Chapter 2
Municipal Waste Overview

Improved waste management is an essential component in order to make countries more resource efficient. This important target is driving European environmental policies and legislations towards a more efficient waste management system.

In this chapter, the "waste management hierarchy," proposed by the 2008/98/EC European Union Directive, is described. Moreover, in order to provide a general overview on municipal solid waste (MSW), this chapter focuses on waste generation and disposal for both the European and the Italian markets. Information and data concerning European Union (EU) countries' progress in enhancing recycling rates will be discussed, with a focus on on related policies such as landfill average costs and taxes.

2.1 Municipal Solid Waste Definition and Management System Hierarchy

The definition of "municipal waste" used all around the EU countries varies, reflecting different waste management operations. In order to collect and compare yearly reporting data of waste generation and management from European countries, "municipal waste" is defined as follows [1]: "Municipal waste is mainly produced by households, though similar wastes from sources such as commerce, offices and public institutions are included. The amount of municipal waste generated consists of waste collected by or on behalf of municipal authorities and disposed of through the waste management system."

In this context, municipal waste is understood as waste collected by or on behalf of municipalities.

In the EU's Landfill Directive, MSW is defined as [2] "waste from households, as well as other waste which, because of its nature or composition, is similar to waste from households."

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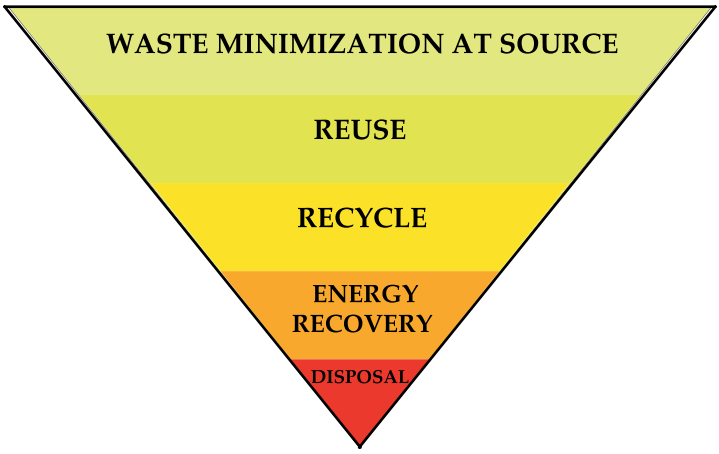


Fig. 2.1 Waste management hierarchy as suggested by 2008/98/EC Directive

Thus, the definition refers to "household waste and similar waste." The typical MSW composition contains food and kitchen waste, green waste, glass, paper, plastics, as well as other recyclable materials, etc.

The revised 2008/98/EC Directive also sets the basic concepts and definitions related to waste management and lays down waste management principles such as the "waste hierarchy" [3]. The EU's approach to waste management is based on three fundamental principles: waste prevention, recycling and reuse, and improving final disposal and monitoring. Based on the EU's approach to waste management, the best and most economical way of dealing with waste is to minimize its production; if waste cannot be prevented, as many of the materials as possible should be recovered, preferably by recycling. Where possible, waste that cannot be recycled or reused should be safely incinerated, recovering the energy released with waste combustion and leaving landfill as the last option for waste disposal.

Figure 2.1 schematically shows, through an inverted pyramid, the waste management hierarchy suggested by European Commission's directives.

European environmental policies and national efforts must be in the direction of shifting waste management up the waste hierarchy—reducing waste disposal (i.e., landfilling) while focusing on waste prevention, reuse, recycling, and energy recovery.

Development and progress on waste management for each one of the 32 European Environment Agency (EEA) member countries[1] will be discussed in the next paragraphs, reviewing the latest available data.

[1] The EU-27, Iceland, Norway, Switzerland, Turkey, and Croatia.

