sup>, and in line with these provisions, 91.5% of the waste disposed of in landfills, as well as approximately 51% of the waste incinerated, underwent preliminary treatment in 2021.

In many cases, mechanical biological treatment plants (MBT) are located on the same site where there are also landfills or incinerators. In several cases, both the mechanical biological treatment plant and the bio-waste treatment plant are present on the same site.

A total of 657 municipal waste management plants were operational in 2021. The table shows details by geographical macro-area and by type of plant.

Type of plant		Numbers of plants			
		North	Centre	South	Total
Biological treatment	Composting	174	41	78	293
	Integrated treatment	29	7	6	42
	Anaerobic digestion	18	0	3	21
Mechanical or mechanical-biological treatment	MBT	30	27	47	104
	MT	11	7	2	20
Co-incineration		8	1	5	14
Incineration		26	5	6	37
Landfills		53	28	45	126
<b>Total</b>		<b>349</b>	<b>116</b>	<b>192</b>	<b>657</b>

Source: ISPRA

<sup>1</sup> European List of Waste

<sup>2</sup> Article 7 of Legislative Decree 36/2003, transposing Directive 99/31/EC as amended.

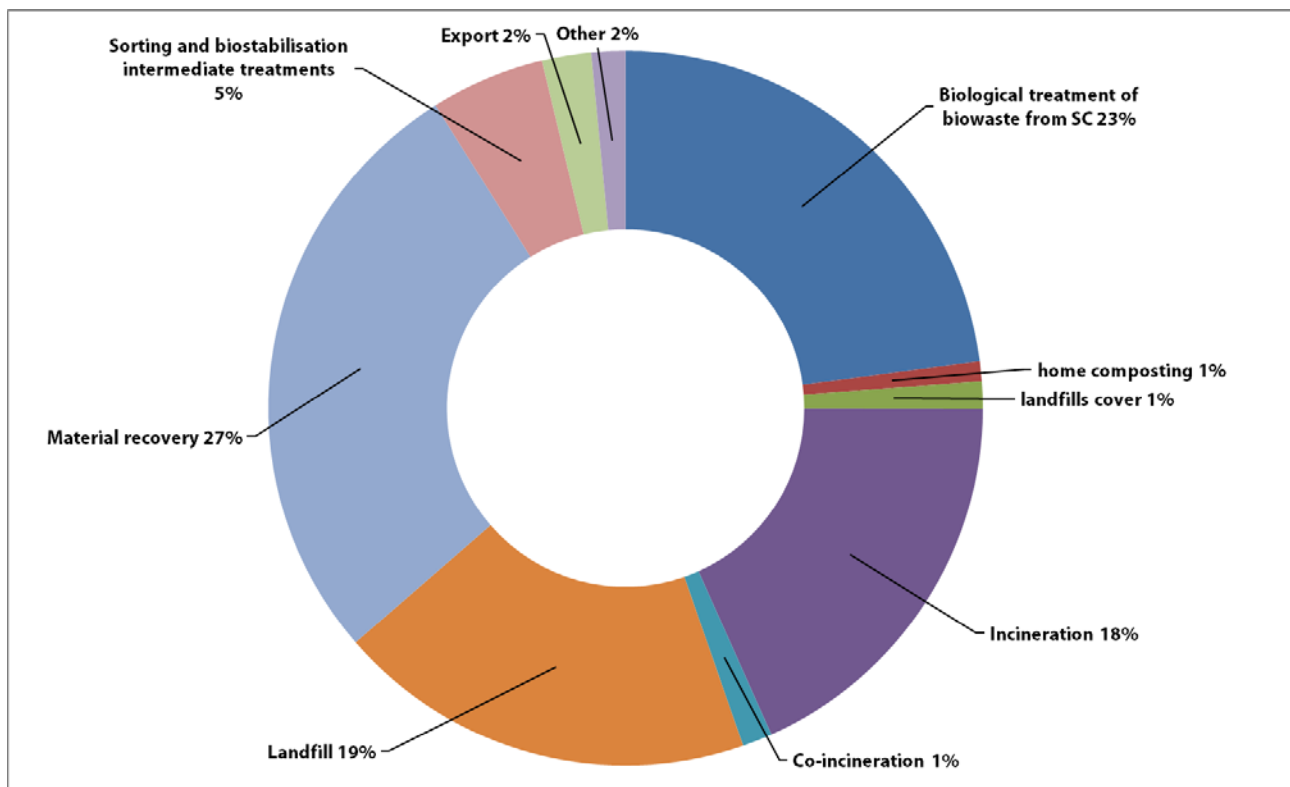
Figure 3.1, which represents the percentage breakdown of the different forms of management in 2021, does not show the share of MW treated in this type of plant, in order to avoid duplication of data, when accounting for the quantities of waste first sent to mechanical-biological treatment and subsequently sent to other management operations.

In 2021, approximately 7.5 million tonnes of mixed municipal waste (LoW code 200301), 233,000 tonnes of other municipal waste fractions, 1.3 million tonnes of waste from the treatment of MW (identified by chapter 19 codes) and 232,000 tonnes of other non-municipal waste were treated in MBT plants.

Data analysis shows that landfilling accounted for 19% of the municipal waste generated in 2021. 50% of the waste generated was sent to material recovery plants for the treatment of separate collections: of this quantitative, 23% is treated in plants that recover the bio-waste fraction and 27% in plants that recover the other fractions.

About 18% of the municipal waste generated was incinerated, while 1% was sent to production plants, such as cement factories, thermoelectric power stations, etc., to be used in order to produce energy within the production cycle; 1% was used to cover landfills after suitable treatment; 5%, consisting of waste from MBT plants, was sent for further treatment such as the production of combustible waste or biostabilisation; 2% was exported (about 659 thousand tonnes) and 1% was managed directly by citizens through home composting (265 thousand tonnes). "Other waste" (2%) includes: quantities of waste that remain in storage at the end of the year at treatment plants, process losses and waste produced by mechanical-biological treatment plants whose destination cannot be deduced from the database. Export data (2%) does not include quantities of exported materials qualified as 'products' or 'secondary raw materials' generated by waste recycling operations.

**Figure 3.1 – Percentage breakdown of municipal waste management, year 2021**



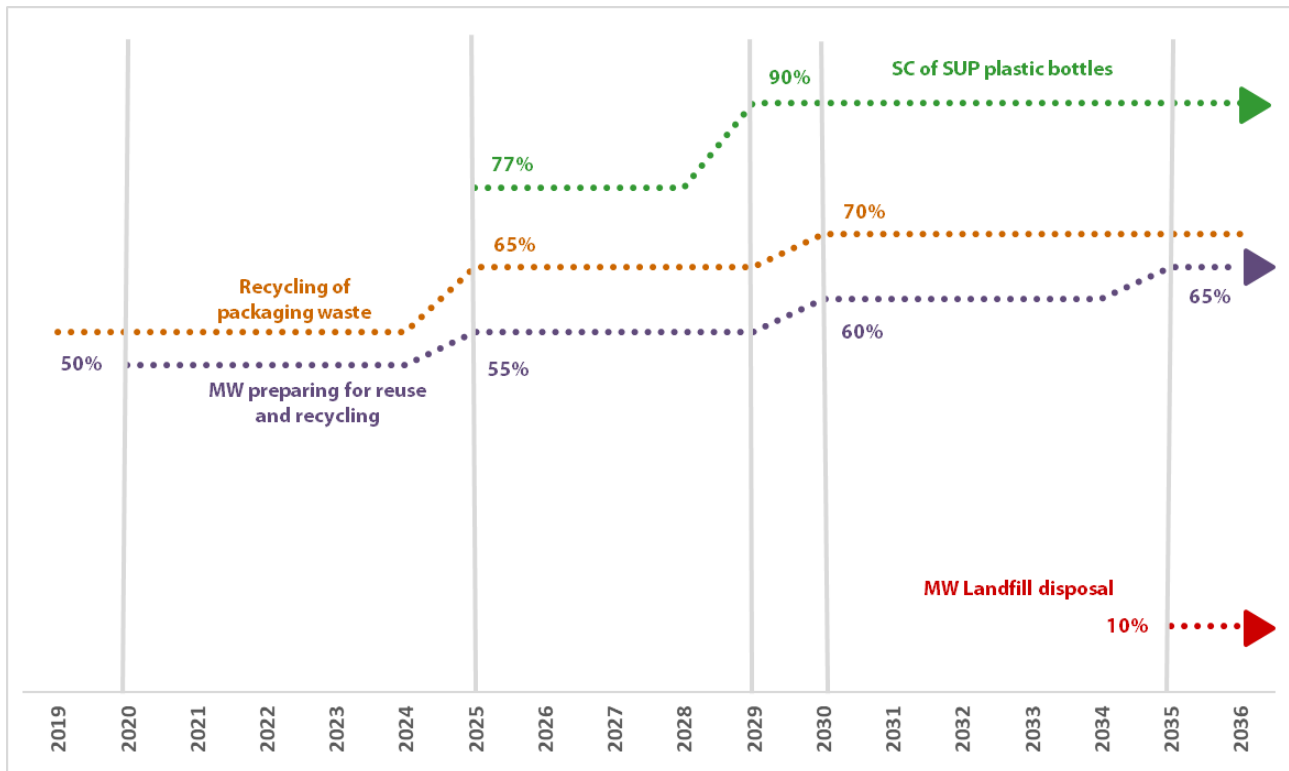
Source: ISPRA

Data analysis of MW management showed that there is a need to accelerate the improvement of the management system, especially in some parts of the country, to enable the achievement of the challenging new targets set by European legislation, briefly depicted in Figure 3.2.

Landfill disposal in the next 15 years will have to be halved (10% by 2035), the percentage of waste sent to material recovery operations will have to be significantly increased to ensure the achievement of 60% recycling by 2030 and 65% by 2035.

The need for change seems all the more urgent considering that with the new targets, new calculation methodologies have also been introduced for both recycling and landfilling, which appear to be much more restrictive than those used to date.

**Figure 3.2 - Main targets under European legislation**



Source: ISPRA own elaboration.

Landfilling in 2021 involved 5.6 million tonnes of municipal waste, with a reduction of 3.4% (over 198,000 tonnes) compared to 2020. The data by geographic macro-area show that 26.1% of the total amount (about 1.5 million tonnes) was disposed of in plants located in the north of the country, 30.5% (1.7 million tonnes) was disposed of in plants located in the Centre, while 43.4% of the total (over 2.4 million tonnes) was disposed of in plants located in the South. In the South, there was a decrease of 5.8% (about 151 thousand tonnes) and in the Centre, a decrease of 2.1% (-37 thousand tonnes) compared to 2020, attributable to improved separate collection in both areas. The reduction in the North was less significant, where there was a decrease of 0.7% (about 11 thousand tonnes).

Figure 3.3 shows an increase of 1.6% between 2020 and 2021 for incineration. 71.5% of this waste is treated in the North, 9.7% in the Centre and 18.8% in the South. Substantial shares of waste produced in Central and Southern Italy are, however, treated in plants located in the North. Lombardy alone receives almost 347,000 tonnes of waste from outside the region, mainly from Piemonte, Lazio, Campania, Liguria and Puglia.

The treatment of bio-waste from separate collection showed an increase of 190,000 tonnes, or 2.9%, from almost 6.6 million tonnes to about 6.8 million tonnes.

The integrated aerobic/anaerobic treatment plants showed an increase of 4.8% in the treated quantities (147 thousand tonnes) in the last year (+37.1% compared to 2017), while the composting sector, although with less significant variations, increased of 1.9% (59 thousand tonnes).

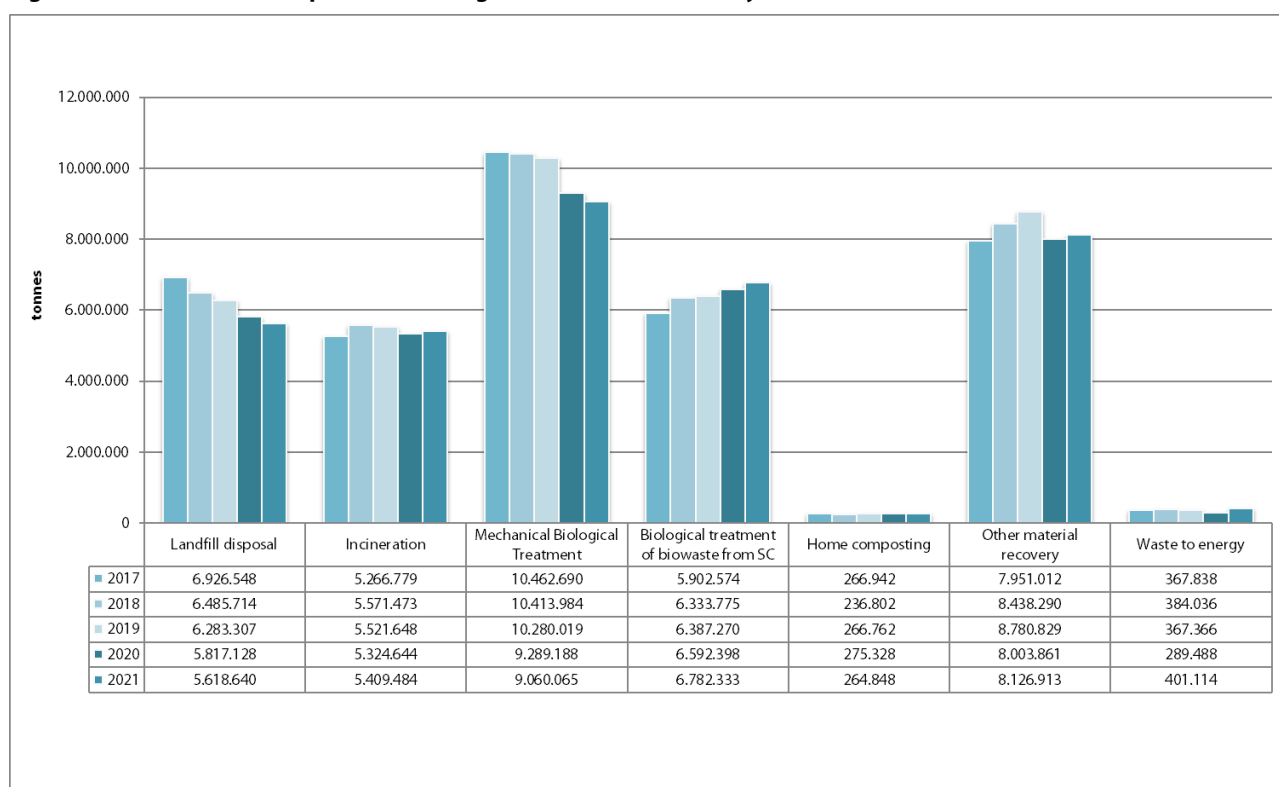
The national per capita value for biological treatment of bio-waste in 2021 is 115 kg/inhabitant, but values vary according to geographical macro-areas: 167 kg/inhabitant in the North, 69 kg/inhabitant in the Centre and 71 kg/inhabitant in the South.

These data are not fully comparable with those of bio-waste collection at territorial level. Due to the smaller number of plants in the central and southern areas of the country (174 composting plants out of 293 operating nationwide, 29 out of 42 integrated treatment plants and 18 out of 21 anaerobic digestion plants, are located in the North) significant quantities of waste are moved from these areas to plants in the North. The collection of the bio-waste fraction (net of home composting), in fact, at a national level reaches 121 kg/inhabitant, with 129 kg/inhabitant in the North, 119 kg/inhabitant in the Centre and 110 kg/inhabitant in the South.

The valorisation of the organic fraction of municipal waste appears to be a key element in achieving the new and challenging targets set by the European Union. As a matter of fact, this fraction represents 34.7% (about 10.3 million tonnes) of municipal waste. The legislation states that organic waste can be counted towards recycling if treatment produces compost, digestate or another product with a recycled content yield similar to the input, intended to be used as a recycled product, material or substance. Where the output product is used on land, it is only counted as recycled if its use results in agricultural benefits or environmental improvements. Analysing the data on the different forms of management implemented at regional level, it is evident how, where there is an integrated waste cycle thanks to a developed plant park, the use of landfill is significantly reduced. For example, in Lombardia landfilling is reduced to 3.6% of municipal waste generated, in Friuli-Venezia Giulia to 5.2%, in Emilia-Romagna to 7.5%, in Trentino-Alto Adige to 10.1%, in Piemonte to 12.2% and in Veneto to 16.1%. In these regions, separate waste collection stands at 73%, 67.9%, 72.2%, 72.6%, 65.8% and 76.2% respectively and large shares of waste are treated in incineration plants with energy recovery.

There are regions where the plant framework is inadequate and not very diversified, e.g. Sicilia, where municipal waste disposed of in landfills still accounts for 51.5% of the total waste produced, but also Lazio and Campania, which fail to close the cycle within the regional territory.

**Figure 3.3 – Forms of municipal waste management at national level, years 2017 - 2021**



Source: ISPRA



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To limit the analysis of the data to the regional level, in many cases, can be misleading because the waste produced by mechanical-biological treatment plants (codes of Chapter 19 of the European List of Waste) is incinerated, disposed of in landfills or recovered in plants located outside the region. This is the case, for example, of Molise where 74.9% of the combustible waste incinerated comes from other regions.

The same applies, as highlighted, to the treatment of the bio-waste in composting plants. In the case of Campania, for example, the separate collection of this fraction was almost 648 thousand tonnes in 2021, of which only just over 140 thousand tonnes were recovered in regional plants (21.7% of the total collected). In Lazio, more than 576 thousand tonnes of bio-waste were separately collected, but existing plants in the region were able to treat only 258 thousand tonnes (44.8%).

In 2021 home composting reached about 265 thousand tonnes at national level, showing a negative drop of 3.8% compared to last year. The regions where this activity is most widespread are Veneto, Toscana and Piemonte.

The calculation of the recycling rate for municipal waste and the individual forms of management are described in the following paragraphs.

### **3.1 Calculation of municipal waste recycling rates for targets verification under Article 181 of Legislative Decree No 152/2006**

Directive 2008/98/EC introduced targets for preparing for re-use and the recycling of municipal waste. By 2020, the preparing for re-use and the recycling of waste materials should have been increased to a minimum of overall 50% by weight. Further targets for 2025 (55%), 2030 (60%) and 2035 (65%) were set as a result of the amendments introduced by Directive 2018/851/EU. While calculation methods established by Decision 2011/753/EU for the 50% target were more flexible, new targets calculation methods established by Decision 2019/1004/EU are more rigid and have been designed to ensure that the calculated percentages are indeed representative of the actual recycling capacity.

For the 2020 target, it was possible to choose which waste streams to apply the calculation to, as long as they included at least "paper, metal, plastic and glass from households, and possibly from other origins, insofar as these waste streams are similar to households".

The targets presented in previous editions of the Municipal Waste Report referred to the approach of Article 11 of the WFD and the criteria of Decision 2011/753/EU. As of this edition, however, the new criteria are applied, which no longer provide for the possibility of selecting a calculation option, i.e. choosing which waste types to apply the target measurement to.

The new targets and the related calculation rules were transposed into national law by Legislative Decree No. 116/2020.

With regard to the calculation methods, it is worth mentioning that some fractions (e.g. multi-material waste collection, construction and demolition waste), which were previously included in the calculation of separate collection, can no longer contribute to the recycling targets set by Directive 2008/98/EC.

