MUNICIPAL SOLID WASTE MANAGEMENT IN ITALY

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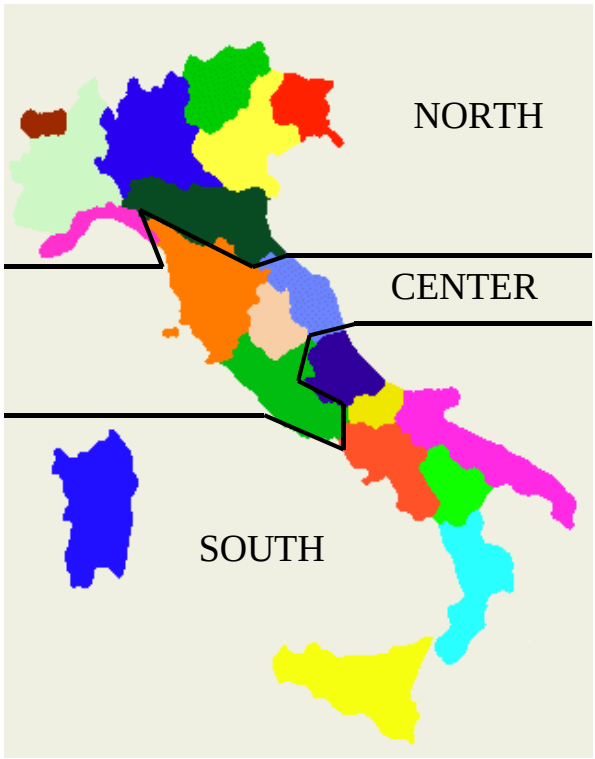
SUMMARY:

Italy is a European country with population of 58.5 million. It is divided into 20 regions that can be aggregated in three macro-geographical areas (North, Center and South). The generation of municipal solid wastes (MSW) in Italy in 2004 was 31.1 million metric tones. The source - separated collection of recyclables and compostables was 22.7% of the total MSW production. However, the situation is very different between the macro-geographical areas of Italy: the North has reached a value of 35.5%, the Center 18.3% and the South 8.1%.
The tonnage of MSW combusted at waste-to-energy (WTE) facilities more than doubled from 1.6 million in 1996 to 3.5 million tonnes in 2004. In general, the regions of the North of Italy are those that send to WTE facilities the largest quantity of MSW and RDF (Refuse Derived Fuel). In 2004, the mechanical-biological treatment (MBT) facilities managed about 9 million tonnes of MSW: 20% of these processes are dedicated to the production of compost, while the other 80% produce a large variety of materials such as bio-stabilized, dry fraction and RDF.
From 2000 to 2004, the number of landfills in Italy decreased from 657 to 401. The distribution of landfills is not uniform across the nation: most of them are situated in the South of Italy. Landfilling remains the principal way of disposal in Italy, but in the period of 2000 to 2004 the use of landfills decreased from 72.4% to 51.9%, whereas WTE increased from 8.5% to 9.7%. The use of mechanical-biological treatment and composting has remained nearly constant between 2003 and 2004 at about 28%.