2.2 Overview of Waste Production and Disposal for European Countries

The socioeconomic growth of the most industrialized countries has involved a progressive increase of MSW production. In the EU-27, the average MSW production was about half a metric ton per person in 2010 [4]; hence, issues related to the disposal of MSW turn out to be very important. Figure 2.2 shows the amount of MSW produced per person for the 32 EEA members in 2001 and 2010.

A comparison of yearly MSW generation data shows that most of the countries (21 of 32) generated more municipal waste per capita in 2010 than in 2001, while 11 reduced municipal waste per capita.

Despite the problem that the MSW definition differs between countries (which means that data should be used with caution), a very wide range of waste generation can be observed.

The EU-27 average value equaled 502 kg/p.p. in 2010; countries such as Cyprus or Switzerland considerably exceed the EU average value, whereas Eastern

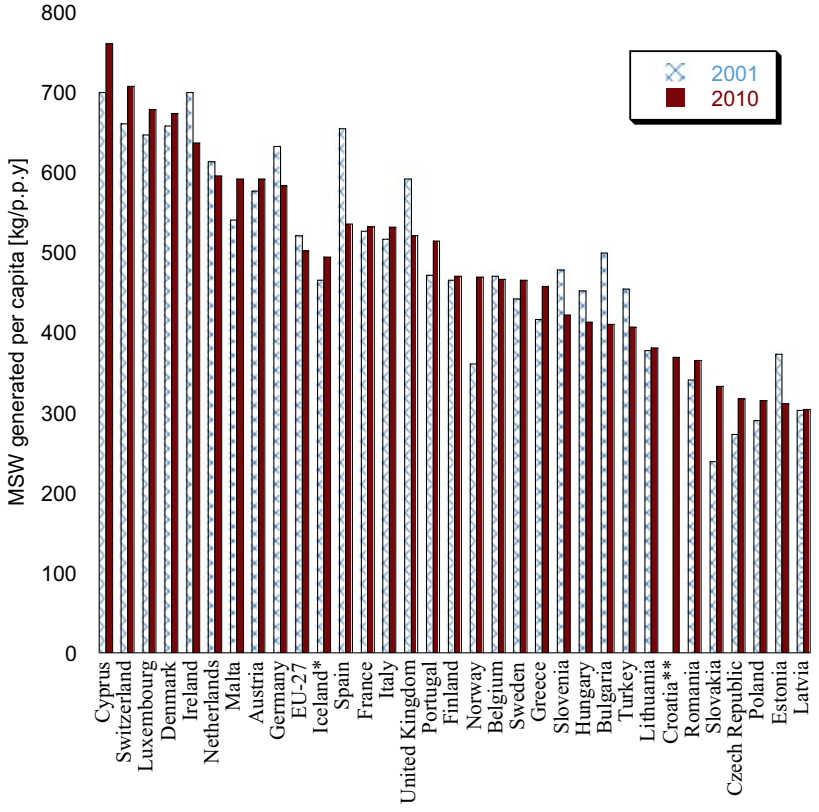


Fig. 2.2 Municipal waste generated per capita in 2001 and 2010 [4]. (Iceland: 2008 data used for 2010; Croatia: 2004 data used for 2001)