In this section, provisional calculations of the recycling rate on a national basis, conducted through an application-oriented approach to the new calculation methodologies, are reported.

In order to gather more information on the quantities of waste entering final recycling operations, specific changes were made to the Environmental Declaration Form (MUD) through the introduction of a specific 'recycling' section. This information was used in the application of the new calculation method. In addition, in accordance with the provisions of the framework directive, the recycling data for some waste streams were compared with information on the quantities of secondary raw materials produced, again using the MUD databases, starting from the collected waste quotas.

In the case of the bio-waste, the recycled quantities were determined using the input values to the composting and/or anaerobic digestion plants, net of the waste from the treatment processes, as per the guidance provided by the Implementing Decision and the Eurostat implementation guidelines. The quantities of bio-waste recycled included the shares declared by the municipalities as going to domestic composting, in accordance with regulatory requirements.

In addition, the (residual) quantities from the mechanical biological treatment processes of mixed municipal waste subjected to recycling treatments were also counted as recycled.

Taking into account the fact that European legislation excludes construction and demolition waste from the calculation of municipal waste (although national legislation includes some types of such waste in the calculation of separate collection), the recycling percentage has been calculated net of inert waste.

More in detail, the total generation of municipal waste is determined by ISPRA through the 'Guidelines for calculating the percentage of separate collection of municipal waste' contained in the Ministerial Decree of 26 May 2016. The latter, starting from 2016, has included some construction and demolition waste (LoW codes 170107 and 170904) in the separate collection, limited to the portions coming from small demolition works carried out directly by the tenant of the house. This waste amounted to approximately 364,000 tonnes in 2021, 1.9% of the national separate collection and 1.2% of the total generation.

The accounting methods identified by the decree differ, for this type of waste, from the definition of municipal waste given by Directive 2008/98/EC, as amended by Directive 2018/851/EU, and transposed into national law by Legislative Decree No. 116/2020. According to this definition, C&D waste is totally excluded from municipal waste and hence cannot be counted in the recycling targets. Therefore, for the purpose of calculating the recycling rate, this waste was excluded from the count.

According to the estimates made by ISPRA from the databases at its disposal, municipal waste shows the composition displayed in Table 3.1. The percentages in the table represent average values, calculated for the period 2009-2021 by combining data on the composition of mixed municipal waste, from waste analyses available to ISPRA, with data on the separate collection of the various fractions.

Bio-waste (biodegradable waste from kitchens and canteens and from garden and park maintenance) accounts for almost 35% of the waste produced annually nationwide . Paper and cardboard account for just under 22%, while plastics account for just under 13%.

In 2021, the rate of preparation for re-use and recycling, calculated according to the methodological approach described, stands at 48.1% (Figure 3.4).

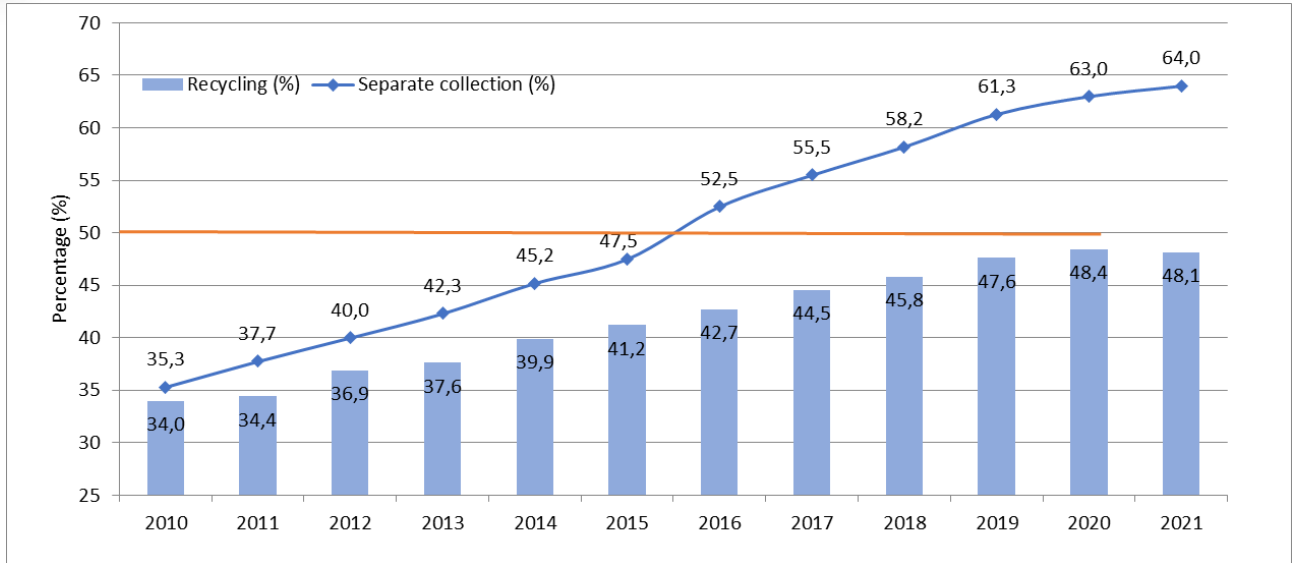
Overall, the use of a stricter calculation approach leads to a substantial stability of the recycling rate compared to 2020, when a value of 48.4% was recorded. It should also be noted that the 2020 data had already been partially processed on the basis of the new methodology.

**Table3.1 – Municipal waste composition estimated by ISPRA (average 2009 - 2021)**

Fractions	North	Centre	South	Italy
	(%)			
Bio-waste (biodegradable kitchen and canteen wastes + garden and park wastes)	34,0	30,2	38,8	34,7
Paper and cardboard	21,4	24,3	20,6	21,8
Plastics	11,8	14,5	13,0	12,7
Metals	2,4	2,5	2,3	2,4
Glass	9,5	6,7	7,2	8,2
Wood	4,8	2,8	1,9	3,5
WEEE	-	-	-	1,0
Clothes/Textiles	-	-	-	4,4
C&D materials/street-cleaning residues	-	-	-	0,7
separate collection of selected waste	-	-	-	0,3
Diapers/absorbent materials	-	-	-	4,7
Other	-	-	-	5,6
			<b>Total</b>	<b>100,0</b>

Source: ISPRA estimates

**Figure 3.4 - Recycling rates of municipal waste (net of C&D waste quantities from separate collection), years 2010 - 2021**

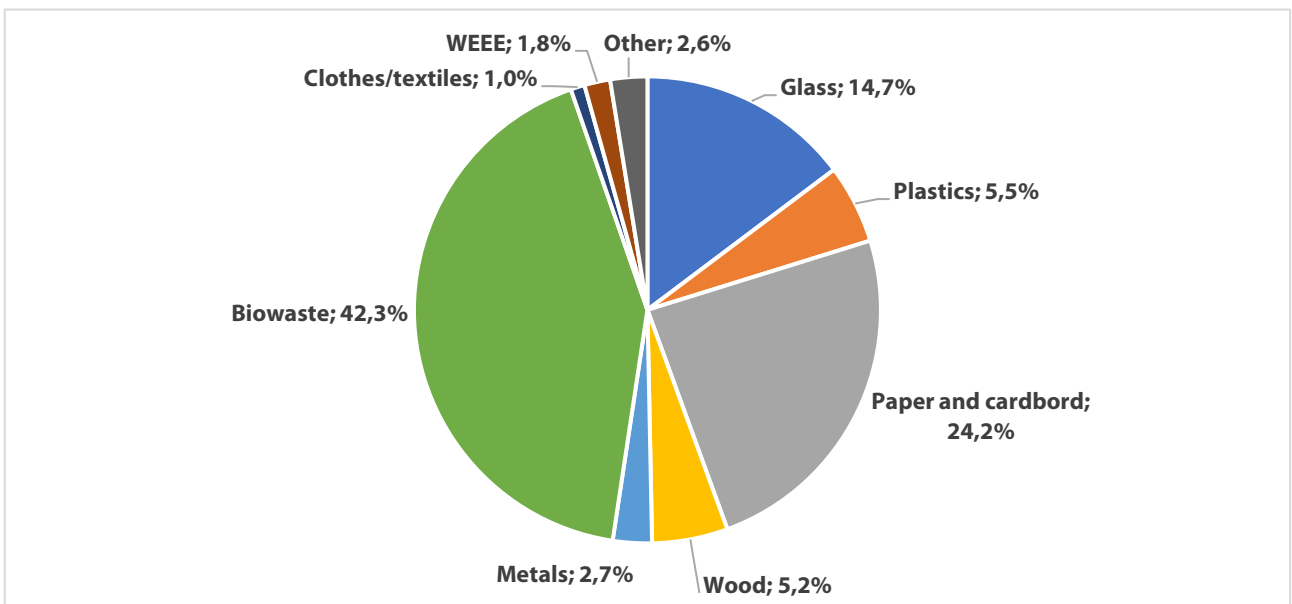


Source: ISPRA

In recent years, there has been a progressive widening of the gap between the percentage of separate collection and the recycling rates, proof of the fact that collection, while being a step of primary importance to ensure that homogeneous flows are obtained, cannot represent the only element to achieve high recycling levels as it is necessary to ensure that the quantities collected are also characterised by a high quality for effective recycling. The development of separate collections must also necessarily be accompanied by the availability of an adequate management plant system.

The percentage breakdown of the quantities sent for recycling by product fraction (Figure 3.5) shows that bio-waste accounted for 42.3% and paper and cardboard for 24.2% (25.2% in 2020). Glass represented 14.7% of the total recycled, wood 5.2% and plastic 5.5% (4.6% in 2020).

**Figure 3.5 – Percentage distribution of municipal waste sent for recycling, year 2021**



Source: ISPRA



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### 3.2 Biological treatment of *bio-waste*

The growing demand for the treatment of biodegradable municipal waste, determined by the progressive increase of separate collection over the years, has favoured a considerable development of the biological treatment sector, which has also evolved by adopting innovative plant technologies.

Alongside the traditional aerobic treatment systems, aimed at producing agricultural soil improvers, the national plant system, also through the reconversion of existing plants, has over the years equipped itself with integrated systems that combine aerobic treatment with anaerobic digestion. This type of plants allows for the combination of material and energy recovery, the containment of emissions and the usage of generated and purified biogas for the production of energy and biomethane.

In 2021 the national plant allocation remains virtually unchanged from the previous year, confirming that the biological treatment sector has the treatment capacity to respond adequately to the increasing development of separate waste collection.

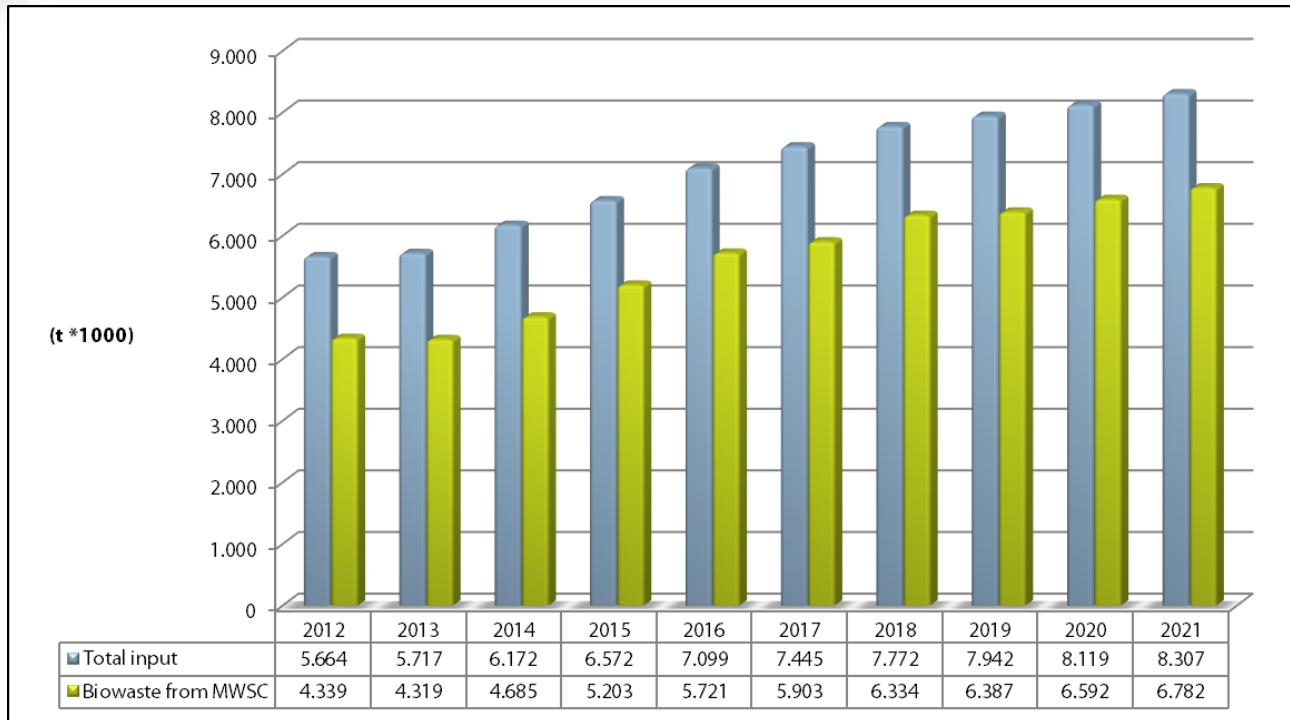
The plant system as a whole consists of 356 operating units, with a total authorised quantity of approximately 11.2 million tonnes, of which:

- 293 plants dedicated to aerobic treatment only (composting);
- 42 anaerobic/aerobic integrated treatment plants;
- 21 anaerobic digestion plants.

Figure 3.2.1 shows the trend in the quantities of waste managed in the period from 2012 to 2021, with details of the bio-waste fraction from separate collection. Data analysis shows a progressive growth in the sector, both in terms of the total quantities treated (+46.7% between 2012 and 2021) and in terms of the quantities of bio-waste, which increased by 56.3% over the same period.

The total amount of waste recovered through biological treatment processes (8.3 million tonnes) shows an increase of 188,000 tonnes (+ 2.3%) compared to 2020. The share of bio-waste, in particular, rises from about 6.6 million tonnes to about 6.8 million tonnes (81.6% total treated), showing an increase of 190 thousand tonnes (+ 2.9%).

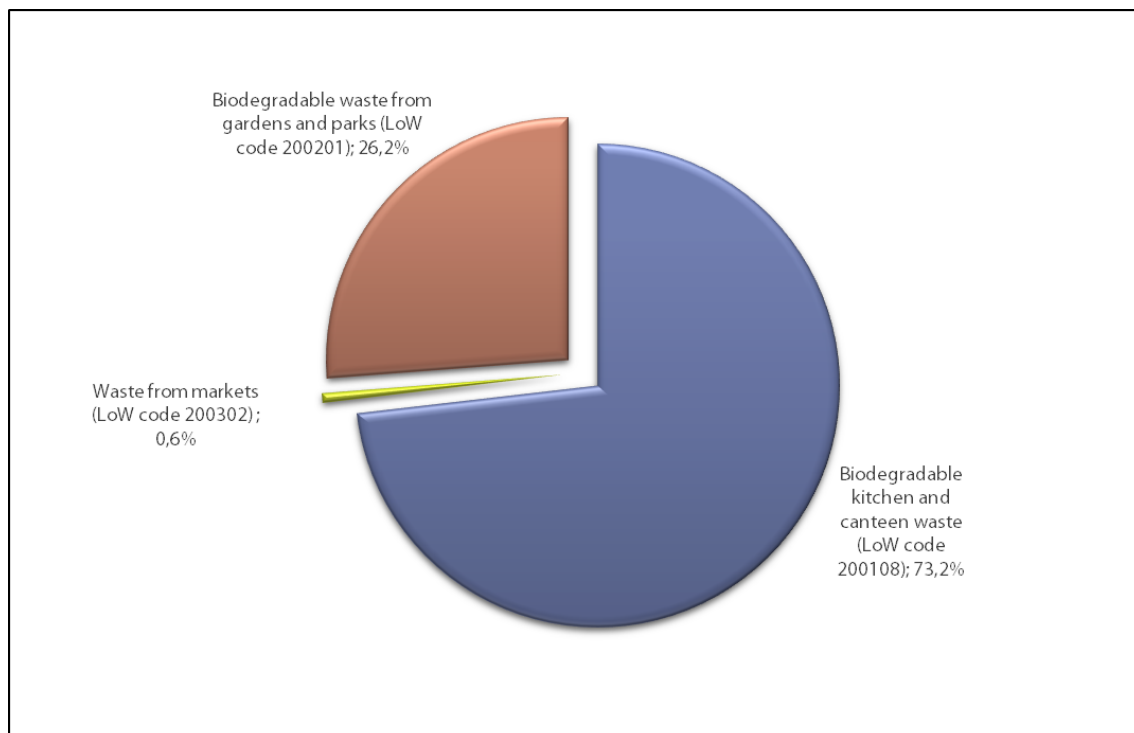
**Figura 3.2.1 - Quantities of waste undergoing biological treatment, years 2012 - 2021**



Source: ISPRA

Bio-waste from separate collection, treated in 2021 mainly consisted of 'biodegradable kitchen and canteen waste' (LoW code 200108) with about 5 million tonnes, or 73.2% of the total. The 'biodegradable waste from gardens and parks' (LoW code 200201), with about 1.8 million tonnes, accounted for 26.2% of the total, while 'waste from markets' (LoW code 200302), with more than 42 thousand tonnes, accounts for the residual share of 0.6% (Figure 3.2.2).

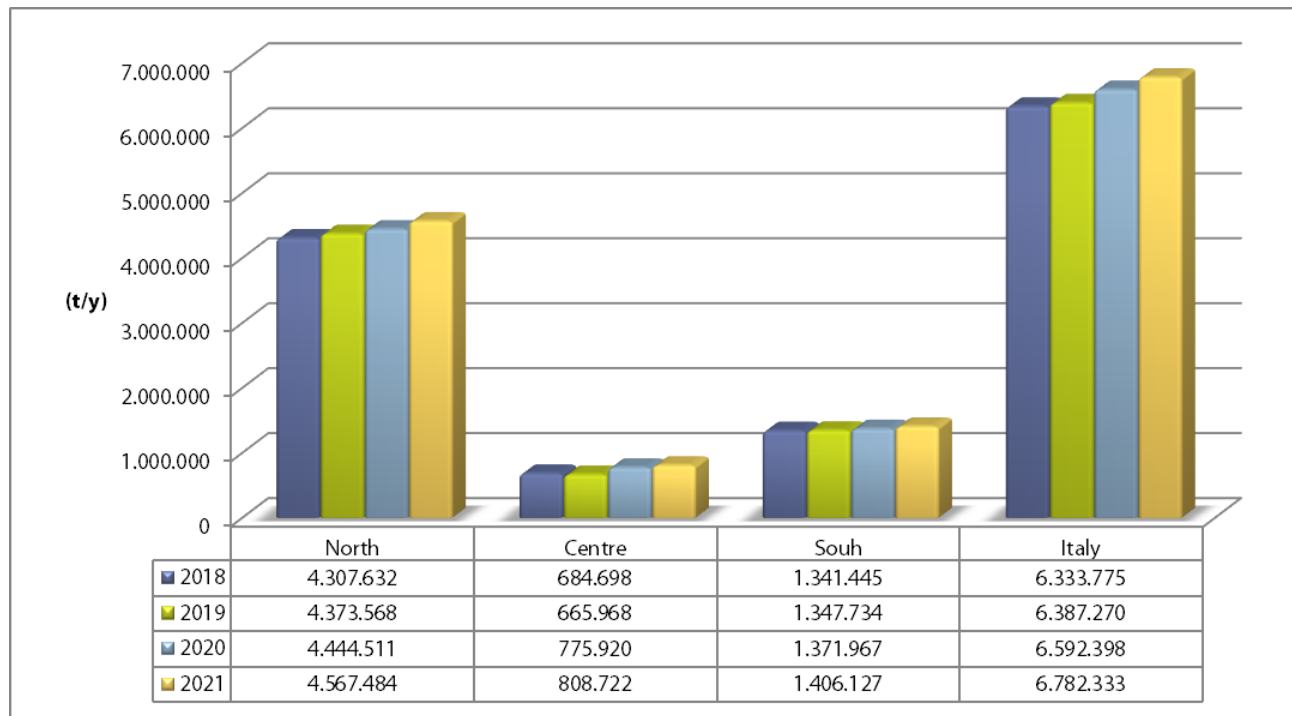
**Figura 3.2.2 – Composition of the bio-waste fraction from separate collection undergoing biological treatment, year 2021**



Source: ISPRA

The trend in the quantities of bio-waste treated showed an increase in all regions of the country (Figure 3.2.3). The northern regions showed a growth of about 123,000 tonnes (+ 2.8%), despite the fact that plant equipment decreased by 6 units (3 composting plants, 1 integrated treatment plant and 2 anaerobic digestion plants). Growth in the central regions was lower, but higher in percentage terms (about 33,000 tonnes, +4.2%), with a reduction of 2 composting units. In the southern regions, the progression was steady, the organic fractions from separate collection increased by more than 34 thousand tonnes (+2.5%) and there were 5 more operating units than in 2020, all dedicated to composting.