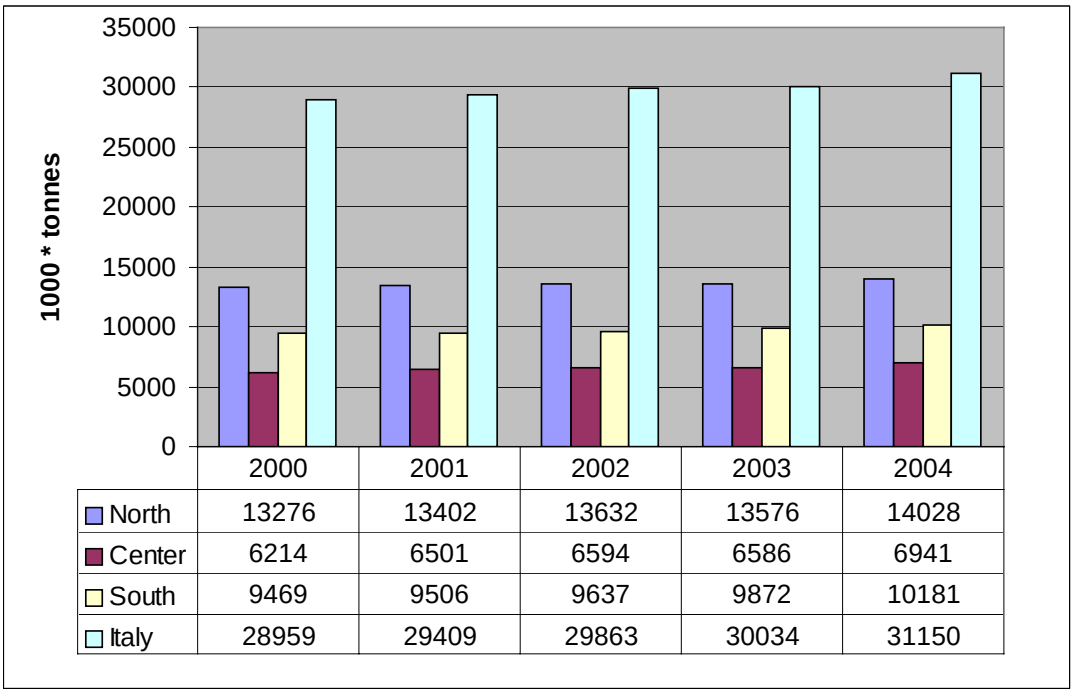
Introduction

Italy is a European country with population of 58.5 million. It is divided into 20 regions that can be aggregated in three geographical areas, as shown in Figure 1.
The current generation and disposition of municipal solid wastes (MSW) in Italy is described in the publication “Rapporto rifiuti”, annually published by APAT (Agenzia per la Protezione dell’Ambiente e per i Servizi Tecnici) and ONR (Osservatorio Nazionale sui Rifiuti).
The MSW generation in Italy in 2004 was 31.1 million metric tonnes, with a percent increase, in comparison with 2003 data, of 3.7% (Fig. 2). In 2004, the MSW generated per capita in the North was 530 kg, in the Center 617 kg, and in the South 491 kg; the Italian average was 533 kg (Fig. 3).



ITALY		
Macro-geographical area	Regions	Population (year 2004) in thousands
North	Piemonte	4,330
	Valle d'Aosta	123
	Lombardia	9,393
	Trentino Alto Adige	975
	Veneto	4,700
	Friuli Venezia Giulia	1,205
	Liguria	1,592
	Emilia Romagna	4,151
	Total North	**26,469**
Center	Toscana	3,598
	Umbria	859
	Marche	1,519
	Lazio	5,270
	Total Center	**11,246**
South	Abruzzo	1,299
	Molise	322
	Campania	5,789
	Puglia	4,068
	Basilicata	597
	Calabria	2,009
	Sicilia	5,013
	Sardegna	1,650
	Total South	**20,747**
	Total Italy	**58,462**

Fig. 1: Italy: macro-geographical areas, regions and corresponding population (APAT and ONR, 2005)



	2000	2001	2002	2003	2004
North	13276	13402	13632	13576	14028
Center	6214	6501	6594	6586	6941
South	9469	9506	9637	9872	10181
Italy	28959	29409	29863	30034	31150

Fig. 2: Production of MSW from 2000 to 2004 in the North, Center and South of Italy and in Italy as whole (APAT and ONR, 2005)