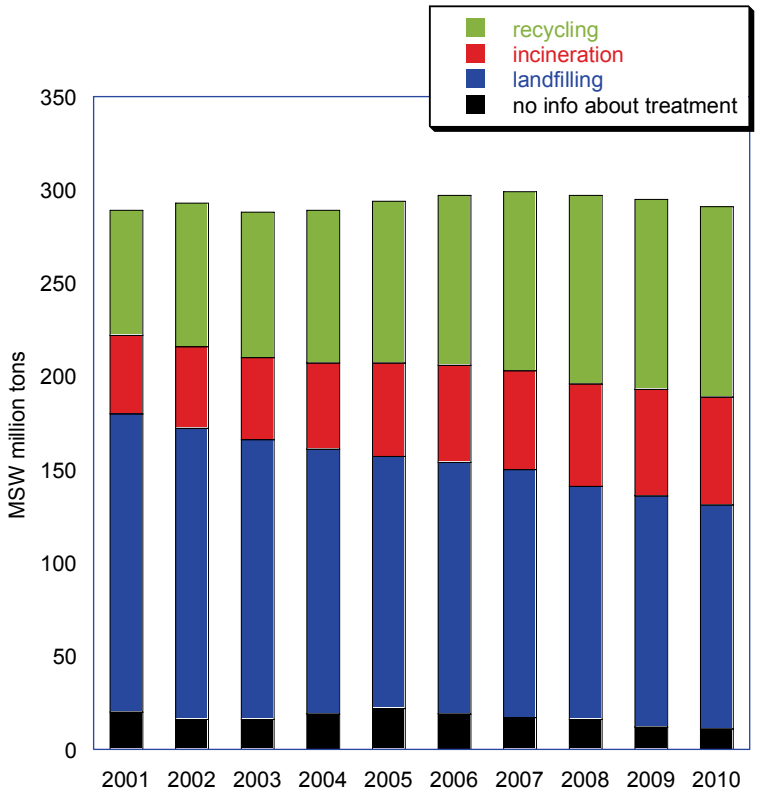


Fig. 2.3 Development of municipal waste management in 32 European countries, from 2001 to 2010 [4]

European countries have lower values. Italy, with a MSW production of about 530 kg/p.p./year, lies just above the EU-27 average value.

Figure 2.3 shows the MSW total generation and final treatments for the 32 EU countries from 2001 to 2010. The data highlight that European countries are climbing up the waste hierarchy for municipal waste management, thereby implementing one or more key principles of the Waste Framework Directive (such as recycling and incineration) while reducing the use of landfills.

Figure 2.3, however, highlights that more than half of the countries still landfill over 50% of their municipal waste. The main reason is that landfill is still the cheapest and simplest way, among all waste-processing technologies, to deal with waste disposal in most of the countries.

In Fig. 2.4, percentages of MSW final treatments in the EU-27 countries are reported in detail. Only few exceptions (such as the Netherlands, Denmark, and Sweden) have a high level of alternatives for final treatment disposal. The percentage of incinerated waste ranges from zero (e.g., East European countries) to over 50% (e.g., Denmark) with an average value equal to about 18% for 27 EU countries in