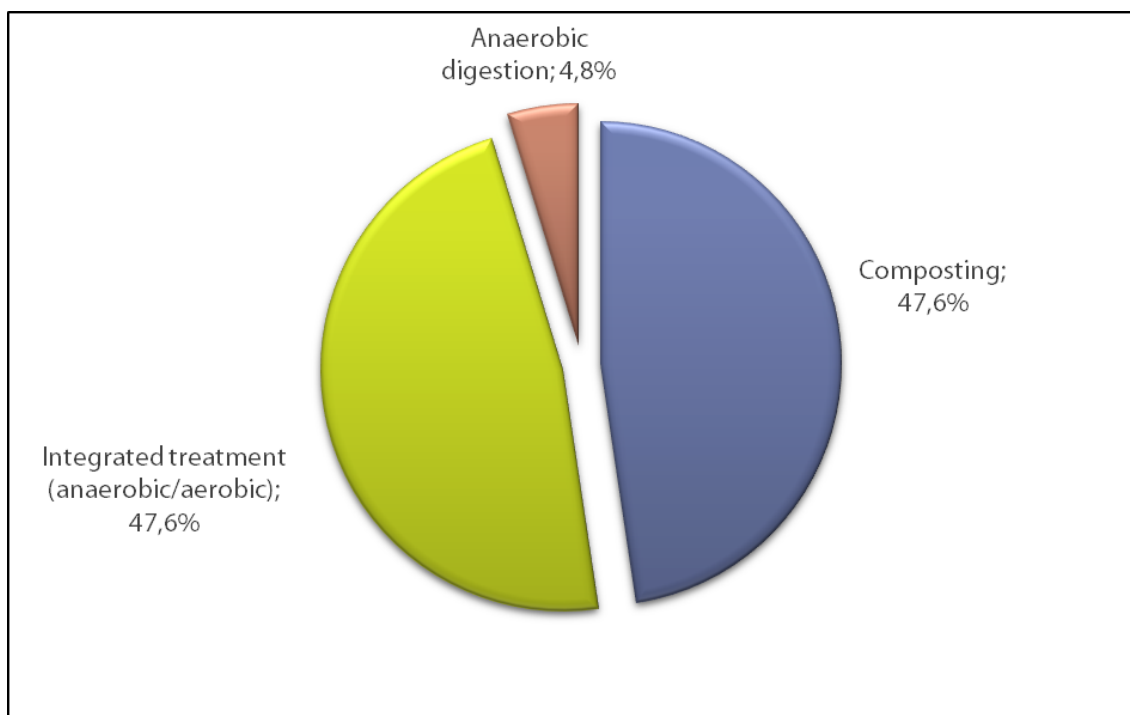
**Figure 3.2.3 – Treatment of the bio-waste from separate collection, by geographical macro-area, years 2018 - 2021**



Source: ISPRA

Figure 3.2.4 shows the percentage distribution of the different types of biological treatment of bio-waste adopted at national level. Integrated treatment (anaerobic/aerobic) now contributes to the recovery of sorted bio-waste in a similar way to composting. In 2021, in fact, the two treatments, each with 3.2 million tonnes, contributed equally (47.6% of the total) to the treatment of bio-waste, while the remaining 4.8%, over 321 thousand tonnes, is managed in anaerobic digestion plants.

**Figure 3.2.4 – Biological treatment of the bio-waste fraction from separate waste collection, year 2021**



Source: ISPRA

Figure 3.2.5 shows the trend of the quantities subjected to the different types of management in the period from 2017 to 2021.

It is noticeable how integrated treatment is characterised by a constant growth that, between 2020 and 2021, stands at 147 thousand tonnes, or 4.8% (+ 37.1% compared to 2017). A similar trend, albeit with less significant variations, is registered for composting, with an increase of 59 thousand tonnes, corresponding to 1.9%. Compared to 2017, this sector shows a slight loss of 0.9% in the treatment of bio-waste.

Anaerobic digestion, on the other hand, shows a decrease of 17 thousand tonnes, (-4.9%), compared to 2020, while the trend compared to 2017 remains positive (+ 11.7%).

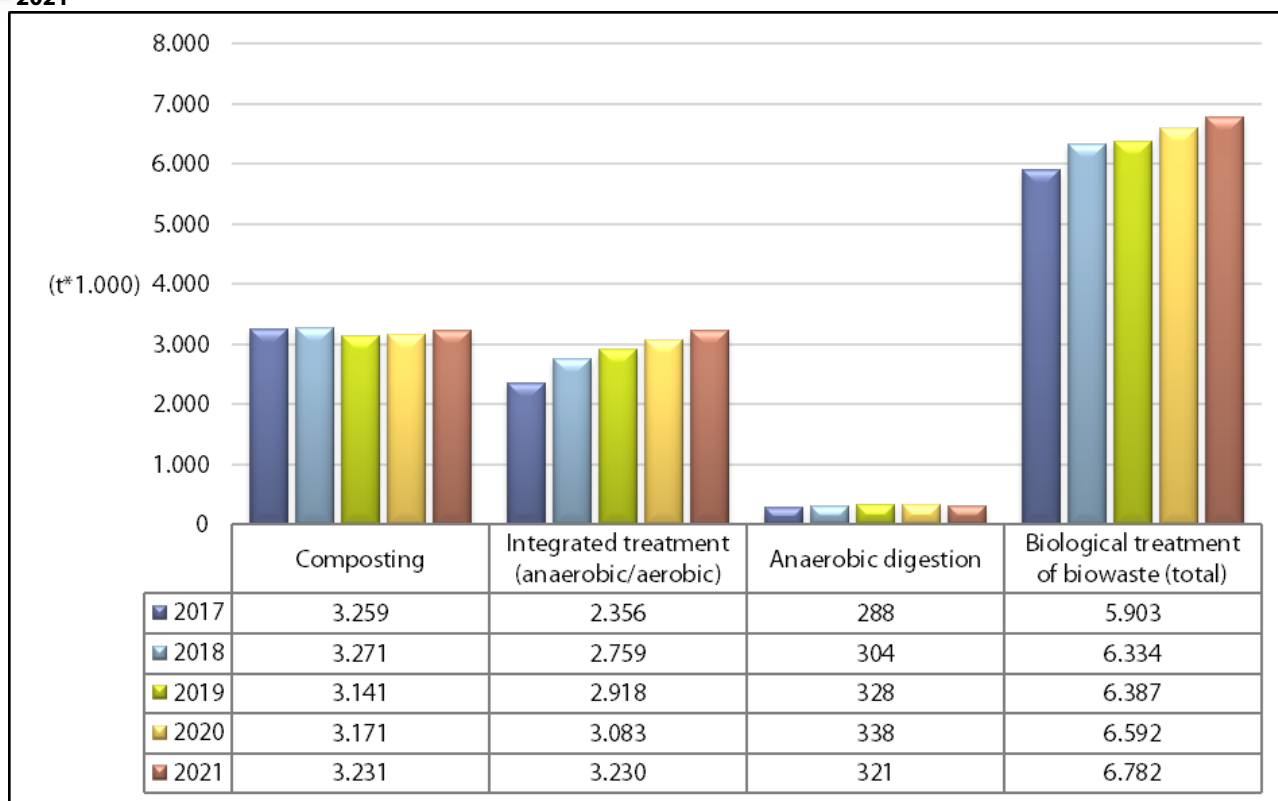
The analysis of the data shows how the combination of the two processes, anaerobic and aerobic, proves decisive in increasing the quantities of bio-waste recovered thanks to the possibility of producing, on the one hand, quality soil improvers that comply with the characteristics required by the regulations on fertilisers to be used in agriculture, and, on the other, of using the biogas generated directly for the cogeneration of electricity and heat, and/or further purified, for the production of biomethane for automotive use and other uses instead of natural gas.

In fact, data for the year 2021 showed a growing interest in the biogas purification technology; there are 13 (10 in 2020) integrated treatment plants dedicated to biomethane production. In the North of the country, most of the regions have a plant of this type (Piemonte (TO), Lombardia (BG), Trentino-Alto Adige (TN), Veneto (PD), Friuli-Venezia Giulia (PN) and Liguria (SV)); while 3 are located in Emilia-Romagna, in the provinces of Piacenza, Modena and Bologna. In the Centre, there are two operating plants, one in Umbria (PG) and one in Lazio (RM); while in the South, a new plant has been operating in Sicily (CL) since November 2021 and one in Calabria (CS) since 2018.

Other 3 plants dedicated to anaerobic digestion started producing biomethane already in 2020, located in Lombardia (LO), Emilia-Romagna (RA) and Molise (CB).

Other plants are expected to start up, either newly built or from conversion of aerobic treatment to an integrated one. A portion of these plants are equipped with biomethane production technology and are located in Piemonte, Lombardia, Liguria, Lazio, Abruzzo and Calabria. Moreover, some of these units are already operational by 2022.

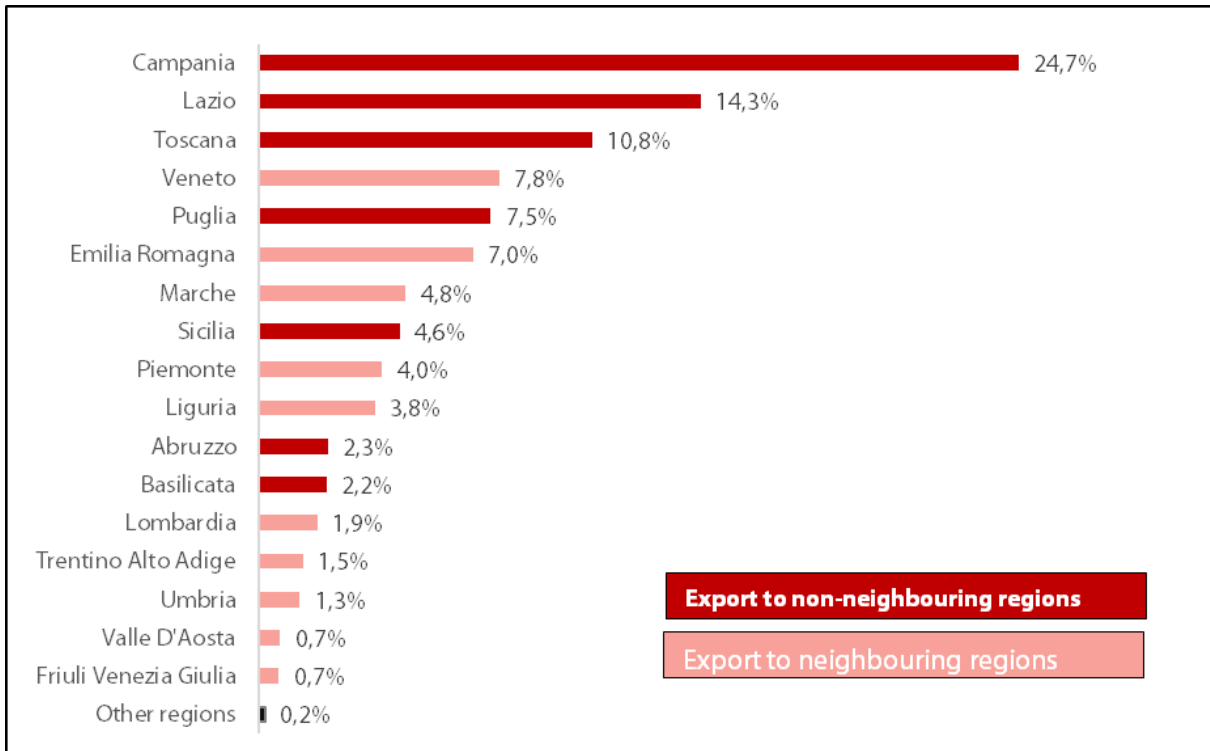
**Figure 3.2.5 – Biological treatment of the bio-waste fraction from separate collection, by type of management, years 2017 – 2021**



Source: ISPRA

Structural inadequacies in some regions have resulted in this waste being moved to plants located outside the territory where it is produced, in regions that are often far away. Analysing the bio-waste flows sent out of the region, it can be seen that the largest quantities come from Campania (490 thousand tonnes), Lazio (285 thousand tonnes) and Tuscany (over 215 thousand tonnes) regions that, therefore, fail to close the bio-waste management cycle on their territory (Figure 3.2.6).

**Figura 3.2.6 - Transfer of the bio-waste from separate collection, in non-regional territories, by region, year 2021**

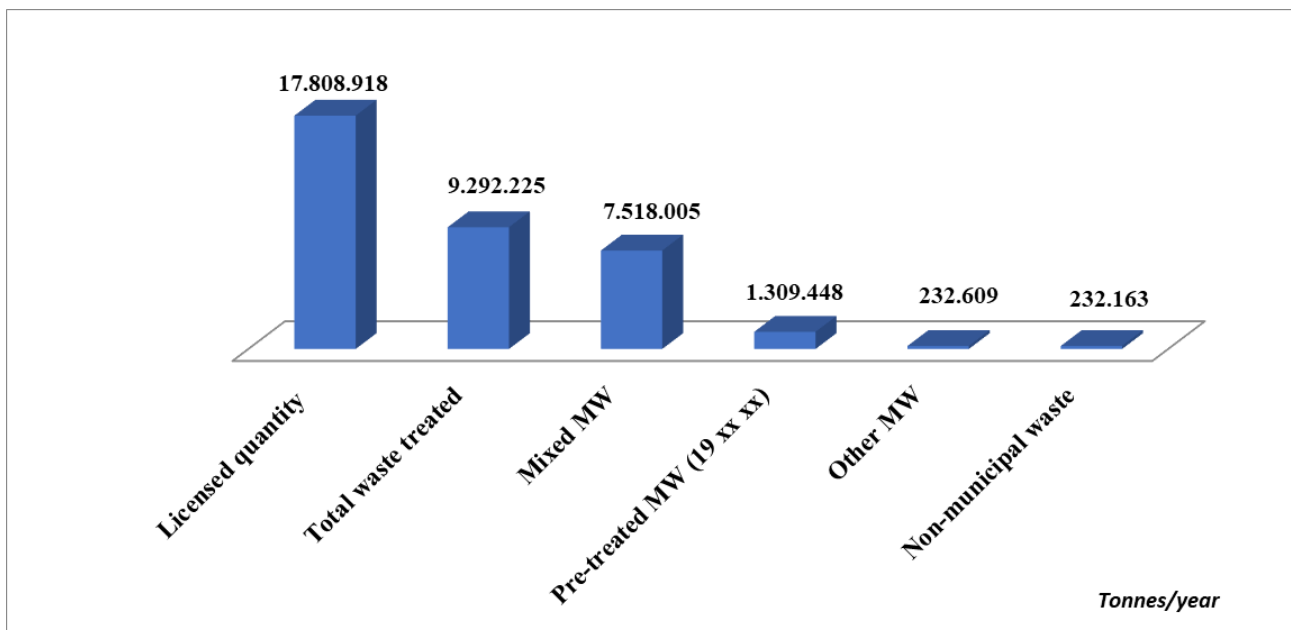


Source: ISPRA

### 3.3 Aerobic mechanical-biological treatment

In 2021, the amount of waste sent for mechanical biological treatment (MBT) or simply mechanical treatment (MT) were almost 9.3 million tonnes (Figure 3.3.1). Of the waste treated, 80.9% is mixed municipal waste (7.5 million tonnes), 14.1% is waste from the treatment of municipal waste (1.3 million tonnes), 2.5% (almost 233 thousand tonnes) are other fractions of municipal waste (paper, plastic, metal, wood, glass and bio-waste fractions from separate collection) and, finally, 2.5% (just over 232 thousand tonnes) are waste from industrial sectors (agro-industry, wood processing, etc.) and from the treatment of other waste (LoW 1912\*\*).

**Figure 3.3.1 - Quantity of waste entering MBT/MT plants (tonnes), year 2021**



Source: ISPRA

In 2021, there were 124 plants operating in Italy; including 20 plants that only perform mechanical treatment of mixed municipal waste and some MBT plants that did not perform the biostabilisation process of the bio-waste fraction in the year under review. Overall, the Italian plant system is authorised to treat 17.8 million tonnes of waste.

Figure 3.3.2 shows the regional distribution of plants; specifically, in the North there are 41 plants (including 11 MTs), in the Centre 34 (7 MTs) and in the South 49 (2 MTs).