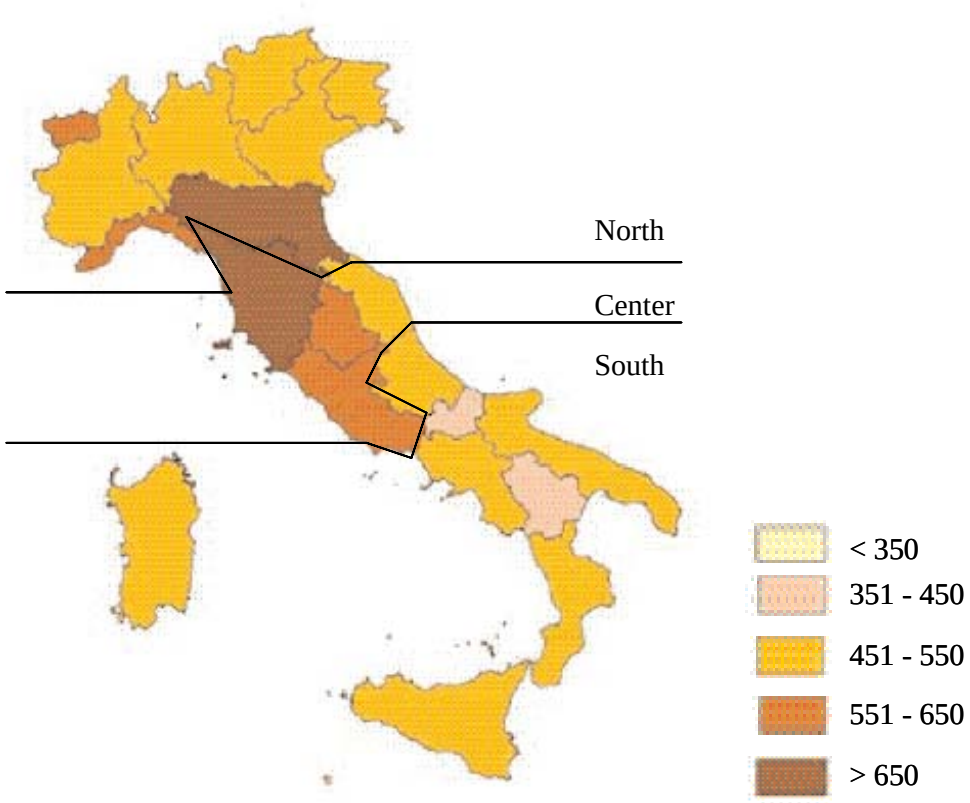
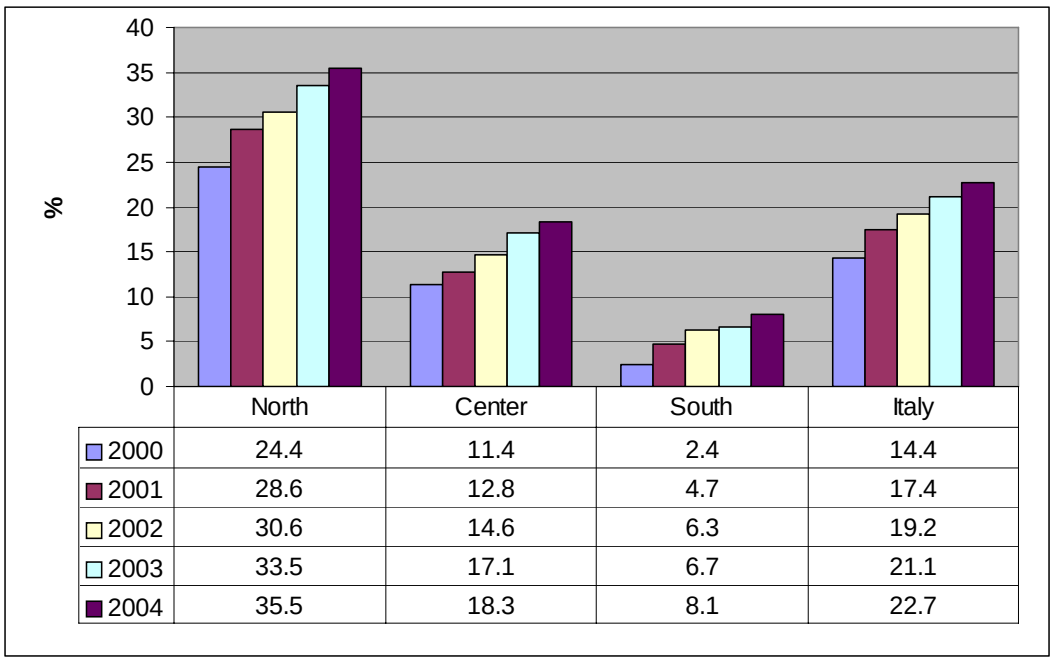


Fig. 3: MSW generated per capita in Italian regions in 2004 (kg/person) (APAT and ONR, 2005)

1. Source - separated collection

In 2004, the source - separated collection of recyclables and compostables in Italy was 7.1 million tonnes, which is equal to 22.7% of the total MSW production. However, the situation is very different between the macro-geographical areas of Italy (Fig. 4): the North has reached a value of 35.5%, the Center 18.3% and the South 8.1%. The Italian regions that separate the largest quantity of recyclables and compostables materials are Veneto (43.9%) and Lombardia (40.9%), in the North, whereas the Italian regions that separate the smallest quantity of materials are Molise (3.6%) and Sardegna (5.3%), both situated in the South (Fig. 5).