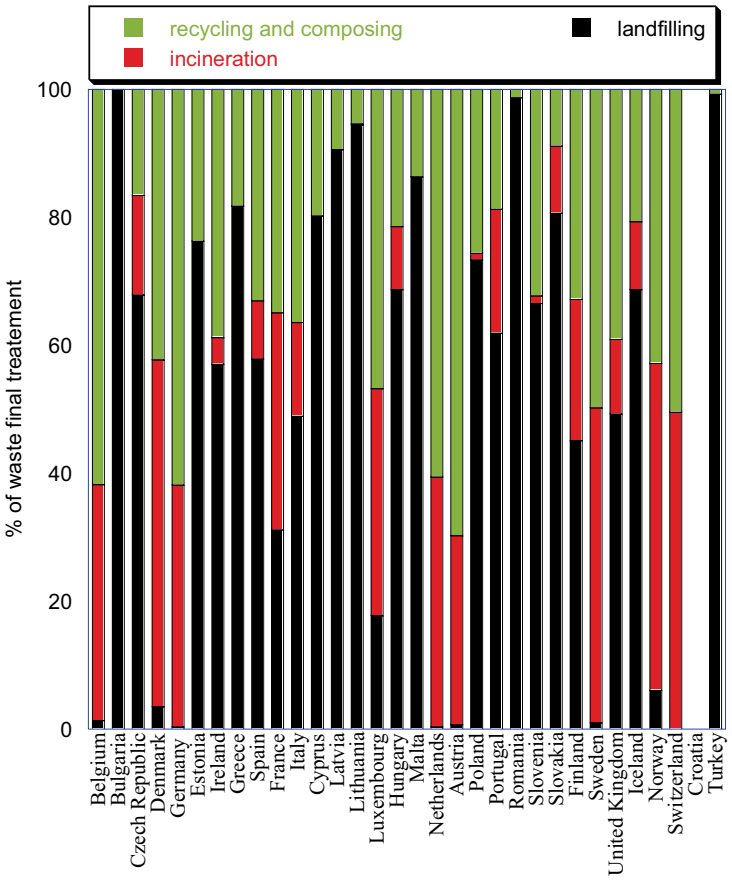


Fig. 2.4 Final treatment percentage allocation for 27 European countries in 2010 [4]. (No data is available for Croatia)

2010. In general, during the period from 2001 to 2010, the increase in recycling and incineration of MSW has led to a decrease in landfill waste (see Fig. 2.3).

Figure 2.5 compares MSW recycling rates (including also composting and digestion of organic waste) for EEA countries in 2001 and 2010. In the analyzed period, although percentage rates show considerable differences in performance between nations, 22 countries have increased their recycling performance between five and ten percentage points. This clearly indicates a significant improvement in recycling performance. Although, five countries (Switzerland, the Netherlands, Belgium, Austria, and Germany) have already achieved the 50% recycling target imposed by the European 20-20-20 targets, the majority of countries will need to make an extraordinary effort in order to achieve this goal.

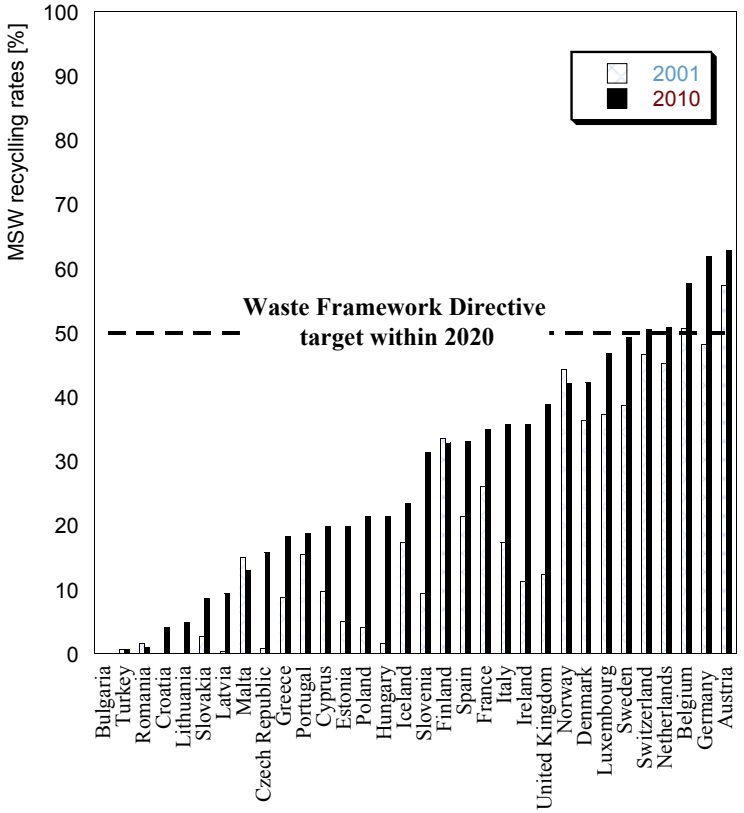


Fig. 2.5 MSW recycled for 32 European countries in 2001 and 2010 [4]. *WFD* Waste Framework Directive

2.2.1 Overview of Municipal Solid Waste Production and Disposal in Italy

Figures 2.6 and 2.7 present the data of MSW total generation from 1998 to 2013 [5] and of MSW generated per capita in 2009 and 2013, focusing on the Italian national and regional markets. According to the report of Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA), there are remarkable differences in per capita production across regions. In 2009, central regions had the highest per capita production of waste, equal to about 604 kg/p.p.y, whereas lower values were recorded for southern regions, namely, 493 kg/p.p.y. Emilia Romagna (with 666 kg/p.p.y) had the highest MSW production per habitant, followed by Toscana (with 663 kg/p.p.y). In 2013, the total generation in Italy was about 29,595 metric tons of municipal waste.