**Figure 3.3.2 – Regional distribution of MBT/MT plants, year 2021**



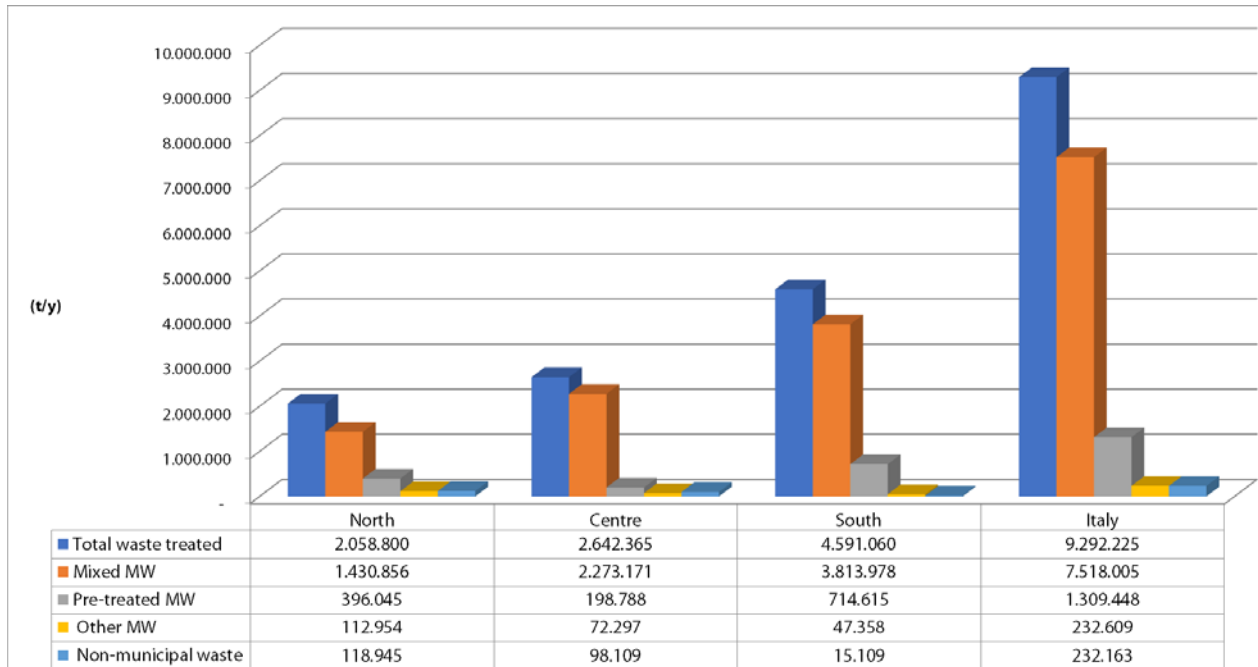
Source: ISPRA

In the North, just over 2 million tonnes of municipal waste were treated, of which more than 1.4 million tonnes were mixed municipal waste (69.5% of the total), the rest being pre-treated municipal waste (396 thousand tonnes, 19.2%), fractions from separate collection (almost 113 thousand tonnes, 5.5%) and waste from economic activities (almost 119 thousand tonnes, 5.8%).

In the Centre, were treated more than 2.6 million tonnes, of which almost 2.3 million tonnes were mixed municipal waste, 86% of the total. The remaining part consisted of pre-treated municipal waste (almost 199 thousand tonnes, 7.5% of the total), fractions from separate collection (over 72 thousand tonnes, 2.7%) and waste from economic activities (over 98 thousand tonnes, 3.7%).

The South is the macro-area that sends the largest amount of waste to such intermediate treatment and the waste treated amounted to almost 4.6 million tonnes, of which 3.8 million tonnes were mixed municipal waste (83.1% of the total). The remaining part consisted of pre-treated municipal waste (almost 715 thousand tonnes, 15.6% of the total), fractions from separate collection (over 47 thousand tonnes, 1%) and waste from economic activities (15 thousand tonnes, 0.3%) (Figure 3.3.3).

**Figure 3.3.3 – Types of waste treated in MBT/MT plants, by geographical macro-area (tonnes), year 2021**



Source: ISPRA

The quantities treated in the investigated plants decreased by almost 335 thousand tonnes (-3.5%) compared to 2020, due to a decrease in quantities of both mixed municipal waste and waste resulting from its treatment. This decrease is smaller, compared to 2020, due to the national economic recovery after the emergency phase related to the pandemic.

In detail, the quantities of mixed municipal waste subjected to mechanical biological treatment/mechanical treatment decreased by 2.2% (over 166,000 tonnes). Similarly, pre-treated waste decreased by 11.5% (almost 170 thousand tonnes), while the other fractions of separated waste collection remained almost stable (+339 tonnes). An increase of 0.4% was observed for waste from economic activities, amounting to approximately 1,000 tonnes.

The reduction in the quantities of treated waste involved all geographical areas. In particular, the most significant reduction was recorded in the South where treated waste decreased by 3.5% compared to 2020 (over 164 thousand tonnes). The Centre shows a decrease of over 91 thousand tonnes of waste, equal to 3.3% and, finally, the North a diminishment of 79 thousand tonnes, equal to 3.7%.

Figure 3.3.4 shows detailed information on waste generated by TMB and TM plants and destined for other forms of treatment.

With reference to LoW code 191212, it is necessary to specify that plant operators use this code to identify the dry fraction, but also waste from waste treatment and sometimes the wet fraction. Therefore, where plant operators have provided detailed data, through a specific questionnaire prepared and administered by ISPRA, it has been possible to distinguish the different fractions. On the other hand, where no such distinction could be made, LoW code 191212 was identified as the dry fraction.

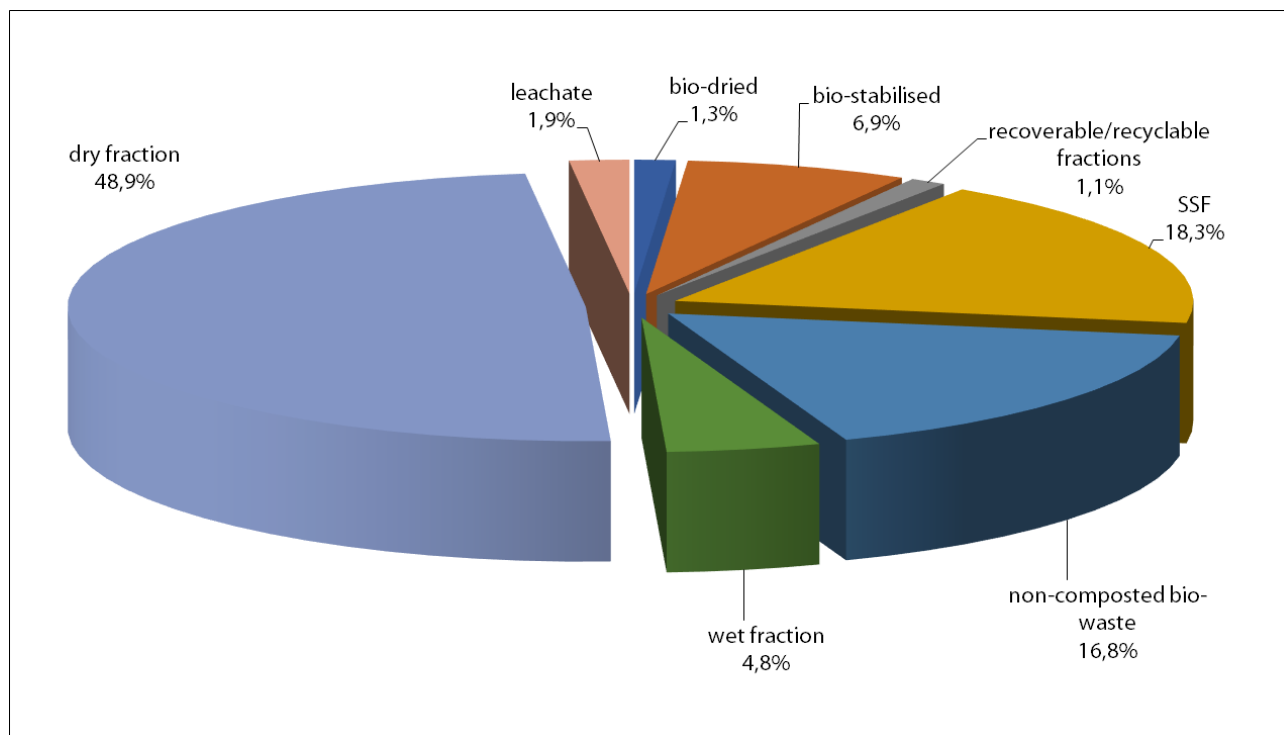
The waste produced by the mechanical biological and mechanical treatment plants in the year 2021 was approximately 8.1 million tonnes and consisted of:

- dry fraction : over 3.9 million tonnes (48.9% of the total waste produced);



- combustible waste (RDF): almost 1.5 million tonnes (18.3%);
- non-composted bio-waste: about 1.4 million tonnes (16.8%);
- bio-stabilised waste: over 560,000 tonnes (6.9%);
- bio-dried waste : almost 104 thousand tonnes (1.3%);
- recoverable/recyclable fractions sent to recovery operations, including recycling, such as paper, plastic, metals, wood, glass: almost 91 thousand tonnes (1.1%).
- wet fraction: 387 thousand tonnes (4.8%);
- leachate: 151 thousand tonnes (1.9%).

**Figure 3.3.4 – Percentage distribution of waste/material produced in MBT/MT plants, year 2021**

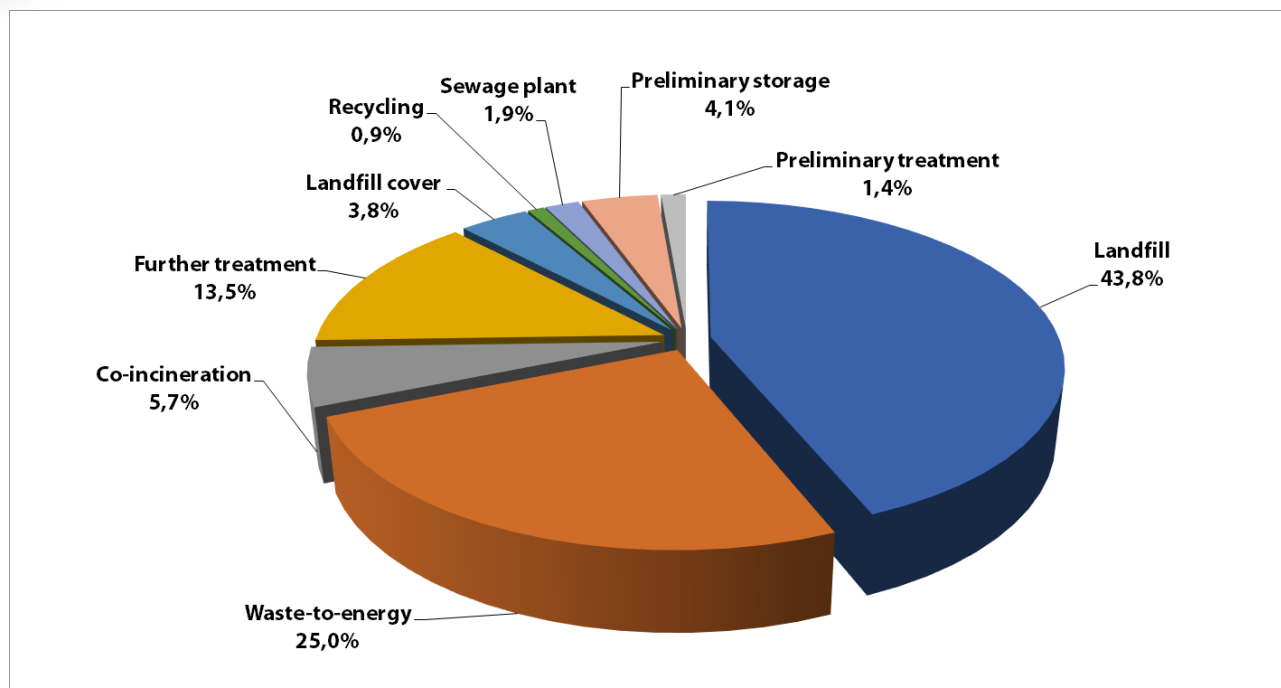


Source: ISPRA

Figure 3.3.5 shows which management operations the waste generated by mechanical biological and mechanical treatment is destined for, in the year 2021. The portion destined for "further treatment" includes quantities sent to biostabilisation and RDF production/refining operations carried out at other similar plants. The quantities of waste destined for "preliminary treatment", on the other hand, are those sent to management plants authorised to waste exchange in order to subject them to one of the operations indicated from R1 to R11 (R12).

Similar to the year 2020, fractions such as paper and cardboard, plastic and rubber, metals, glass, wood, etc. were included in the recovery/recycling operations. However, the same fractions destined for the pre-treatment operation (R12) were not included in recycling.

**Figura 3.3.5 – Management operations for waste generated by MBT/MT plants, year 2021**



Source: ISPRA

More than 3.5 million tonnes or 43.8% of the total waste produced by the treatment plants mentioned above is then disposed of in landfills. This waste produced by the treatment of municipal waste consists mainly of dry fraction (about 2.2 million tonnes), non-composted bio-waste (almost 916 thousand tonnes) and bio-stabilised waste (almost 343 thousand tonnes). Compared to 2020 (Figure 3.3.6), there was a decrease of 7.1% (almost 271 thousand tonnes) in the amount sent to landfill. This reduction is attributable to the decrease in the amount of waste entering the MBT/MT plants.

About 2 million tonnes of this waste (25%) are instead sent to incineration plants with energy recovery, consisting of dry fraction (over 931 thousand tonnes), combustible waste (almost 829 thousand tonnes) and non-composted bio-waste (over 136 thousand tonnes). Compared to 2020, these quantities show a decrease of 10%.

3.5% of this waste, approximately 1.1 million tonnes, required further treatment (i.e. biostabilisation processes and production/refining of combustible waste) mainly involving the dry fraction (651 thousand tonnes), the wet fraction (242 thousand tonnes), the non-composted organic fraction (135 thousand tonnes), the combustible waste (33 thousand tonnes) and the bio-stabilised waste (24 thousand tonnes). Compared to 2020, there has been an increase of 16.5% in this form of intermediate treatment.

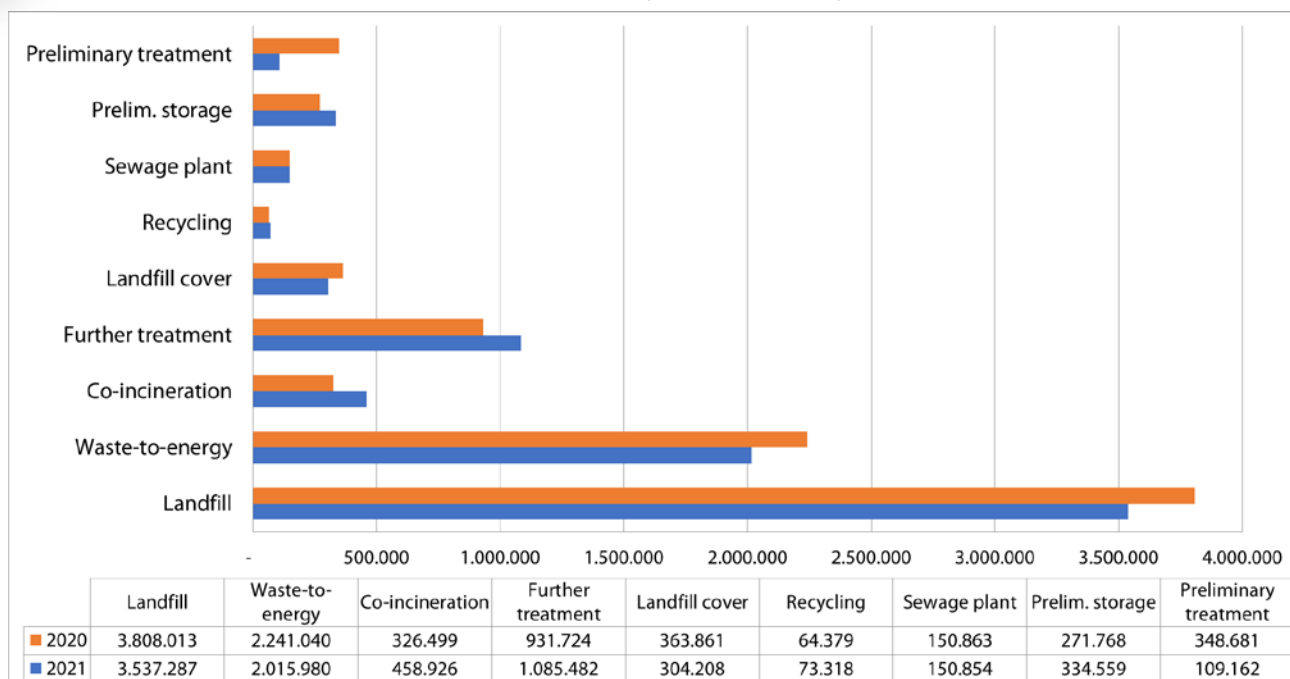
Nearly 459 thousand tonnes of waste, i.e. 5.7% of the total, were sent for co-incineration at production plants (cement plants, power generation plants and wood processing plants). This waste consisted of CSS (323 thousand tonnes), dry fraction (almost 79 thousand tonnes) and non-composted bio-waste fraction (about 53 thousand tonnes). Compared to 2020, the amount of waste sent for co-incineration showed an increase of 40.6%.

304 thousand tonnes of waste (3.8% of the total) were destined for landfill coverage and consisted mostly of bio-stabilised (184 thousand tonnes) and non-composted organic fraction (115 thousand tonnes). Compared to 2020 (Figure 3.2.10), the amount of waste destined for landfill coverage shows a reduction of 16.4%.

Finally, the quantities destined for recycling amount to over 73 thousand tonnes (0.9% of the total) with a reduction of 13.9% compared to 2020. More than 109 thousand tonnes of waste (1.4%) are destined for preliminary treatment operations and 334 thousand tonnes of waste (4.1%) are sent to storage.



**Figure 3.3.6 – Management operations on waste generated by MBT/MT plants, years 2020 - 2021**



Source: ISPRA

### 3.4 Municipal waste incineration

On a national level, 37 incineration plants are operational as of 2021, treating municipal waste and waste resulting from the treatment of municipal waste such as combustible waste (RDF / SRF), dry fraction and bio-dried waste.

These plants are mainly located in northern regions (26 plants). In Lombardia and Emilia-Romagna there are 13 and 7 operational plants respectively, that in 2021 treated a total of approximately 2.9 million tonnes of municipal waste, i.e. 74.3% of the total incinerated in the North and 53.1% of the national total. In the Centre and South of Italy, 5 and 6 plants are operational respectively (Figure 3.4.1 and Figure 3.4.2), which treated almost 527 thousand tonnes and 1 million tonnes of municipal waste.

In 2021, the total amount of municipal waste incinerated was 5.4 million tonnes (+1.6% compared to 2020; +2.7% compared to 2017). 71.5% of this waste is treated in the North, 9.7% in the Centre and 18.8% in the South of Italy.

In 2021, were treated almost 85 thousand tonnes more than in 2020. An increase in the quantity of municipal waste incinerated in the North equal to 3.5% was observed, while in the Centre and in the South regions there were decreases equal to 1.1% and 3.8% respectively.