Table 1 shows that the principal materials that are separated from MSW are organics and paper.



	North	Center	South	Italy
2000	24.4	11.4	2.4	14.4
2001	28.6	12.8	4.7	17.4
2002	30.6	14.6	6.3	19.2
2003	33.5	17.1	6.7	21.1
2004	35.5	18.3	8.1	22.7

Fig. 4: Source-separated collection from 2000 to 2004 (APAT and ONR, 2005)

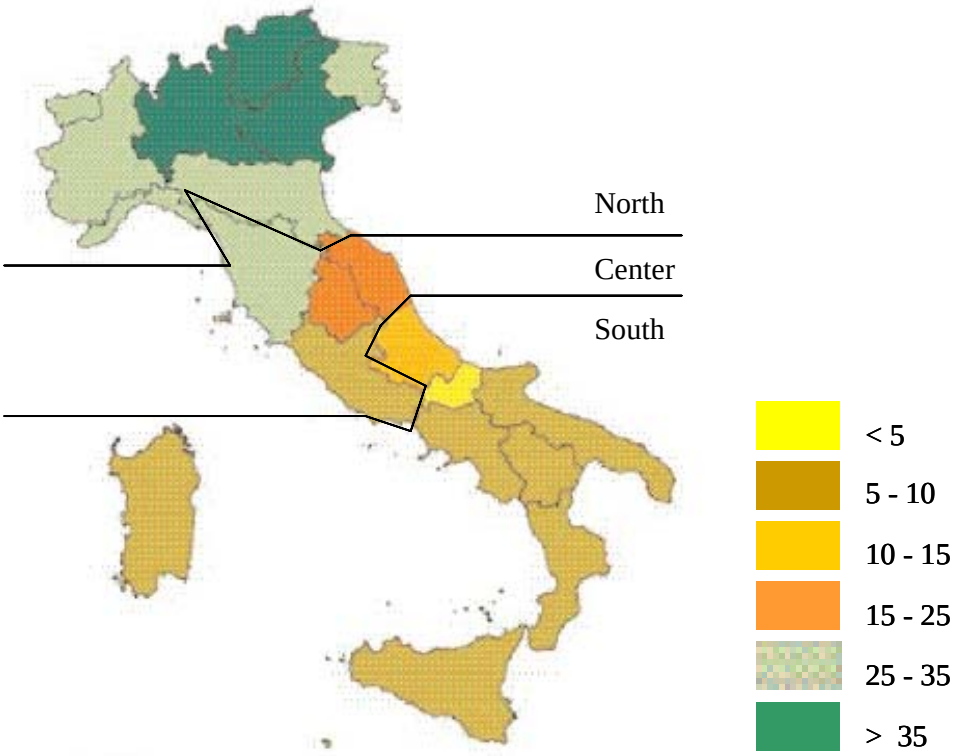


Fig. 5: Percentage of source-separated collection per region, year 2004 (APAT and ONR, 2005)

Tab. 1: Quantity and percentage of materials separated from MSW in 2004 (APAT and ONR, 2005)

	Organics	**Paper**	**Glass**	**Plastic**	**WEEE** [(1)]	**Textile**
1000 * tonnes	2216	2153.8	985.6	336.2	74.1	56.5
%	31.4	30.5	13.9	4.8	1.0	0.8
	Aluminum	**Other metals**	**Wood**	**Bulky**	**Selective** [(2)]	**Other**
1000 * tonnes	14.8	117.1	280.7	676.9	26.9	128.1
%	0.2	1.7	4.0	9.6	0.4	1.8

[(1)]: Waste of Electric and Electronic Equipment

[(2)]: Drugs, bottles with toxic or inflammable products, battery and storage cells, varnish and ink, vegetable oil and mineral oil