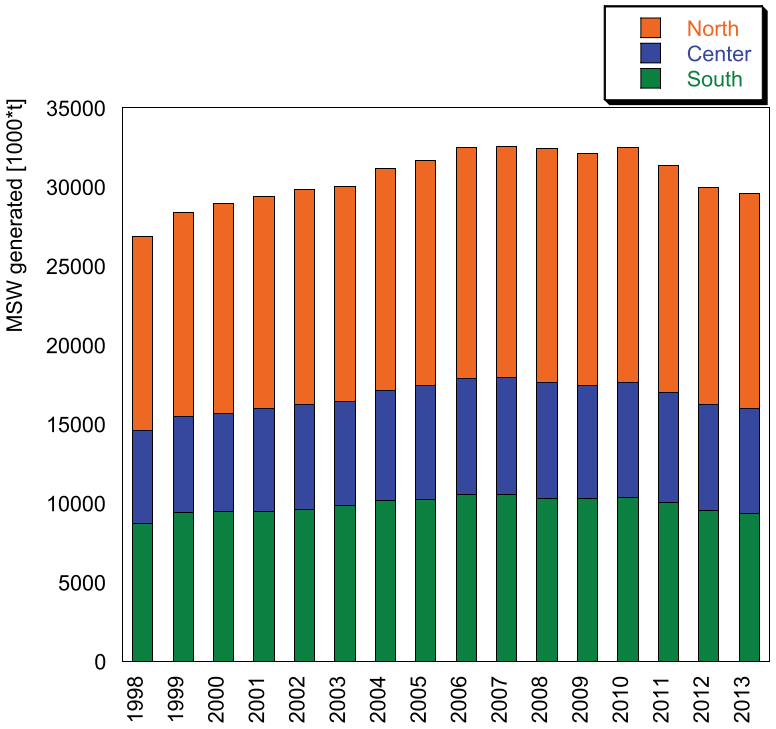


Fig. 2.6 MSW produced in Italy from 1998 to 2013 [5]

In 2009, landfills received around 45 % of the total MSW managed, as shown in Fig. 2.8. Comparing the regional data for waste disposal in 2009, Fig. 2.8 highlights an inhomogeneous situation between regions—northern regions show reduced use of landfill (Lombardia records the lowest use representing 7 % of its total production). An exception, in the southern regions, is represented by Sardegna where regional legislation is driving towards recycle and reuse of waste.

2.3 Average Costs of Municipal Solid Waste Landfill

Cost of various waste disposal methods varies depending on the technology adopted and on the country's specific policy measures (such as taxes). As a rule of thumb, incineration costs are twice the costs of landfill. A recent study [6] quantifies incineration costs between 100 and 250 €/t of waste, whereas costs for landfill have a range down to 20 €/t of waste. Thus, the main reason why landfill is still the predominant treatment option for most of the EU countries is primarily economic. Taxes and charges tend to drive the economics of recycling and composting.