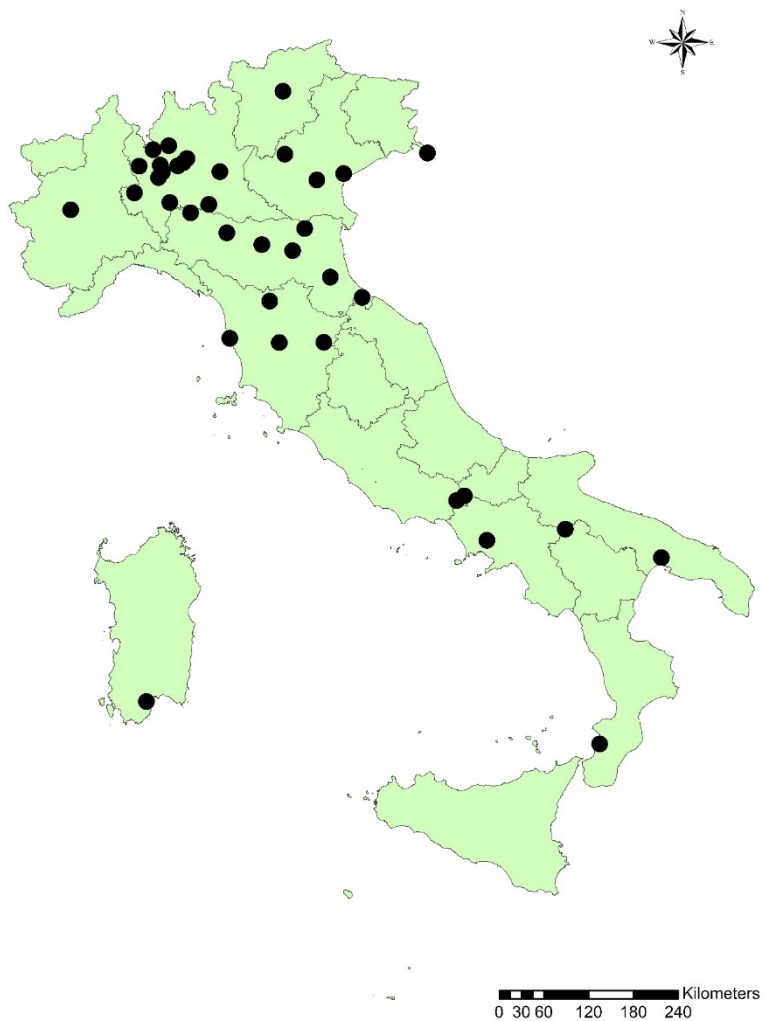
The analysis of regional data shows that 35.7% of the national total of municipal waste was incinerated in Lombardia; followed by Emilia-Romagna (17.4%), Campania (13.5%), Piemonte (9.8%), Lazio (5.7%), Veneto (4.5%), Toscana (4.1%), Friuli-Venezia Giulia (2.4%), Trentino-Alto Adige (1.8%), Molise (1.6%), Puglia (1.3%), Calabria (1.1%), Sardegna (1%) and Basilicata (0.1%).

The per capita amount of municipal waste incinerated increased of 2.1%, from 89.86 kg/inhabitant in 2020 to 91.71 kg/inhabitant in 2021. An analysis of the data for the last five years similarly shows an increase in the amount per capita of 2.8%.

Of the 5.4 million tonnes of waste sent for incineration, slightly more than half (over 2.7 million tonnes) is waste from the treatment of municipal waste (combustible waste, dry fraction and, to a lesser extent, bio-dried waste). The remaining share consists of untreated mixed municipal waste. Of the latter, 96% (almost 2.6 million tonnes) is mixed municipal waste (LoW code 200301), which is incinerated mainly in Lombardia (almost 984 thousand tonnes), Emilia-Romagna (over 644 thousand tonnes) and Piemonte (419 thousand tonnes). In these same plants, almost 657 thousand tonnes of non-municipal waste were incinerated, of which approximately 64 thousand tonnes were hazardous waste, mainly medical waste (almost 41 thousand tonnes).

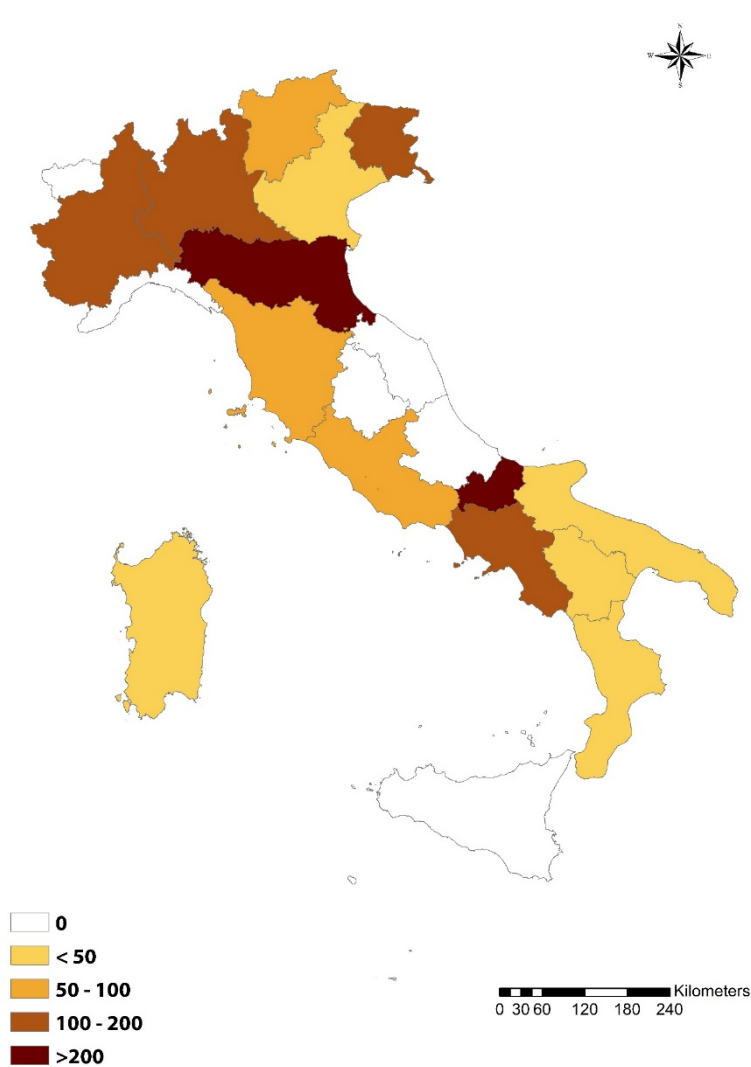
An analysis was made of the origin of certain types of waste treated in the incineration plants (combustible waste - LoW code 191210, waste produced by mechanical treatment of municipal waste - LoW code 191212, non-composted part of municipal waste and similar - LoW code 190501, and off-specification compost - LoW code 190503). The analysis allowed, with a good approximation, to distinguish waste of municipal origin from waste produced by the treatment of other non-municipal waste. The information were deduced from the MUD database, where the registrant is required to specify whether such waste is of municipal origin, and from specifically requested information where the plants from which the waste originated treated mainly municipal waste (e.g. mechanical biological treatment and composting plants).

Figure 3.4.1 – Geographical position of municipal waste incinerators, year 2021



Source: ISPRA

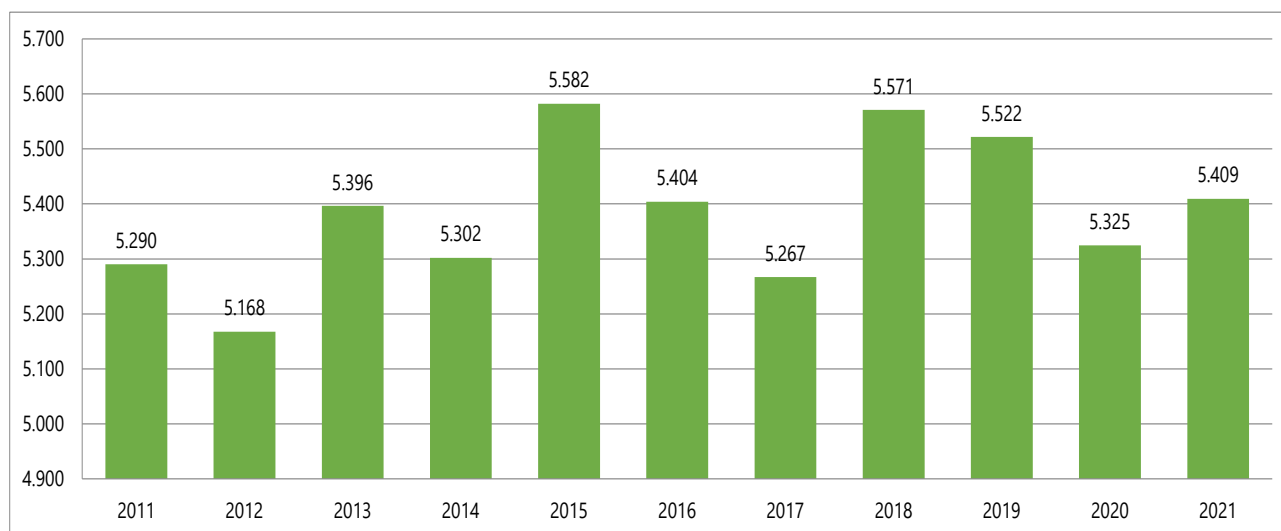
Figure 3.4.2 – Per capita amount of municipal waste incinerated, by region, 2021



Source: ISPRA

The quantities of waste incinerated in the period 2011-2021, shown in figure 3.4.3, remain fairly stable over the decade and range between approximately 5.2 and almost 5.6 million tonnes.

**Figure 3.4.3 – Municipal waste incineration in Italy (1,000\*tonnes), years 2011 – 2021**



Source: ISPRA

Table 3.4.1 shows the data for 2021 concerning electrical and thermal energy recovery, differentiating between plants in which a cogeneration cycle is present.

**Table 3.4.1 – Energy recovery in incineration plants treating municipal waste, year 2021**

	No. of plants	Total waste treated (t)	Energy recovery		Energy recovery per kg	
			Electrical (MWh)	Thermal (MWh)	kWhe/kg	kWht/kg
<b>RET&amp;E plants</b>	13	3.241.966	2.203.111	2.430.493	0,68	0,75
<b>REE plants</b>	23	2.824.214	2.196.371	0	0,78	-
<b>Total</b>	<b>36</b>	<b>6.066.180</b>	<b>4.399.481</b>	<b>2.430.493</b>	<b>0,73</b>	<b>0,40</b>

**Legend - RET&E=** plants with cogeneration cycle; **REE=** plants with electrical energy recovery only.

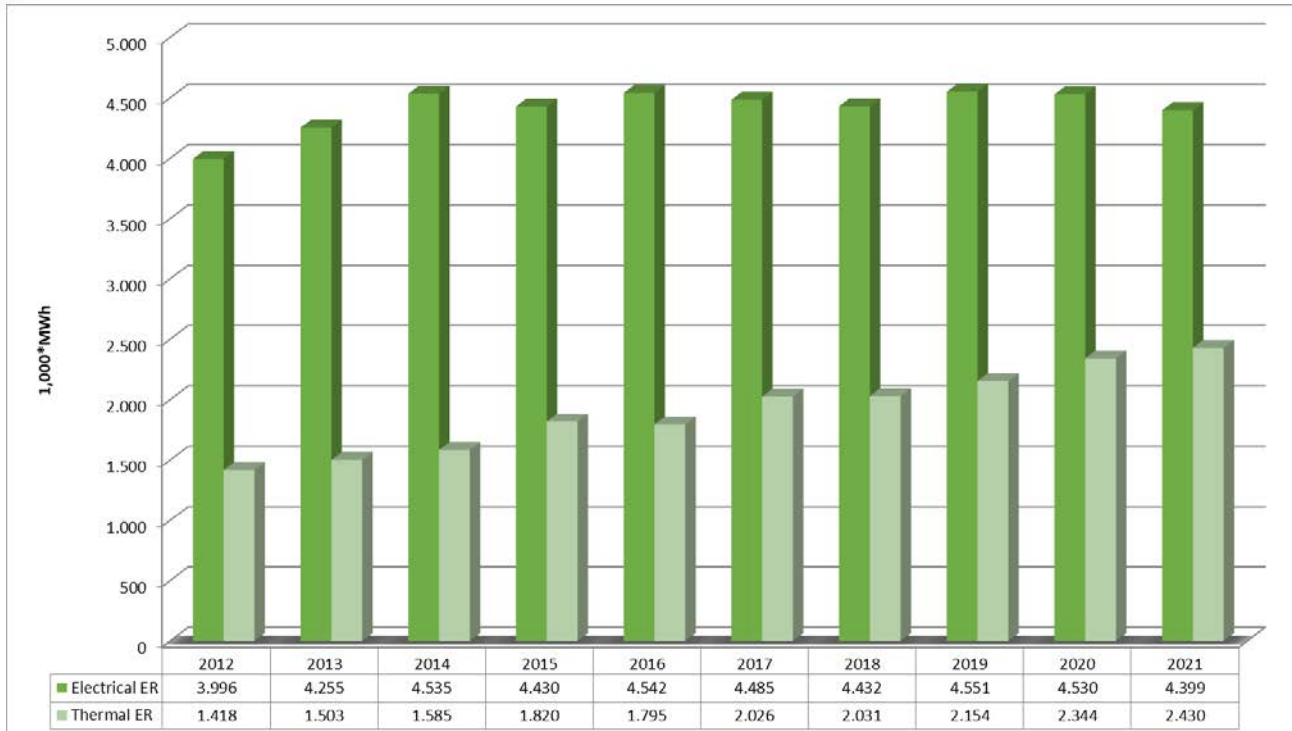
Source: ISPRA

Data analysis shows that all incineration plants in Italy recover energy, except one. 23 plants treated about 2.8 million tonnes of waste and recovered almost 2.2 million MWh of electrical energy. 13 plants are equipped with cogeneration cycles and have incinerated over 3.2 million tonnes of waste, recovering over 2.4 million MWh of thermal energy and 2.2 million MWh of electrical energy. It should be noted that the recovery of electrical/thermal energy is attributable to the total amount of waste treated by the individual plants and it is not possible to distinguish the share relating to the incineration of municipal waste only.

Figure 3.4.4 shows the trend, in the period 2012-2021, of the energy recovered by incineration plants that treat mostly municipal waste. The amount of electrical energy produced in the 2012-2021 period shows a progressive increase from 4 million MWh in 2012 to over 4.5 million MWh in 2021. Thermal energy, produced exclusively by the plants located in the North, increases from about 1.3 million MWh in 2012 to over 2.3 million MWh in 2021.



**Figure 3.4.4 – Energy recovery in incineration plants (1,000\*MWh), years 2012 - 2021**



Source: ISPRA

## Co-incineration of municipal waste

In 2021, 401 thousand tonnes of municipal waste were used as an alternative to traditional fuels in 14 production plants. In particular, these plants are predominantly cement plants and electricity/thermal power plants.

The waste consisted almost exclusively of combustible waste (LoW code 191210) and/or dry fraction (DF - LoW code 191212) mainly produced in mechanical biological treatment plants.

The analysis of data at geographical macro-area shows that in the North of Italy, co-incinerated municipal waste amounted to 220 thousand tonnes (54.9 % of the total), in the South over 170 thousand tonnes (42.5%) and in the Centre about 10 thousand tonnes (2.6%) (Table 3.4.2).

**Table 3.4.2 - Co-incineration of municipal waste, year 2021**

Region	Province	Municipality	MW	Dry Fraction, RDF/SRF	Total MW	Other Non-hazardous Waste	Other Hazardous Waste	Total
Piemonte	CN	Robilante	-	60.172	60.172	-	-	60.172
Lombardia	BG	Calusco D'Adda	-	12.607	12.607	10.432	-	23.039
Lombardia	LO	Castiraga Vidardo	-	32.260	32.260	-	-	32.260
Lombardia	VA	Caravate	-	9.987	9.987	10.723	-	20.710
Lombardia	VA	Comabbio	-	28.463	28.463	46.904	14.952	90.319
Lombardia	MN	Sustinente	-	18.496	18.496	99.993	-	118.490
Friuli-Venezia Giulia	PD	Fanna	-	2.197	2.197	-	-	2.197
Emilia-Romagna	RA	Faenza	34.449	21.660	56.109	47.767	-	103.876
<b>North</b>			<b>34.449</b>	<b>185.842</b>	<b>220.291</b>	<b>215.819</b>	<b>14.952</b>	<b>451.063</b>
Toscana	AR	Castel Focognano	-	10.419	10.419	19.980	-	30.399
<b>Centre</b>			-	<b>10.419</b>	<b>10.419</b>	<b>19.980</b>	-	<b>30.399</b>
Molise	IS	Sesto Campano	-	9.512	9.512	15.030	-	24.542
Basilicata	PZ	Barile	-	24.217	24.217	-	-	24.217
Calabria	CZ	Marcellinara	-	4.062	4.062	6.458	-	10.520
Puglia	BT	Barletta	-	27.678	27.678	-	-	27.678
Puglia	FG	Manfredonia	-	104.935	104.935	115.882	-	220.817
<b>South</b>			-	<b>170.404</b>	<b>170.404</b>	<b>137.370</b>	-	<b>307.774</b>
<b>Total</b>			<b>34.449</b>	<b>366.665</b>	<b>401.114</b>	<b>373.169</b>	<b>14.952</b>	<b>789.236</b>

Source: ISPRA



### 3.5 Landfilling of municipal waste

In 2021, 126 landfills for non-hazardous and hazardous municipal waste were operational nationwide. Compared to 2020, the landfill census showed an overall stable situation. The number of landfills in the North remained almost unchanged (-1 unit, from 54 facilities in 2020 to 53 in 2021), in the Centre increased by 2 facilities (from 26 in 2020 to 28 in 2021) while in the South decreased by 6 facilities (from 51 in 2020 to 45 in 2021). However, the increases in the number of facilities do not concern new plant installations but existing landfills that, unlike previous years, received municipal waste in 2021 (Table 3.5.1). Most of the landfills are in the North, thus showing an uneven distribution throughout the country.

**Table 3.5.1 - Landfills for non-hazardous and hazardous waste, disposing of municipal waste, by geographical macro-area (tonnes\*1,000), years 2017 - 2021**

Macroarea	No. of plants					Quantity of MW disposed of (t/y * 1,000)				
	2017	2018	2019	2020	2021	2017	2018	2019	2020	2021
North	51	56	54	54	53	1.719	1.541	1.527	1.479	1.468
Centre	27	25	30	26	28	1.533	1.599	1.910	1.751	1.714
South	45	46	47	51	45	3.675	3.356	2.846	2.587	2.436
<b>ITALY</b>	<b>123</b>	<b>127</b>	<b>131</b>	<b>131</b>	<b>126</b>	<b>6.927</b>	<b>6.496</b>	<b>6.283</b>	<b>5.817</b>	<b>5.619</b>

Source: ISPRA

Figure 3.5.1 shows the geographic location of operational landfills disposing of municipal waste in the year 2021, by category, while Figure 3.5.2 shows the amount of municipal waste disposed of in landfills, at regional level.