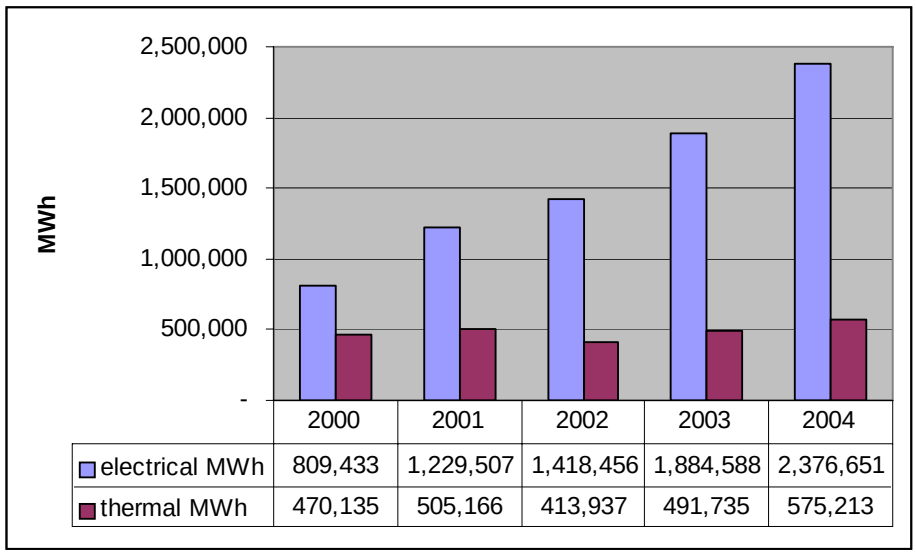
2. Waste-to-energy

The tonnage of MSW combusted at waste-to-energy (WTE) facilities more than doubled from 1.6 million in 1996 to 3.5 million tonnes in 2004: this corresponds to an increase of the combusted MSW from 6.1 to 11.4 percent of the total MSW generated.

In general, the regions of the North of Italy are those that send to WTE facilities the largest quantity of MSW and RDF, in particular, the regions of Lombardia, Emilia-Romagna and Veneto. There are

45 WTE facilities and 3 incinerators in Italy: 29 are localized in the North (13 in Lombardia), 13 in the Center (8 in Toscana and 3 in Lazio) and 6 in the South.

Thanks to the improvement of energy recovery technologies, the increase of the energy production has been greater than the increase of MSW tonnage combusted. In 2004, the plants with energy recovery managed 4.1 million tonnes of waste (3.5 million MSW plus medical waste and other special wastes), recovering 2.4 million MWh of electrical energy and 0.575 million MWh of thermal energy (Fig. 6). In 2004, the specific gross average production of electrical energy was 587 kWh_e per tonne of processed waste and of thermal energy 361 kWh_{th} per tonne. The corresponding BREF energy recovery was 587 * 2.4 + 361 = 1770 kWh_{th} per tonne (for the definition of BREF and the explanation of this conversion, refer to box at page 6).



	2000	2001	2002	2003	2004
electrical MWh	809,433	1,229,507	1,418,456	1,884,588	2,376,651
thermal MWh	470,135	505,166	413,937	491,735	575,213

Fig. 6: Energy recovery in WTE facilities, 2000-2004 (APAT and ONR, 2005)

Definition of BREF

The European IPPC (Integrated Pollution Prevention and Control) Bureau exists to catalyze an exchange of technical information on best available techniques (BAT) under the IPPC Directive 96/61/EC and to create reference documents (BREFs) which must be taken into account when the responsible authorities of Member States determine conditions for IPPC permits.

The IPPC Directive 96/61/EC lays down a framework requiring Member States to issue operating permits for a wide range of industrial activities. These permits must contain conditions based on best available techniques (BAT), to achieve a high level of protection of the environment as a whole. Article 16.2 of the Directive requires the European Commission to organize an exchange of information between Member States and the industries concerned on BAT, associated monitoring and developments in them. The Commission established an information exchange forum (IEF) to assist the work under Article 16.2 and a number of technical working groups have been established under the umbrella of the IEF. Both IEF and the technical working groups include representation from Member States and industry as required in Article 16.2. The documents produced by the technical working groups are called "best available techniques reference documents" (BREFs). The aim of this series of documents is to reflect accurately the exchange of information that has taken place as required by Article 16.2 and to provide reference information for the permitting authority to take into account when determining permit conditions. By providing relevant information concerning best available techniques, these documents should act as valuable tools to drive environmental performance.

In the Waste Incineration BREF (IPPC, 2006a), the paragraph 3.5.3 is dedicated to equivalence factors and it reports table 2.