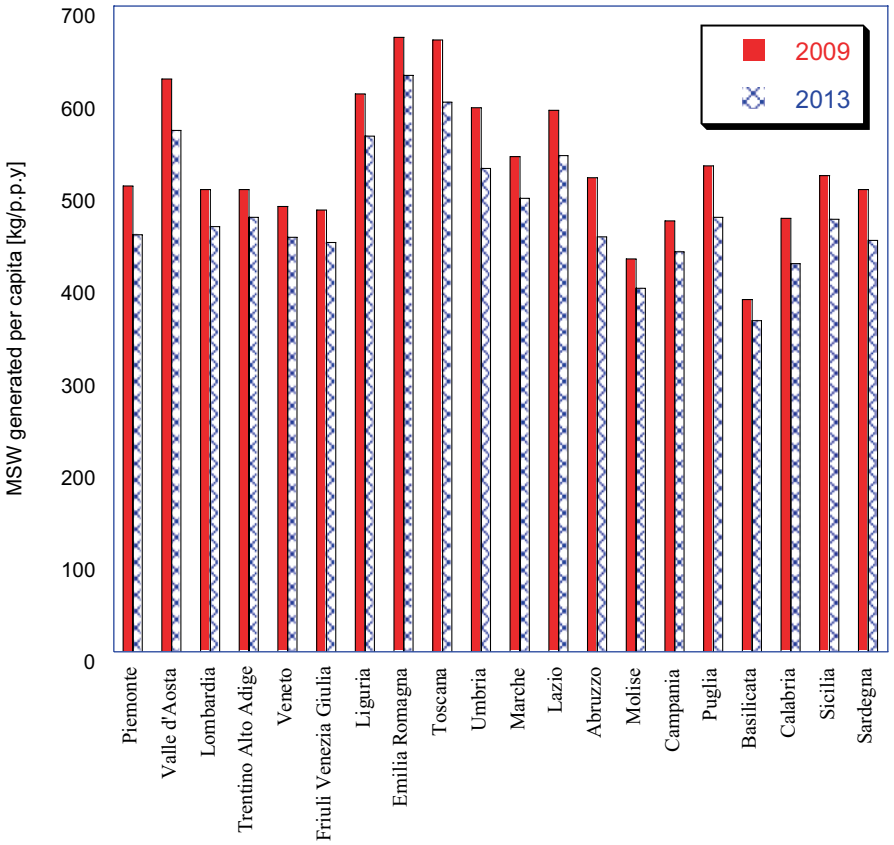


Fig. 2.7 MSW produced per capita in Italian regions in 2009 and 2013 [5]

The most relevant case is Denmark, where cost for landfilling both household waste and hazardous[2] waste drastically increased in the past 17 years [7]. Table 2.1 collects available cost data for some of the EU countries.

A correlation between recycling rates (see Fig. 2.5) and landfill costs is evident. Nations which have sharp policy measures, such as additional landfill taxes or economic support to build up recycling infrastructures, are expected to achieve high recycling rates. As shown in Table 2.1, there is a general trend in increasing costs for waste disposal throughout almost all countries considered. Figure 2.9 shows gate fee and landfill taxes for MSW landfilling in EU Member States. EU countries appear much more likely to meet a 50% recycling target once landfill charges (or the cost of the cheapest disposal option) approach EUR 100 per metric ton [8].

[2] Waste derived from common manufacturing and industrial processes, from specific industries and from commercial chemical products, etc. are classified as hazardous.