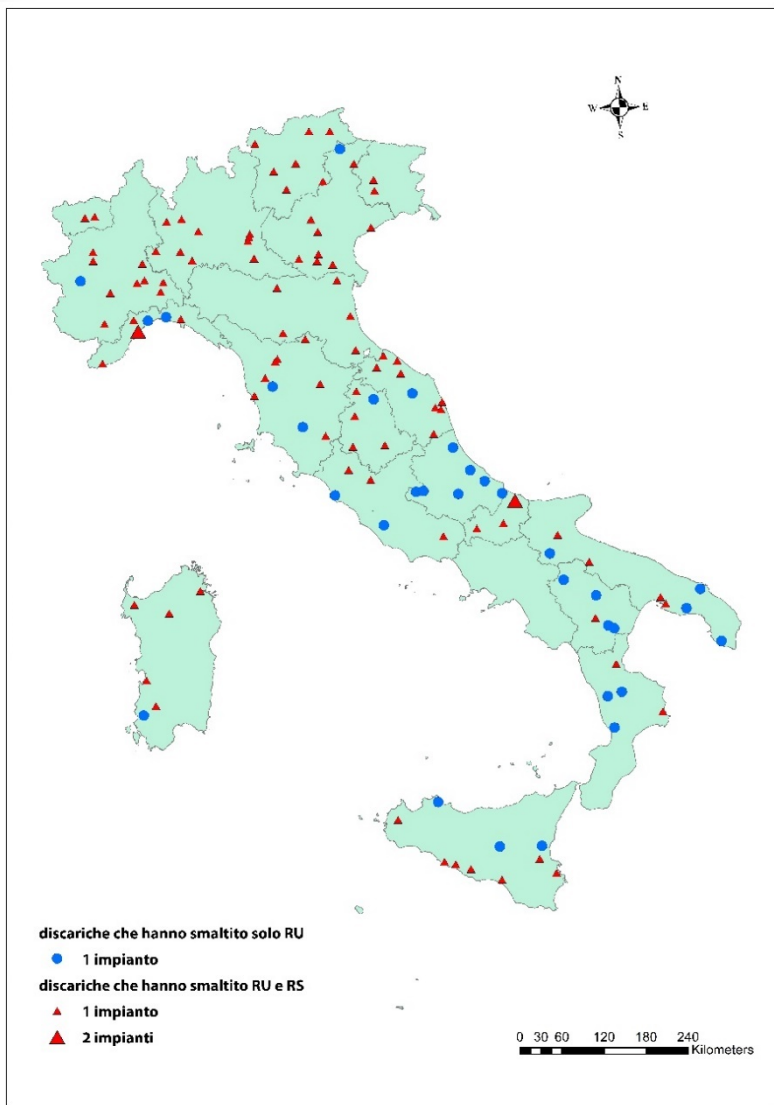
In the year 2021, the total amount of municipal waste disposed of in landfills amounted to 5.6 million tonnes, 19% of the amount of municipal waste generated nationwide (approximately 29.6 million tonnes).

26.1% of the total (1.5 million tonnes) has been disposed of in plants located in the north of the country, 30.5% (1.7 million tonnes) in the Centre and 43.4% (2.4 million tonnes) in the South.

Compared to the 2020, there has been a reduction in the total amount of municipal waste disposed of in landfills of 3.4%, (198,000 tonnes). In the last decade, the use of landfill has been reduced by 52%, from 11.7 million tonnes to 5.6 million tonnes.

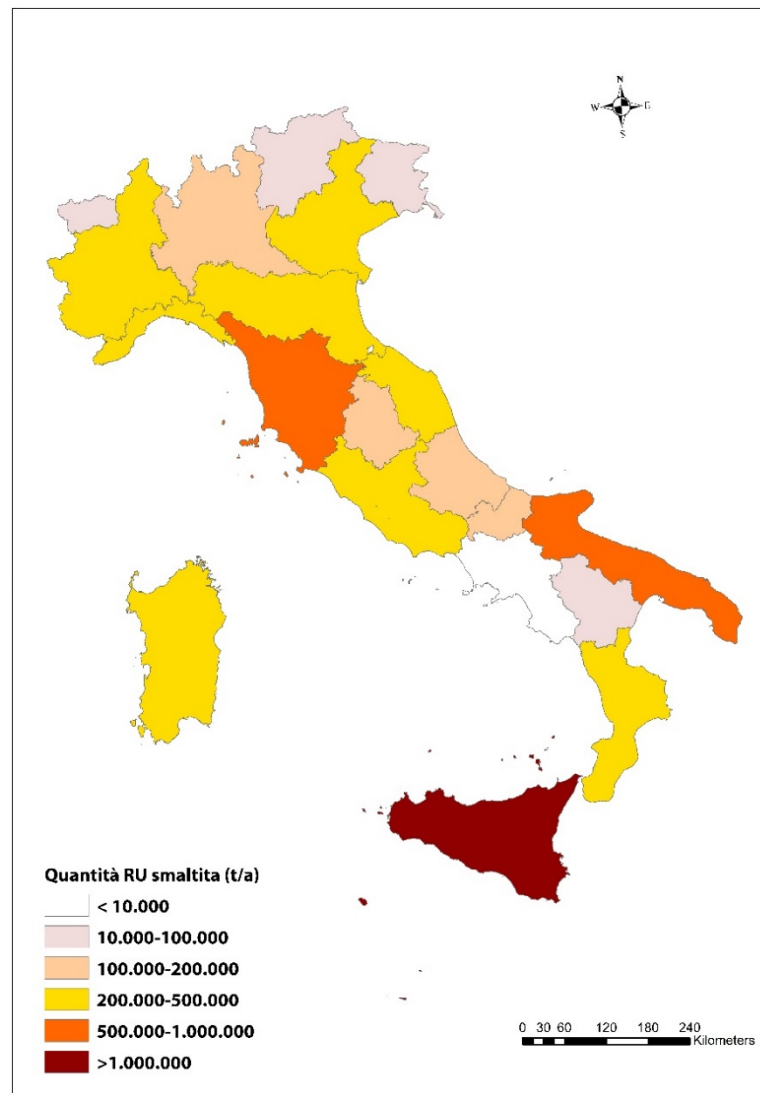
The analysis of the percentage of landfill disposal in relation to the percentage of separate collection over the years, shows that as separate collection increases, landfill disposal decreases proportionally.

**Figure 3.5.1 - Geographical location of landfills disposing of municipal waste, year 2021**



Source: ISPRA

**Figure 3.5.2 - Municipal waste disposal in landfills (tonnes), year 2021**



Source: ISPRA

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The analysis of data at regional level showed a decrease in the amount of waste disposed of in landfills, between 2020 and 2021, especially in the South where the reduction was -5.8% (about 151 thousand tonnes). In the Centre the decrease was around 37 thousand tonnes (-2.1%) and 11 thousand tonnes (-0.7%) in the North.

In the South the largest reductions were observed in Puglia (-15.9%) and Sicilia (-9.5%). In these regions, the decrease in quantities appears to be related to the increase in separate waste collection, which in Puglia changes from 54.5% in 2020 to 57.2% in 2021 and in Sicilia from 42.3% in 2020 to 46.9% in 2021. In Abruzzo, waste disposed of decreases by 4.5% (-9 thousand tonnes).

In Campania, due to the closure of two plants, there has been an increase in the waste disposed of in landfills located outside the region. In fact, exported waste goes from 50 thousand tonnes in 2020 to 54 thousand tonnes in 2021 (identified with code 191212 of the 'European List of Waste').

The quantities disposed of in Basilicata show a significant increase (49 thousand tonnes, +137.5%), due to a higher production of both municipal waste (from 41 thousand tonnes in 2020 to 37 thousand tonnes in 2021) and pre-treated waste (from 36 thousand tonnes to 48 thousand tonnes). However, separate waste collection in this region increased from 56.4% in 2020 to 62.7% in 2021, but about 20 thousand tonnes came from outside the region.

The quantities disposed of in Molise increased by 17% (+15 thousand tonnes) with 32 thousand tonnes imported from outside the region. Increases were also observed in Calabria (+6.9%, 13 thousand tonnes) and Sardegna (+25.1%, 42 thousand tonnes).

In the central regions, as previously mentioned, landfilling decreased by approximately 37 thousand tonnes in the last year (-2.1%). This decrease is specifically attributable to the quantities disposed of in Lazio where there was a 10.3% decrease compared to 2020, with a slight increase in separate waste collection from 52.5% in 2020 to 53.4% in 2021. However, the decrease is determined by a reduced plant capacity and a simultaneous transfer of waste to plants located outside the regional territory, which, although less than in previous years, involved approximately 87,000 tonnes of "waste from the treatment of municipal waste".

Umbria (-8%) and Toscana (-1.2%) also showed a reduction in the amount of municipal waste disposed of in landfills. On the other hand, there has been an increase in Marche (+8.6%) where the percentage of separate collection remained stable.

In the North of the country, there was a slight reduction in the quantities disposed of (-0.7%; about 11 thousand tonnes). Some regions registered reductions (Friuli-Venezia Giulia (-53.9%), Emilia-Romagna (-18.5%), Trentino-Alto Adige (-13.1%), Valle d'Aosta (-2.4%) and Piemonte (-1.1%)), while other regions such as Liguria, Veneto and Lombardia also show increases, respectively of +13.6% (39 thousand tonnes), 11.6% (+40 thousand tonnes) and 4.5% (+7 thousand tonnes). The increase in Liguria is attributable to the higher amount of municipal waste produced in addition to the quantities imported from other regions and disposed of in their own plants (124,000 tonnes), despite an increase in separate waste collection (from 53.4% in 2020 to 55.2% in 2021).

The per capita value of landfilling is a useful indicator to effectively monitor municipal waste management methods. For the purposes of this analysis, the value of regional disposal in landfills was considered, without considering extra-regional flows or the estimated losses from waste treatment, as required by national legislation. Analyses of landfill disposal per capita, for territories where the phenomenon of extra-regional inflows or outflows appears significant, should therefore take into account the actual shares produced in the territory.

In 2021, the per capita value of landfill disposal is 95 kg/inhabitant (-3 kg/inhabitant compared to 2020) in Italy, showing a progressive reduction in recent years.

Figure 3.5.3 shows the trend of the per capita value of regional disposal of municipal waste in 2021 and the corresponding share of bio-waste and the target to be achieved in 2018. In fact, National Legislative Decree 36/2003, as amended, had set targets for the progressive reduction of the landfilling of biodegradable municipal waste (MBW), to be achieved by optimal territorial areas. The targets were placed in the short term (173 kg/year

per inhabitant by 2008), medium term (115 kg/year per inhabitant by 2011) and long term (81 kg/year per inhabitant by 2018). As outlined in the National Strategy for the reduction of biowaste in landfills, the content of bio-waste has been quantified by ISPRA through specific waste analysis campaigns on mixed waste allocated to landfills. The results determined the percentage of MBW in total municipal waste (MW) to be in the range of 58%-65%. ISPRA has set 60% as the average value to be used for the calculation of the biodegradable portion. In 2021, the total amount of municipal bio-waste disposed of in landfills in Italy was 3,371,184 tonnes, corresponding to 20.1% of the RUB produced (reference year 1995), thus far below the target set for 2016 by the European legislation.

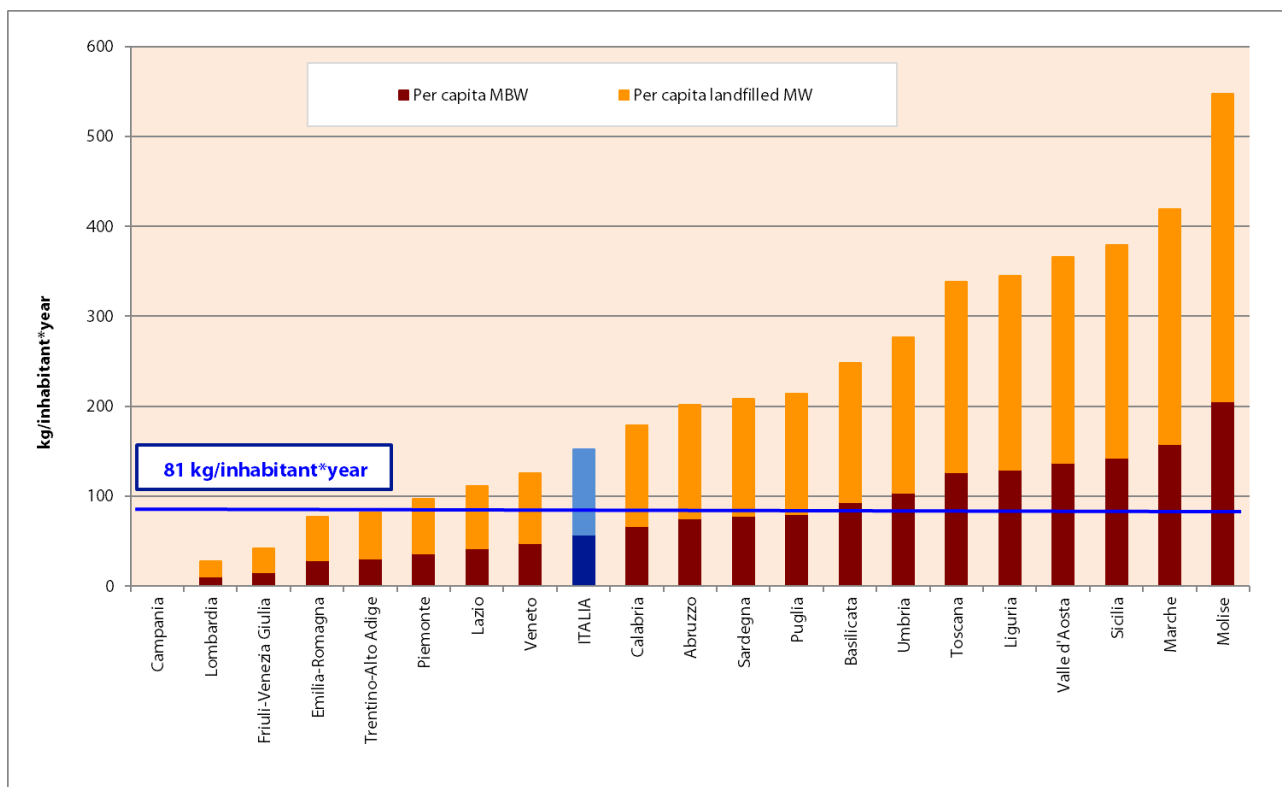
The national per capita value of landfilled bio-waste in 2021 was 57 kg per inhabitant, below the target set by Italian legislation for 2018 (81 kg/year per inhabitant).

An analysis of the data at regional level shows that, in 2021, 12 regions met the 2018 target (Piemonte, Lombardia, Trentino-Alto Adige, Veneto, Friuli-Venezia Giulia, Emilia-Romagna, Lazio, Abruzzo, Campania, Calabria and Sardegna). Puglia is slightly below the target (80 kg/inhabitant) while Basilicata is slightly above (93 kg/inhabitant).

Per capita values below 130 kg/inhabitant were found in Umbria (104 kg/inhabitant), Toscana (127 kg/inhabitant) and Liguria (129 kg/inhabitant).

The regions furthest away from the target are Molise (205 kg/inhabitant), Marche (157 kg/inhabitant), Sicilia (142 kg/inhabitant) and Valle d'Aosta (137 kg/inhabitant). In the case of Molise and Marche that's also due to the incidence of waste from outside the region.

**Figure 3.5.3 - Per capita disposal of municipal bio-waste (MBW) and municipal waste (MW) in landfills, by region, year 2021**



Source: ISPRA

### 3.6 Transboundary movement of municipal waste

In 2021, approximately 659 thousand tonnes of municipal waste were exported, and 219 thousand tonnes were imported. The export of waste accounts for 2% of the national municipal waste generation. Compared to 2020, exports increased by 13.3% while imports decreased by 7.4%.

#### *Exports*

Only 4,436 tonnes of the approximately 659,000 tonnes of municipal waste exported in 2021 were hazardous waste. As shown in Figure 3.6.1, 26.3% of the exported waste, about 172 thousand tonnes, consisted of "waste from the mechanical treatment of municipal waste" (LoW 191212) and a small part (1,426 tonnes) of "other waste from mechanical treatment of waste containing hazardous substances" (LoW 191211\*). The major part of this share (more than 147 thousand tonnes, 85%), was produced in plants located in Campania and was mainly sent to Spain (58 thousand tonnes), Portugal and Germany (about 23 thousand tonnes each). This exported waste undergoes further intermediate treatment (60%) or is recovered in the form of energy (40%). Another 23.9% of exported waste consisted of "Solid Secondary Fuel" - CSS - (LoW 191210), over 157 thousand tonnes, produced mainly in the regions of: Lazio (over 62 thousand tonnes), Abruzzo (around 48 thousand tonnes) and Friuli-Venezia Giulia (over 30 thousand tonnes). CSS is totally recovered in the form of energy and the main destinations were Cyprus (about 45 thousand tonnes), Portugal (about 43 thousand tonnes), Austria (over 22 thousand tonnes) and Greece (about 15 thousand tonnes).

Packaging waste represents 15.9% of the total exported waste, about 105 thousand tonnes, mainly "plastic packaging" (LoW 150102 - 44 thousand tonnes), "paper and cardboard packaging" (LoW 150101 - 36 thousand tonnes) and "wood packaging" (LoW 150103 - over 17 thousand tonnes).

"Non-composted municipal and similar waste" (LoW 190501) represented 15.7% of the exported waste and was produced in Campania and destined mainly for Austria and the Netherlands. 49% of this waste is recycled while 51% is recovered in the form of energy.

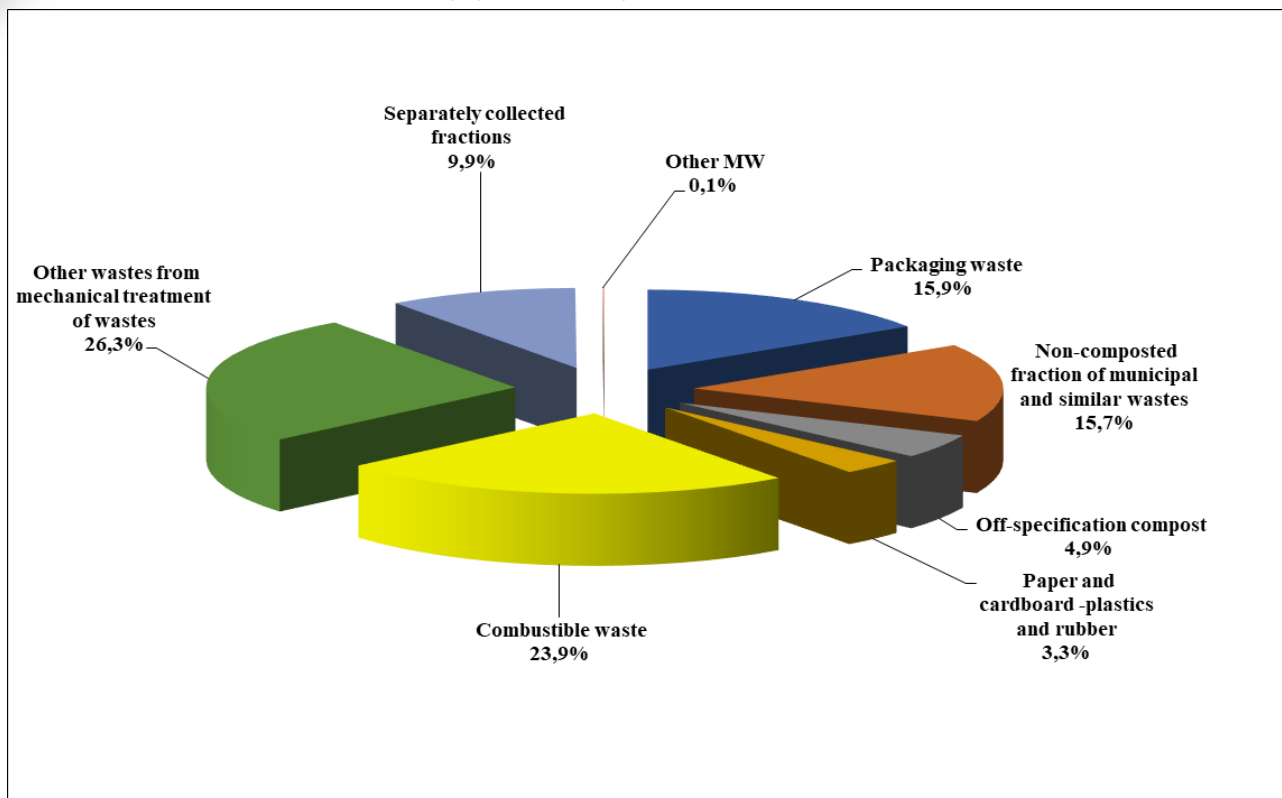
Some fractions of separately collected waste represented 9.9% of the total, more than 65 thousand tonnes. It is mostly textile waste (Clothes), about 48 thousand tonnes, mostly produced in Lombardia, Toscana and Piemonte (10 thousand tonnes each), largely destined for recovery in Tunisia (about 29 thousand tonnes). Edible oils and fats (LoW 200125), about 6 thousand tonnes, mainly produced in Lombardia, are destined for recovery in Austria and Switzerland.