Tab. 2: Energy equivalence conversion factors (IPPC, 2006a)

From:	**Multiply by:**			
To:	**GJ**	**MWh**	**MWh_e**	**MWh_{th}**
GJ	1	0.2778	0.1056	0.2528
MWh	3.6	1	0.38	0.91
MWh_e	9.4737	2.6316	1	-
MWh_{th}	3.9560	1.0989	-	1
Gcal	4.1868	1.163	0.4421	1.0583

Table 2 gives conversion factors (for externally generated sources) assuming an average of 38% for electrical conversion efficiency (i.e. 1MWh = 0.38 MWh_e) and 91% for external heat generation (i.e. 1MWh = 0.91MWhth). So in order to pass from MWh_e to MWh_{th}, MWh_e should be multiplied per 2.6316 and then per 0.91 (2.6316*0.91 = 2.4).

It is important to understand that equivalence values are not exact coefficients or conversion factors. They provide an estimate of the energy that is required to produce the energy externally.

3. Mechanical-biological treatment (MBT)

Mechanical-biological treatment (MBT) of solid wastes is usually designed to recover materials for one or more purposes and to stabilize the organic fraction of the residual (IPPC, 2006b). Another purpose of MBT is material separation for further processing (e.g. preparation of solid waste fuels). MBT plants include a mechanical separation of the waste and a biological treatment (anaerobic and/or aerobic digestion). MBT plants are very flexible and can be built on a modular basis. A schematic diagram of a MBT process is shown in figure 7.

In Italy, the MBT process has increased considerably between 1996 and 2004. In fact, in 2004 it is reported to manage about 9 million tonnes of MSW, nearly three times as much as WTE. About 20% of the mechanical-biological treatment is dedicated to the production of compost from selected fraction, whereas the other 80% produce a large variety of materials such as bio-stabilized, dry fraction and RDF (Refuse Derived Fuel). Often these products, especially the bio-stabilized and dry fractions (which do not have the characteristics of RDF), are disposed in landfills. Also, APAT and

ONR have had difficulty in determining the final destination of MBT products (i.e. landfilling or WTE). This explains why in figures 9 and 10, that show the different ways of MSW management, the MBT products are grouped together as "Dry fraction, bio-stabilized and RDF".

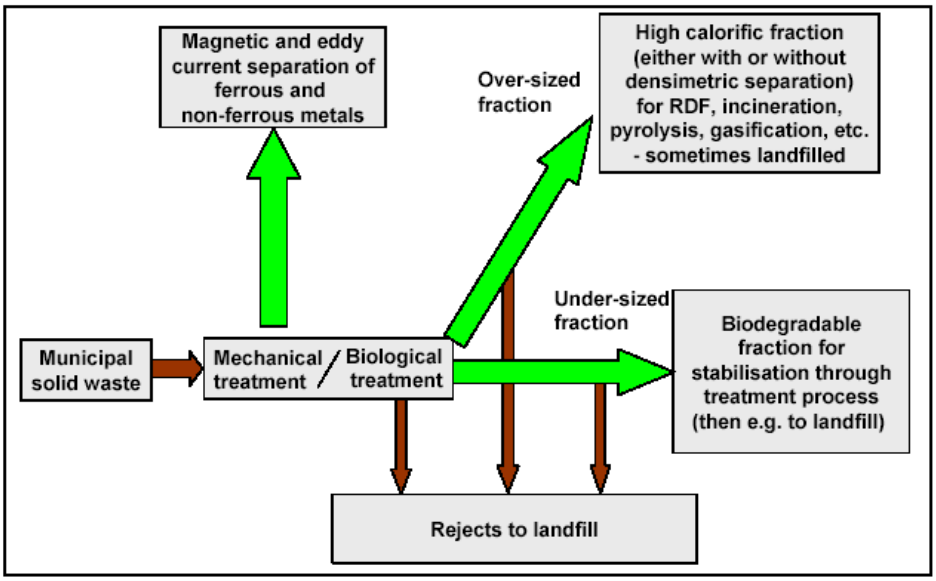


Fig. 7: Schematic representation of mechanical/biological treatment input and outputs (IPPC, 2006b)
Note: Brown arrows represent residual materials. Green arrows represent processes outputs. Mechanical treatment may be carried out before or after the biological treatment.