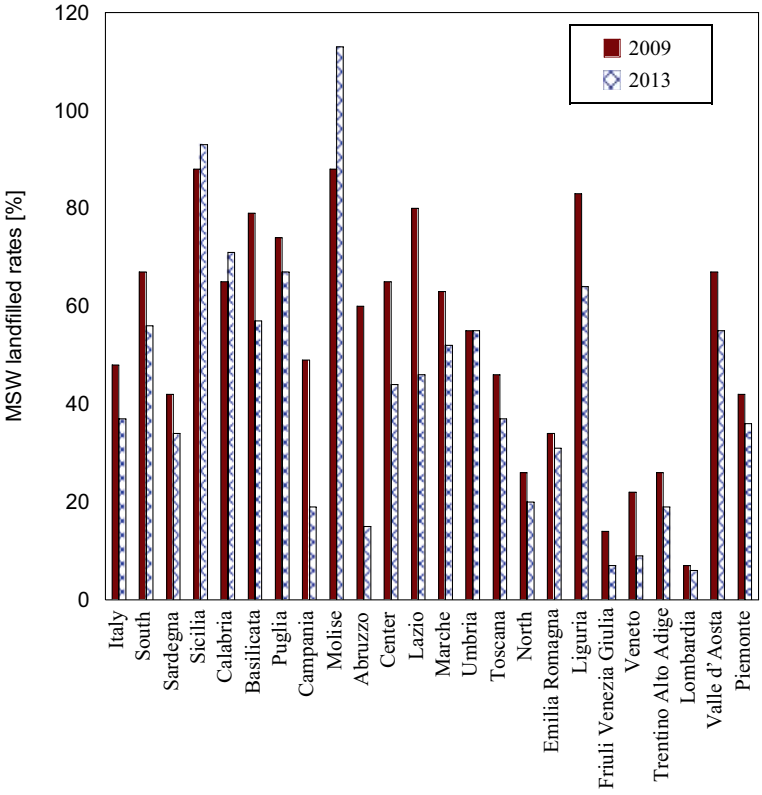


Fig. 2.8 Percentage of landfill disposal of MSW generation in Italian regions in 2009 and 2013 [5]

Table 2.1 Estimated cost range for landfilling of waste (excluding any landfill tax, if relevant) [7]

Country	Latest data	Cost range for MSW [€/t]	% change
Austria	1999	50–150	–
Belgium-Flemish	2003	116	+5 (in 2 years)
Denmark	2004	110	+57 to +340 (in 17 years)
Finland	2003	30–121	–
Germany	2005	123 (average from 12 sites)	–
Greece	2005	8–35	+75 (in 6 years)
Ireland	2005	120–240	+52 (in 4 years)
Italy	2003	90–110	–
Luxembourg	2003	50	–
Netherlands	2002	58	−8 (in 4 years)
Portugal	2004	26	–
Spain	2004	12	–
Sweden	2004	70–90	–
UK	2003	21	–

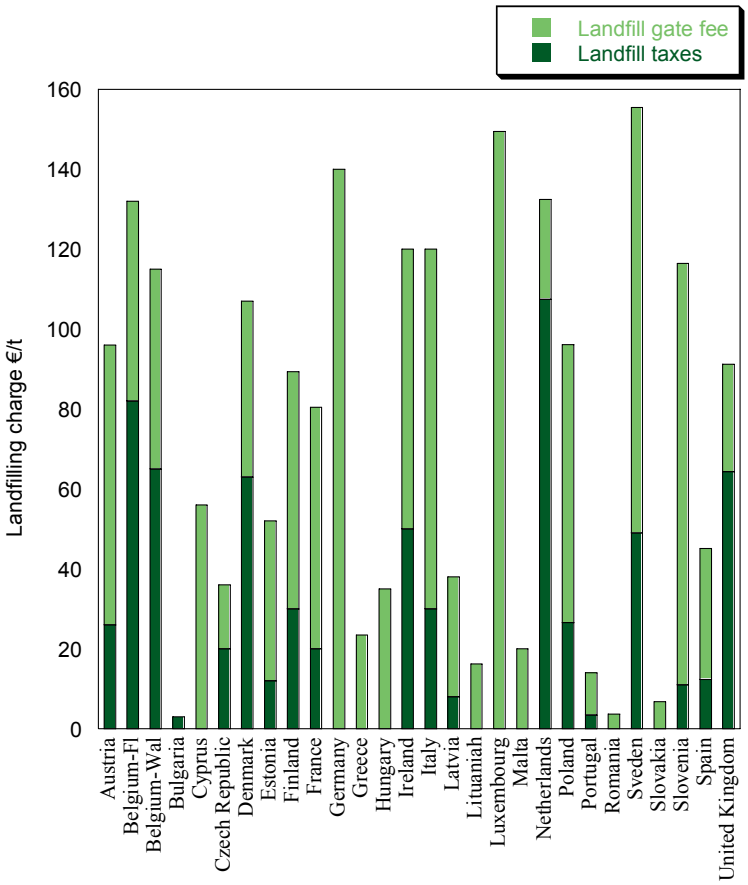


Fig. 2.9 Typical charges (gate fee and taxes) for MSW landfilling in EU Member States and regions [4, 8]

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