4.9% of the total exported MW (over 32 thousand tonnes) was "off-specification compost" (LoW 190503), shipped to Hungary from the Emilia-Romagna and Lazio regions; 67% of this waste was recycled while 33% was disposed of in landfills.

Lastly, 3.2% of exported waste was represented by paper, cardboard, plastic and rubber (about 22 thousand tonnes), produced by the mechanical treatment of waste (LoW 191201, 191202, 191203, 191204).

The data presented do not include secondary raw materials, which, under national legislation, lose their waste status and are exported as products.

**Figure 3.6.1 – Municipal waste exported by type of waste, year 2021**



Source: ISPRA

### **Imports**

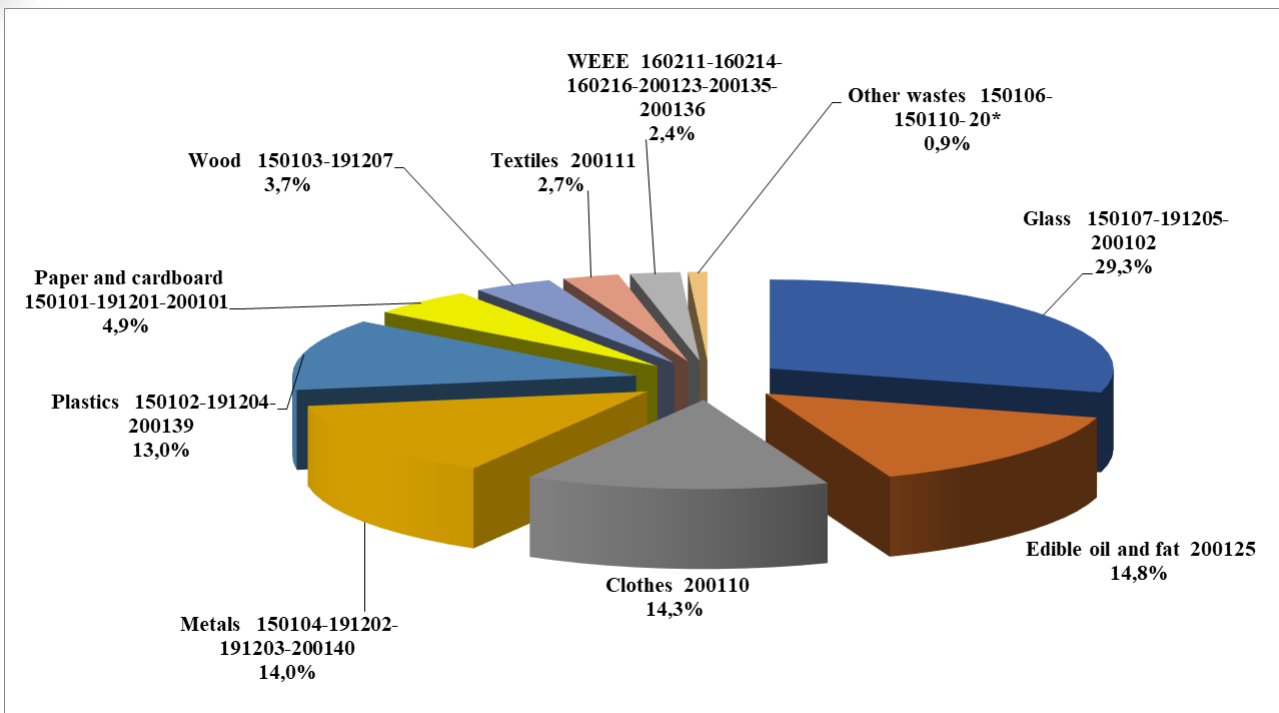
In 2021, 219 thousand tonnes of municipal waste were imported, of which more than 2 thousand tonnes were hazardous waste (mainly 'end-of-life equipment' - WEEE (LoW 200123\*)).

The largest quantity, 56 thousand tonnes, 25.5% of the total imported, came from France; then Germany with 21.7% and Switzerland with 19.8% of the total.

Plants located in the country imported mainly glass (29.3%), edible oils and fats (14.8%), clothing (14.3%), metal (14%), and plastic (13%). Glass mainly from Switzerland is destined for recycling and processing plants located mostly in Lombardia. Piemonte and Lombardia import also plastic, mainly from France. Campania and Toscana, on the other hand, import mostly clothes/textiles for recycling.

In line with previous surveys, and as shown in figure 3.6.2, the main type of waste imported was "Glass"(over 64 thousand tonnes), followed by "Edible oils and fats" (over 32 thousand tonnes) and "Clothes/textiles" waste (over 31 thousand tonnes). "Metal" and "Plastic" waste represent 14% (about 31 thousand tonnes) and 13% (about 29 thousand tonnes) of the total imported respectively.

**Figure 3.6.2 - Municipal waste imported by type of waste, year 2021**



Source: ISPRA

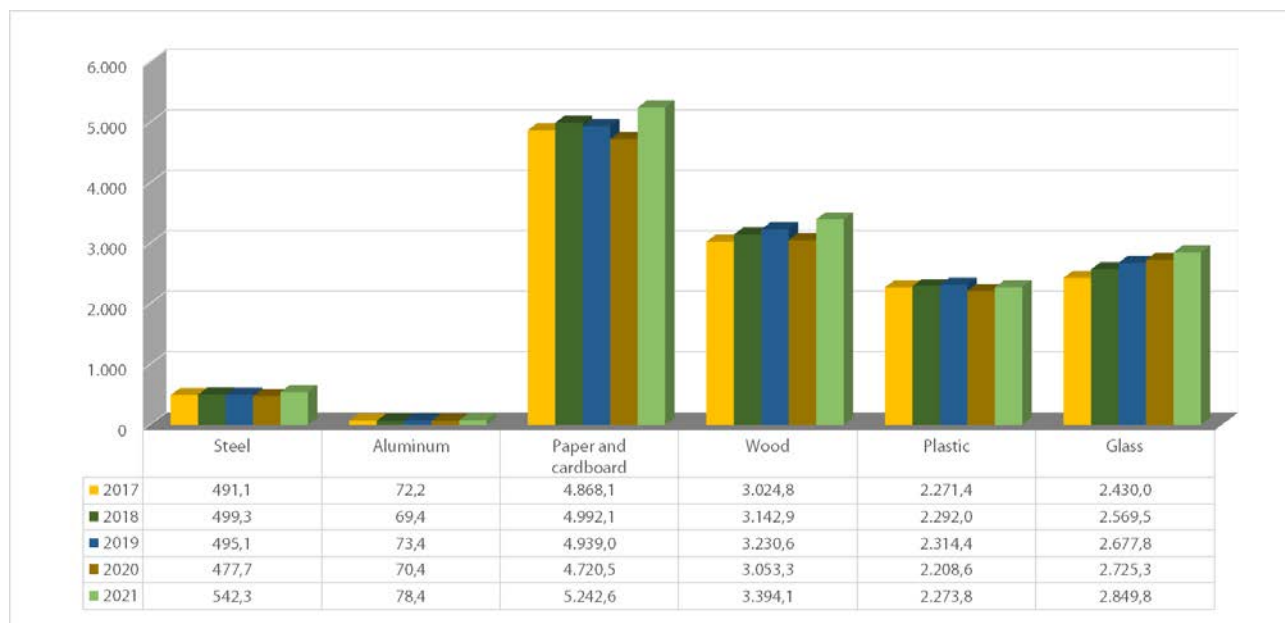
## 4. Packaging and packaging waste

European legislation has set ambitious recycling targets to be reached in 2025 and 2030 for packaging waste, which is one of the main waste streams monitored.

In 2021, 14.4 million tonnes of packaging were placed on the national market, with an increase of 8.5% compared to 2020, due to the post-pandemic economic recovery. This increase in quantities placed on the market was recorded for all packaging materials. The packaging materials showing the most significant percentage increases are steel (+13.5%), aluminium (+11.4%), wood (+11.2%) and paper (+11.1%). Lower increases were recorded for glass (+4.6%) and plastic (+3%). The latter is affected by European and national regulatory developments, especially in terms of banning or reducing the use of certain single-use plastic products.

Over the years, paper has confirmed to be the most marketed packaging material, accounting for 36.5% of the domestic market, in 2021, followed by wood with a 23.6% market share, glass (19.8%) and plastic (15.8%) (Figure 4.1).

**Figure 4.1 – Packaging placed on the market by packaging materials (1.000\*tonnes), years 2017 – 2021**



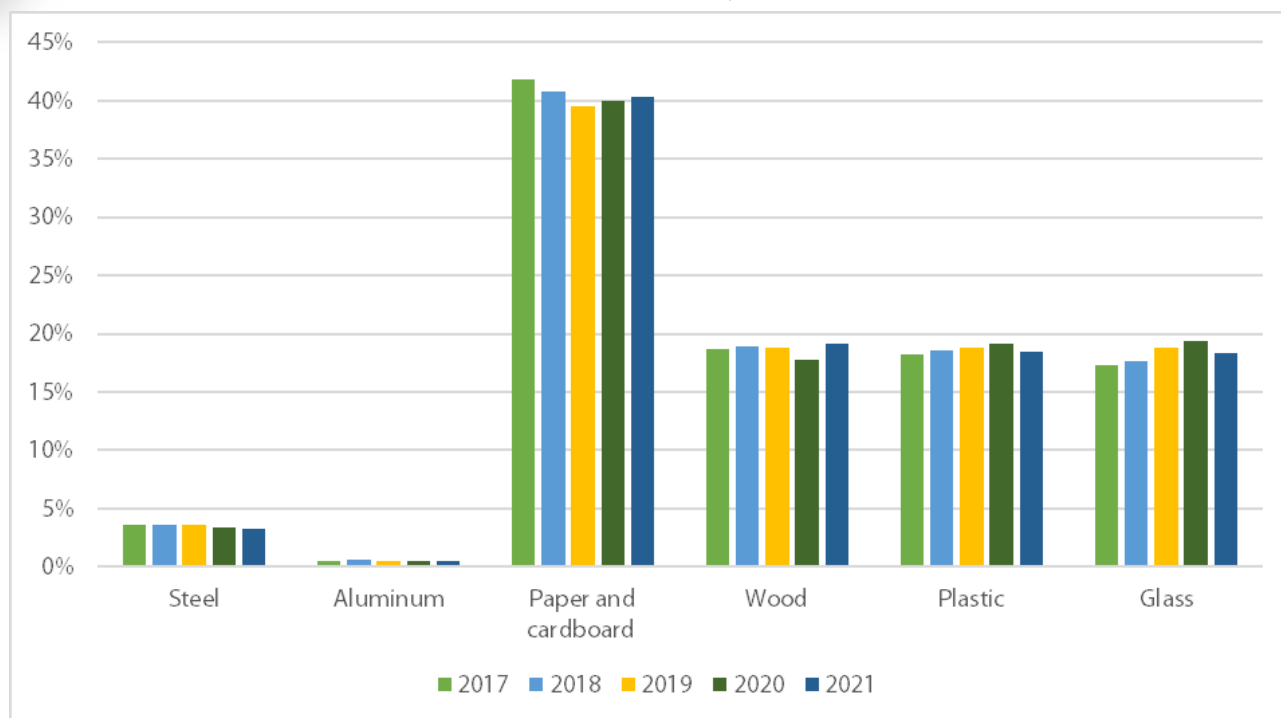
Source: ISPRA elaborations on CONAI data

In 2021, the amount of packaging waste sent for recovery was almost 11.9 million tonnes, with an increase of +7.5% compared to 2020.

The share of recovered packaging waste made of plastics, paper, aluminium and glass also includes the quantities of waste sent for recycling abroad. All packaging materials show an increase in total recovery. Wood packaging shows the most significant increase (+15.7%), followed by aluminium (+9%), paper (+8.6%), steel (+5.1%), plastics (+3.5%) and glass (+1.8%). In terms of quantity, paper and wood increased by 380,000 tonnes and 308,000 tonnes respectively, followed by plastic with 73,000 tonnes and glass with almost 40,000 tonnes more than in 2020. Cellulosic packaging waste remains the most recovered fraction, accounting for 40.4% of the total (Figure 4.2).



**Figure 4.2 – Percentage distribution of packaging waste recovered, years 2017 - 2021**



Source: ISPRA elaborations on CONAI and PROs data

Recycling accounts for 88.8% of total recovery, including preparation for reuse through remanufacturing or repair operations.

At over 10.5 million tonnes, the quantities sent for recycling increased by 9.3% compared to 2020. Significant increases in the quantities sent for recycling are shown for wood (+16.2%), plastic (+11.8%) and aluminium (+11.5%), followed by paper (+9.7%), steel (+5.1%) and to a lesser extent glass (+1.8%). Recycled packaging waste from “public land” (municipal and assimilated waste stream) accounts for about 54% of the total amount of recycled packaging (almost 5.7 million tonnes); the residual part, about 4.9 million tonnes, results from industrial and commercial (secondary and tertiary) packaging waste stream. In detail, the share of recycling from public land shows an increase of 9.3% compared to 2020.

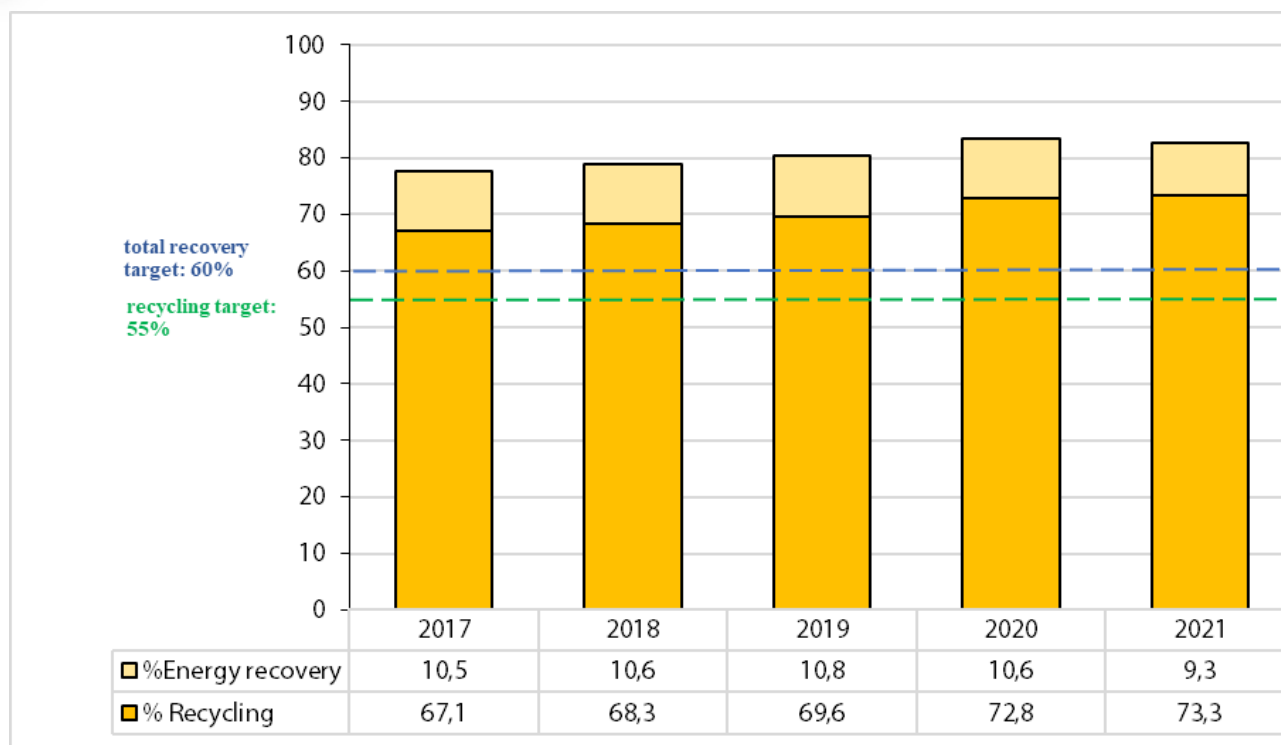
In 2021, the amount of packaging waste sent for energy recovery from public land is 1.3 million tonnes, showing a decrease of 5.2% compared to 2020, corresponding to about 73,000 tonnes. Packaging materials most sent for energy recovery were plastic (69.5% of the total) and paper (25.1%), for which there has been, however, a reduction in the quantities sent for this form of management. As a matter of fact, plastic packaging waste decrease from 986 thousand tonnes in 2020 to 925 thousand tonnes in 2021 (-6.1%), while paper waste from 347 thousand tonnes to 334 thousand tonnes (-3.9%). Wood is the only packaging material with a slight increase of 3.2%, from 67 to 69 thousand tonnes.

In 2021, the total recovery<sup>3</sup> of packaging waste was 82.6% of the amount placed on the market, slightly decreasing compared to 2020. The percentage of recycled<sup>4</sup> packaging waste compared to the amount placed on the market went from 72.8% to 73.3%, while energy recovery reduced by more than one percentage point, settling below 10% (Figure 4.3).

<sup>3</sup> Calculated according to the old methodology.

<sup>4</sup> Calculated according to the old methodology.