4. Landfilling

From 2000 to 2004, the number of landfills in Italy decreased from 657 to 401. As is the case for other waste management technologies (e.g. WTE facilities), the distribution of landfills is not uniform across the nation (Fig. 8): most of them are situated in the South of Italy.

Because of the new law (D.Lgs. 36/2003) relating to the EU directive of 1999, the use of landfills will decrease further: in fact, this law fixes a maximum value of biodegradable waste that can be disposed in landfill and forbids the disposal of particular materials (e.g used tires) and materials characterised by a lower heating value (LHV) higher than 13,000 kJ/kg.

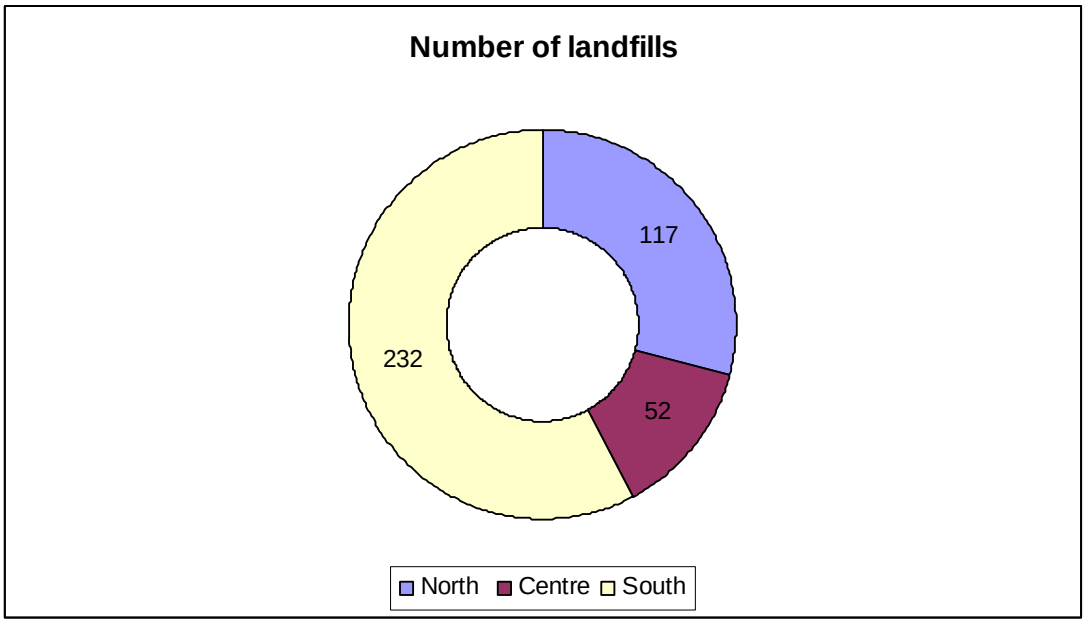


Fig. 8: Number of landfills in the macro-geographical areas of Italy in 2004 (total = 401) (APAT and ONR, 2005)

5. Conclusions

Figures 9 and 10 summarize the MSW management in Italy. In both of them, the category "landfill" includes the MSW directly landfilled and also residual wastes from recycling, WTE stabilized Air Pollution Control (APC) ash, and WTE bottom ash. The category "waste-to-energy" includes the MSW and RDF combusted in dedicated plants and also 0.3% of RDF that is used in power plants and cement kilns. The category "other recovery" includes all the materials that are recycled and also the ashes produced by incineration that are used beneficially in industrial plants (e.g. in cement kilns). The categories "Compost from selected fraction" and "Dry fraction, bio-stabilized, RDF" include the materials that are sent to composting or MBT plants.

It can be seen that the principal way of disposal in Italy remains landfilling, but in the period of 2000 to 2004 the use of landfills decreased from 72.4% to 51.9%, whereas WTE increased from 8.5% to 9.7%. The use of mechanical-biological treatment and composting has remained nearly constant between 2003 and 2004 at about 28%.