**Figure 4.3 – Recovery and recycling rates of packaging waste, according to the old calculation methodology, years 2017 - 2021**

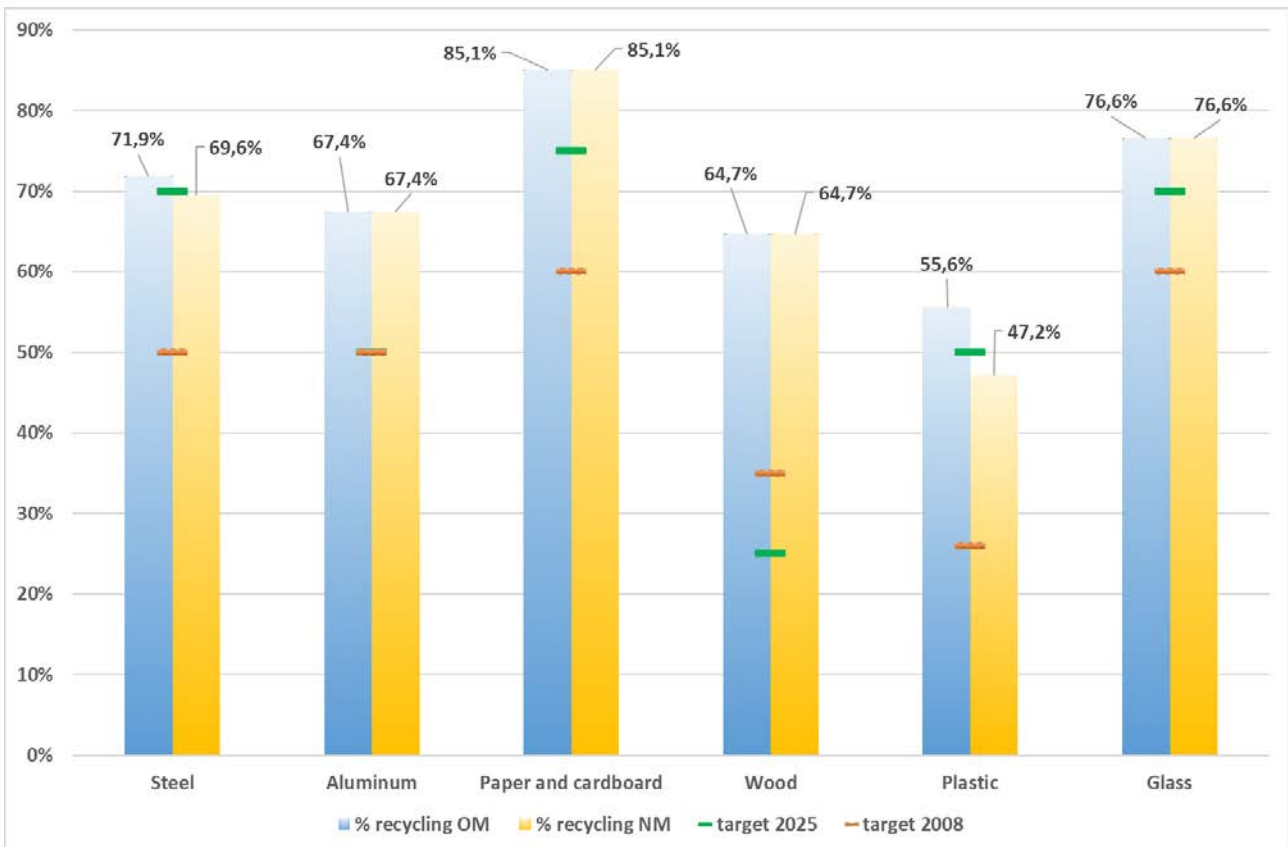


Source: ISPRA elaborations on CONAI and PROs data

To ensure uniform measurement conditions for the new targets on the amount of packaging waste recycled into new products, materials or substances, stringent calculation methodologies were defined at European level, also for packaging waste. With the application of the new calculation methodologies, the targets for 2025 are already achieved for all packaging fractions except plastic (Figure 4.4). For this fraction, therefore, increasing recycling is a priority.

The development of new treatment technologies is one of the lines of action on which it is necessary to intervene, especially for waste that is currently difficult to recover by mechanical processes. It is also essential to reduce the existing gaps at territorial level and in this respect important measures are contained in both the National Waste Management Programme (PNGR) and the National Recovery and Resilience Programme (PNRR). Even with regard to the definition of a National Plastics Strategy, it will be crucial to address the issue in a coherent manner, ensuring both the control of dispersion in the environment and a better valorisation of the resource.

**Figure 4.4 - Comparison of recycling rates according to the old methodology (OM) and the new calculation methodology (NM) introduced by Decision 2019/665/EU, year 2021**



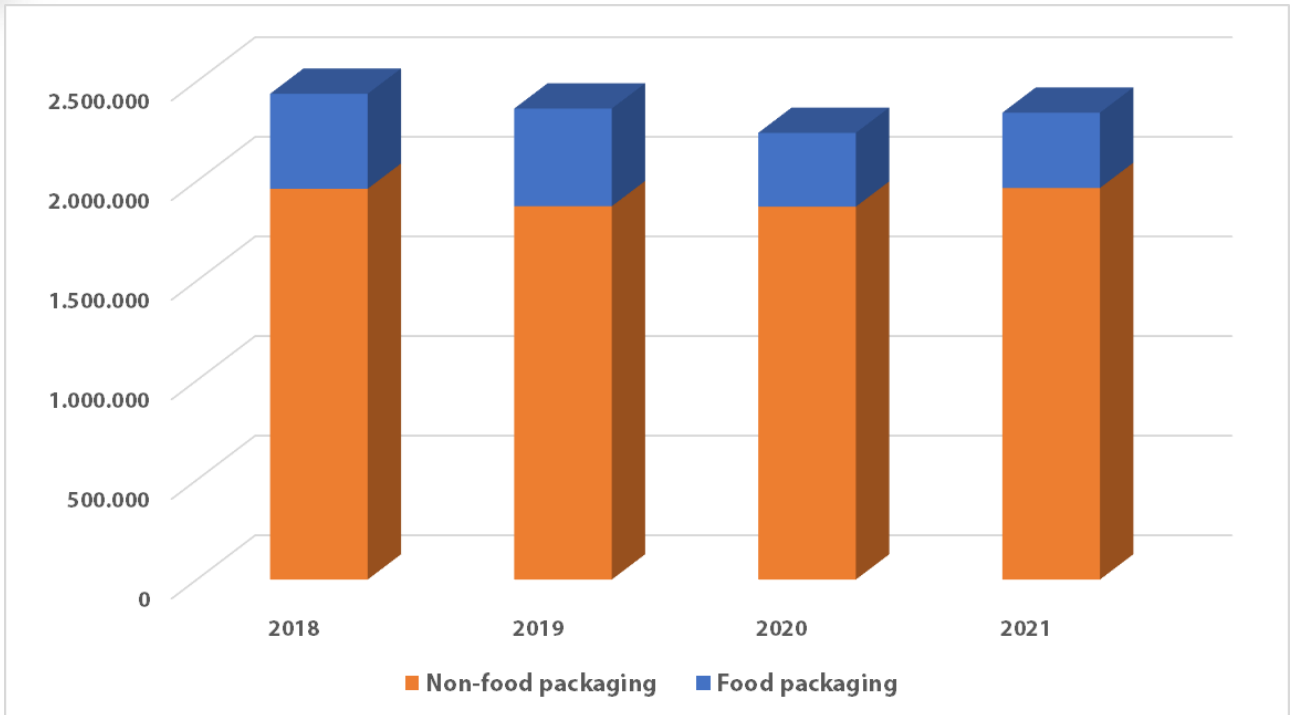
Source: ISPRA elaborations on CONAI data

In 2021, the reuse of packaging amounts to more than 2.3 million tonnes, an increase of 4.5% (101 thousand tonnes) compared to 2020, according to CONAI data.

More in detail, about 378 thousand tonnes of food packaging and almost 2 million tonnes of non-food packaging were reused (Figure 4.5). An analysis of the data shows that food packaging reused are mainly glass bottles (49.4% of the total) and plastic crates (37.6%), whereas non-food packaging reused are mainly wooden pallets (47.5% of the total) and plastic pallets (22.7%) as well as steel containers and drums (18.1%) and industrial wooden packaging (7.1%).



**Figure 4.5 – Total amount of reused packaging in Italy (tonnes), years 2018 - 2021**



Source: ISPRA elaborations on CONAI data

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## 5. Assessment of operation costs of the municipal waste management service, year 2021

This chapter analyses the costs faced by municipalities for the management of municipal waste. National Law 205 of 2017, granted the Regulatory Authority for Energy and Networks and Environment (ARERA) powers to regulate and control the cost of municipal waste management service.

The Authority has, among others, the task of:

- "dissemination of knowledge and transparency of the conditions under which services are provided for the benefit of users";
- "protection of users' rights [...]";
- "preparation and updating of the method for the determination of tariffs for the integrated waste service and the individual management services, for the coverage of operating and investment costs, including the remuneration of capital, based on the evaluation of efficient costs and the 'polluter pays' principle";
- "approval of the tariffs defined, in accordance with the legislation in force, by the governing body of the optimal territorial ambit for the integrated service and by the treatment plant operators";
- "verification of the correct drafting of the territorial ambit management plans by expressing observations and remarks".

With Resolution 443 of 2019, ARERA adopted the Waste Tariff Methodology (MTR) containing the "criteria for the recognition of efficient operating and investment costs of the integrated waste service, for the period 2018-2021". With Resolution 238 of 2020 ARERA integrated Resolution 443/2019, for the period 2020-2021 in order to take into account the COVID-19 pandemic emergency. The Deliberation defines tariff revenues for the integrated management service as the sum of variable cost revenues and fixed cost revenues.

ARERA also defined the management scope subject to the new tariff method, so that it is uniform throughout the country. It includes:

- (a) street sweeping and street washing
- b) collection and transport of municipal waste
- c) tariff management and customer relations;
- d) treatment and recovery of municipal waste
- e) treatment and disposal of municipal waste.

The Resolution also defines, by way of example, activities outside the integrated waste cycle. In this chapter, taking into account the ARERA Resolutions, the costs related to the municipal waste management cycle have been analysed.

The costs related to the municipal waste management cycle were analysed here, considering the ARERA Resolutions. Specifically, "Operating Costs", "Common Costs" and "Capital Use Costs" were examined.

The analysis of the cost items was carried out by processing the financial data reported in the "Municipal Waste Communication" sheet of the Environmental Mandatory Declaration. The subjects obliged annually, by law, to this communication are municipalities, their consortia, unions of municipalities and other public and private managers.

In addition, an in-depth study was conducted on the municipalities that adopt the Pay-As-You-Throw system, carrying out a census of the municipalities and an analysis of the cost items that contribute to the definition of management costs.

The economic indicators of the management cycle of the examined municipal services are:

- annual cost per capita for mixed waste collection and transport activities (CRT) and per kg of mixed waste
- annual cost per capita for separate waste collection and transport activities (CRD) and per kg of separated collected waste;
- annual cost per capita for municipal waste treatment and recovery activities (CTR);
- annual cost per capita for municipal waste treatment and disposal activities (CTS);
- total annual cost per capita of the service and per kg of total waste;
- census of Italian municipalities adopting the Pay-As-You-Throw system;
- annual costs per capita and per kg of waste, of some fractions of separate and/or selective collections.

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The data used to determine the economic indicators of the municipal waste management cycle are the following:

- municipal data on municipal waste production and selective collection for the year 2021, derived from the elaborations carried out by ISPRA;
- data on the resident population as of 31 December 2021 at municipal level, derived from the annual ISTAT Demographic Balance Sheet.

The analysis of the annual per capita costs and revenues deriving from the application of the so-called 'TARI' and/or tariff refers to the resident population. It should, however, be noted that the urban hygiene service covers both domestic users and non-domestic users (such as commercial, artisan, industrial, offices, etc., as well as costs due to the presence of non-residents, such as commuting workers, students and tourists), for which it would be appropriate to introduce the parameter 'number of equivalent inhabitants'.

For the year 2021, the sample consisted of 6,670 municipalities, or 84.4% of the Italian municipalities (7,903), corresponding in population terms to 53,164,123 inhabitants, or 90.1% of the Italian population (58,983,122). Compared to 2020, there is an increase in the sample of +6.6% (411 municipalities - 2,224,330 inhabitants). It should be noted that, in the year 2021, the ISTAT figure for the national population showed a reduction of 0.5%, more than 274,000 fewer inhabitants.

In terms of geographical coverage, the sample referring to the population is distributed as follows: in the North the coverage is 96.1%, in the Centre it reaches 93.9%, while in the South the lowest coverage is 79.7%. Compared to 2020, the increase in coverage is +1.2% in the North, +5.9% in the Centre and, finally, +7.1% in the South.

As a preliminary remark, it is necessary to point out that the analysis of the data showed that in many cases the declarant, instead of assigning values to the individual cost items, provided an aggregate value by attributing it to a single cost item; nevertheless, the sample also includes these cases.

Figure 5.1 shows, with regard to the cost items of variable nature, that the largest cost incurred is related to the collection and transport of separated fractions (CRD), with 26.1% (+0.3% compared to 2020) of the total costs. The cost of treating and disposing of municipal waste (CTS) represented 12.5% (-0.9% compared to 2020) of the total cost, the cost of collecting and transporting mixed municipal waste (CRT) represented 11.1% (-1.1% compared to 2020) and, finally, the cost of treating and recovering municipal waste (CTR) corresponded to 10.9% (+0.5% compared to 2020).

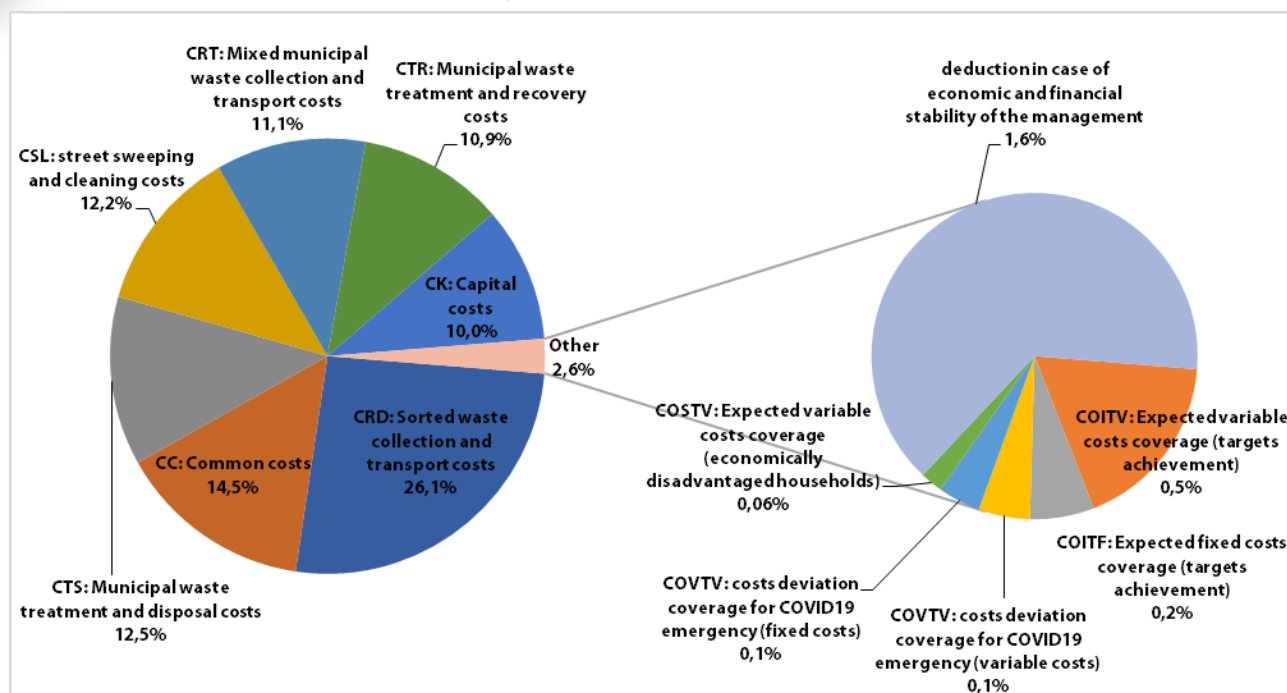
The items of fixed nature, common costs (CC) and the cost of sweeping and washing (CSL), represented 14.5% (-0.6% compared to 2020) and 12.2% (-0.4% compared to 2020) of total costs, respectively, while the cost of capital use (CK) corresponded to 10% (+1.0% compared to 2020).

Finally, 2.6% of total costs (+1.1% compared to 2020) included items of predictive nature such as:

- items intended to cover the expected variable and fixed costs related to the achievement of quality improvement targets and/or changes in the scope of operations ( $COI^{exp}_{TV}$ ,  $COI^{exp}_{TF}$ );
- additional variable and fixed cost item, intended to cover expected deviations from the actual cost values of the reference year ( $COV^{exp}_{TV,2021}$ ,  $COV^{exp}_{TF,2021}$ );
- item to cover variable charges resulting from the implementation of protection measures in favour of economically disadvantaged households ( $COS^{exp}_{TV}$ ).

In addition, economic reductions in the event of financial equilibrium were also taken into account.

**Figure 5.1 – Breakdown of management costs, year 2021**



Legend: CRT = Mixed municipal waste collection and transport costs; CTS = Municipal waste treatment and disposal costs; CTR = Municipal waste treatment and recovery costs; CRD = Sorted waste collection and transport costs; COlexpTV, COlexpTF = Expected variable and fixed costs coverage, relating to the achievement of targets for improving quality levels and/or changes in the management perimeter; COVexpTF,2021 = costs deviation coverage for COVID19 emergency (variable and fixed costs), intended to cover expected deviations from the actual cost values of the reference year; COsexpTV = Expected variable costs coverage, arising from the implementation of protection measures in favour of economically disadvantaged households, as identified by Resolution 158/2020/R/RIF; CSL = street sweeping and cleaning costs; CC = Common costs; CK = Capital costs.

Source: ISPRA

The national average annual per capita cost of municipal waste management is 194.5 euro/inhabitant (in 2020 it was 185.6), an increase of 8.9 euro/inhabitant. The cost is the result of the contribution of several components, such as: collection and transport of separated fractions (CRD), €50.7/inhabitant; treatment and disposal (CTS), €24.4/inhabitant; collection and transport of mixed municipal waste (CRT), €21.7/inhabitant; treatment and recovery (CTR), €21.2/inhabitant; common costs (CC), €28.2/inhabitant; sweeping and washing costs (CSL), €23.8/inhabitant; capital use costs (CK), €19.5/inhabitant.


In 2021, the total annual per capita cost of the service, by geographic macro area, was highest in the Centre with 230.74 euros/inhabitant (+8.99 euros/inhabitant compared to 2020), followed by the South with 202.3 euros/inhabitant (+6.63 euros/inhabitant compared to 2020) and the North with 174.61 euros/inhabitant (+9.02 euros/inhabitant compared to 2020).

The cost of collecting and transporting the separated fractions (CRD) is the one that accounts for the largest share of the total cost, with 60.2 euro/inhabitant in the Centre (+3.5 compared to 2020), 53.6 euro/inhabitant in the South (+3.8 compared to 2020) and 45.0 euro/inhabitant in the North (+1.5% compared to 2020).

For the treatment and disposal cost (CTS), a value of 34.8 euro/inhabitant (-1.7 compared to 2020) was recorded in the Centre, 31.4 euro/inhabitant in the South (-1.0 compared to 2020) and 15.8 euro/inhabitant in the North (-0.4 compared to 2020).

The cost of collecting and transporting mixed municipal waste (CRT) was €26.8/inhabitant in the South (-1.4 compared to 2020), €23.2/inhabitant in the Centre (-2.5 compared to 2020) and €18.0/inhabitant in the North (-0.2 compared to 2020). Lastly, the cost of treatment and recovery (CTR) was 21.9 euro/inhabitant in the North (+1.6 compared to 2020), 21.5 euro/inhabitant in the Centre (+2.0 compared to 2020) and 19.6 euro/inhabitant in the South (+2.3 compared to 2020).

The cities with the highest costs were Venezia with 389.8 euro/inhabitant, Cagliari with 307 euro/inhabitant and Firenze with 299.4 euro/inhabitant. The lowest costs were registered for Catanzaro, 160.3 euro/inhabitant,



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Campobasso, 165.2 euro/inhabitant and Trento with 177.3 euro/inhabitant. In Rome the cost of the service is 273.9 euro/inhabitant.

A specific analysis was carried out on a sample of 887 municipalities, about 6.4 million inhabitants, which apply the 'Pay-As-You-Throw' system. The analysis confirmed what was found in previous 'Pay-As-You-Throw' surveys, i.e. that the average total cost per capita for these municipalities is lower than for those applying the standardised tariff. The average cost found in the sample is 180.5 euro/inhabitant per year. In the only regional capitals in the sample, Trento, Cagliari and Potenza, the per capita cost was 177.3 euro/inhabitant, 307 euro/inhabitant and 231.4 euro/inhabitant, respectively. For these capitals, separate collection was 82%, 74.1% and 61.9%.