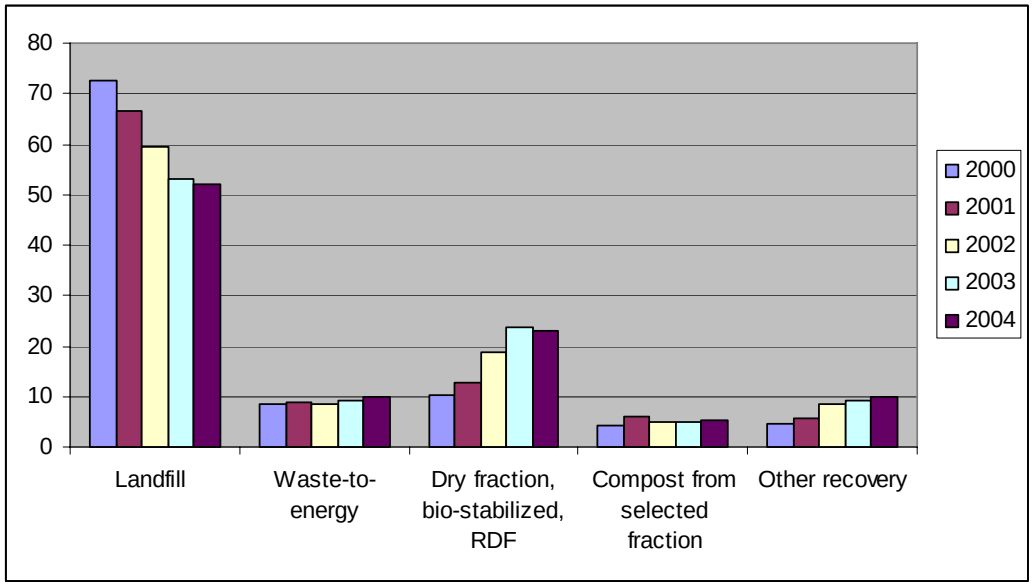


Fig. 9: Variation of MSW management in Italy from 2000 to 2004 (APAT and ONR, 2005)

Note: The categories "Compost from selected fraction" and "Dry fraction, bio-stabilized, RDF" indicate the input, and not the output, of composting or MBT plants.

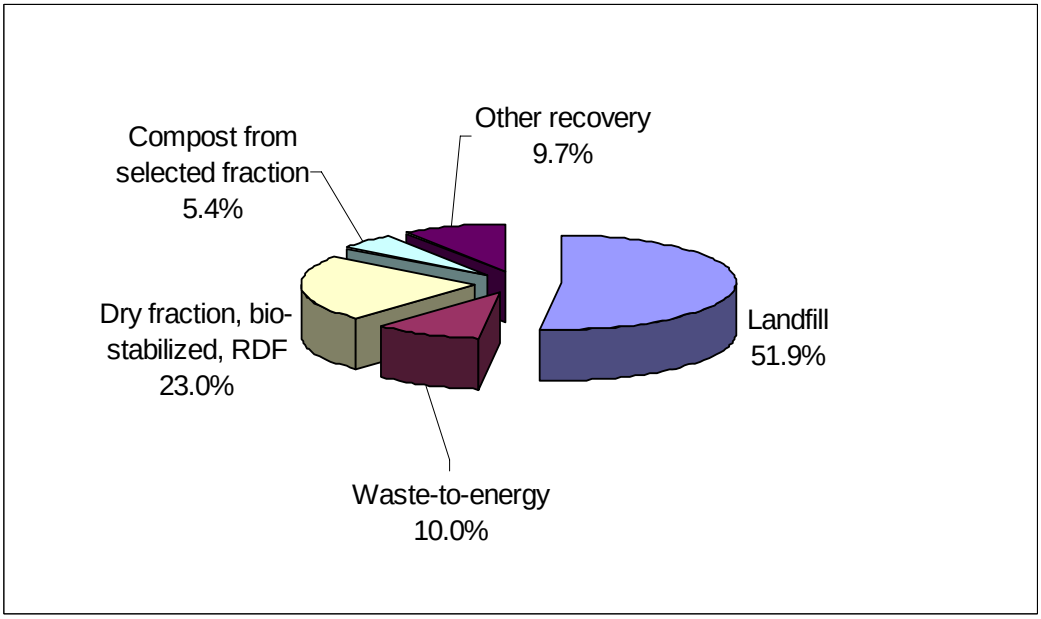


Fig. 10: Disposition of MSW in Italy in 2004 (APAT and ONR, 2005)

Note: The categories "Compost from selected fraction" and "Dry fraction, bio-stabilized, RDF" indicate the input, and not the output, of composting or MBT plants.

References

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