

Municipal waste management



Portugal 

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Context

This country profile was prepared within the EEA's work on municipal waste, resulting in the following outcomes:

- [32 country profiles](#) (this document) – The country profiles were originally produced by the ETC/SCP and were published by the EEA in 2013. The ETC/WMGE updated them for the EEA under its 2015 and 2016 work programme.
- [An EEA briefing on Municipal waste management across European countries](#)

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Related country information

Country information on waste prevention programmes can be found at:
<http://www.eea.europa.eu/publications/waste-prevention-in-europe-2015>

For country profiles on material resource efficiency policies, please visit:
<http://www.eea.europa.eu/publications/more-from-less/>

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Highlights

- In 2014, Portugal sent 49 % of its generated municipal solid waste (MSW) to landfill.
- Portugal has been slowly increasing its recycling rate since 2002, to 30 % of MSW generated in 2014, mainly because of an increase in material recycling. In recent years, however, there has been a sharp rise in organic recycling.
- Still, Portugal will need to increase its effort if it is to fulfil the 50 % recycling target of the Waste Framework Directive (WFD) by 2020.
- The third national waste management plan (PERSU 2020) was adopted in 2014.
- Ten new mechanical biological treatment (MBT) plants came into operation in 2010, which can be expected to have a significant effect on the development of the entire MSW management system. Further investment in MBT technology is expected.
- Portugal needs to intensify its efforts for meeting the final two targets of the Landfill Directive.

1 Introduction

1.1 Objective

Based on historical municipal solid waste (MSW) data for Portugal, and EU targets linked to MSW in the Waste Framework Directive (WFD), the Landfill Directive and the Packaging Directive, the analysis undertaken includes:

- historical MSW management performance based on a set of indicators;
- uncertainties that might explain differences in country performance, which may relate more to variations in reporting methodology than to management performance;
- indicators relating to the country's most important initiatives for improving management of MSW;
- possible future trends.

2 Portugal's municipal solid waste management performance

Portugal has made substantial progress since the end of the last century, when depositing in open dumps was the dominant, if not exclusive, treatment method.

The drivers behind developments in MSW management include national legislation, which predominantly transposes the EU Directives, and the national waste plans (NWMPs). There have been three NWMPs in Portugal: PERSU I was ratified in 1997 and covered the period to 2006, when PERSU II came into play for 2007–2013. Finally, the new NWMP, PERSU 2020 covering the period 2014–2020, was approved in September 2014.

The legal framework governing waste management has been consolidated over the last few years, with systems for managing specific waste flows, and placing the onus on producers to follow targets for prevention, separate collection, recycling and other forms of recovery (SOER, 2010). Besides the general frameworks such as PERSU, there are various other decrees regulating specific waste streams or treatment options.

The Ministry of the Environment is responsible for all waste legislation, while the waste management system involves three other types of organisations (APA, 2015a; Magrinho *et al.*, 2006):

- municipalities which are responsible for collection of (normally only mixed) waste;
- 23 urban wastes management systems (SGRUs) which are entities dealing with waste treatment, many of which are also responsible for separate waste collection; 11 have recently been privatised, while the others remain public entities;
- management organisations for specific waste streams included in municipal waste. These include SPV, the Portuguese Green Dot System responsible for recycling packaging waste; VALORMED, responsible for medicine packaging generated by the common citizens; Ecopilhas and Gestão e Valorização de Baterias (GVB) responsible for batteries and accumulators; and Amb3E and European Recycling Platform (ERP) responsible for batteries, accumulators and waste electrical and electronic equipment (WEEE).

Municipalities in Portugal must ensure the collection of MSW of up to 1 100 litres per producer per day; larger amounts of waste may be separately charged by the municipality. Large producers of waste, generating more than 1 100 litres daily, can use private waste operators; this waste is not accounted as municipal waste. The choice of the type and specific features of the collection system lies with the municipalities and the systems vary throughout the country and even within a given municipality. Typically, municipal waste collection from households is covered by contracts with the municipality or with private collectors operating on their behalf – in many municipalities separate collection is carried out by SGRUs. (APA, 2015a; Gibbs *et al.*, 2014a)

The formal waste collection system reportedly serves all households in Portugal. Approximately 95 % are served by collection points; door-to-door collections exist in some major urban centres such as Lisbon and Porto but only for some waste types, including glass, packaging and organic waste. Around 70 % of the collection points take mixed waste only, and the remainder are equipped for separate collection of three forms of recyclables: paper and cardboard; glass; and metals and plastics. In addition, there are 189 civic amenity sites (recycling centres) in Portugal for the collection of bulky waste, garden waste, large furniture, batteries and accumulators, WEEE, cooking oil and packaging waste. (APA, 2015a; Gibbs *et al.*, 2014a)

Funding for the waste collection system is raised by municipalities in the form of fees calculated on the household's invoiced water consumption. Most municipalities have fixed tariffs while others apply mixed systems (fixed and variable tariffs) or variable tariffs. Typically, the tariffs are insufficient to meet actual costs, but some municipalities are able to fully cover their costs (Gibbs *et al.*, 2014a). The tariff system is currently under review. (APA, 2015b)

Portugal generated 4.7 million tonnes of MSW in 2014 and all generated waste was reportedly treated (Eurostat, 2016). Waste treatment is still heavily based on landfill, but Portugal has invested in other treatment options including incineration, composting and mechanical biological treatment (MBT) technology. In the decade from 2001 to 2010, landfill remained the dominant option accounting for 60 % of MSW, but since then it has decreased and in 2014 was down at 49 %. This is mainly due to recycling, which increased to 30 % in 2014, while 21 % of MSW was incinerated.

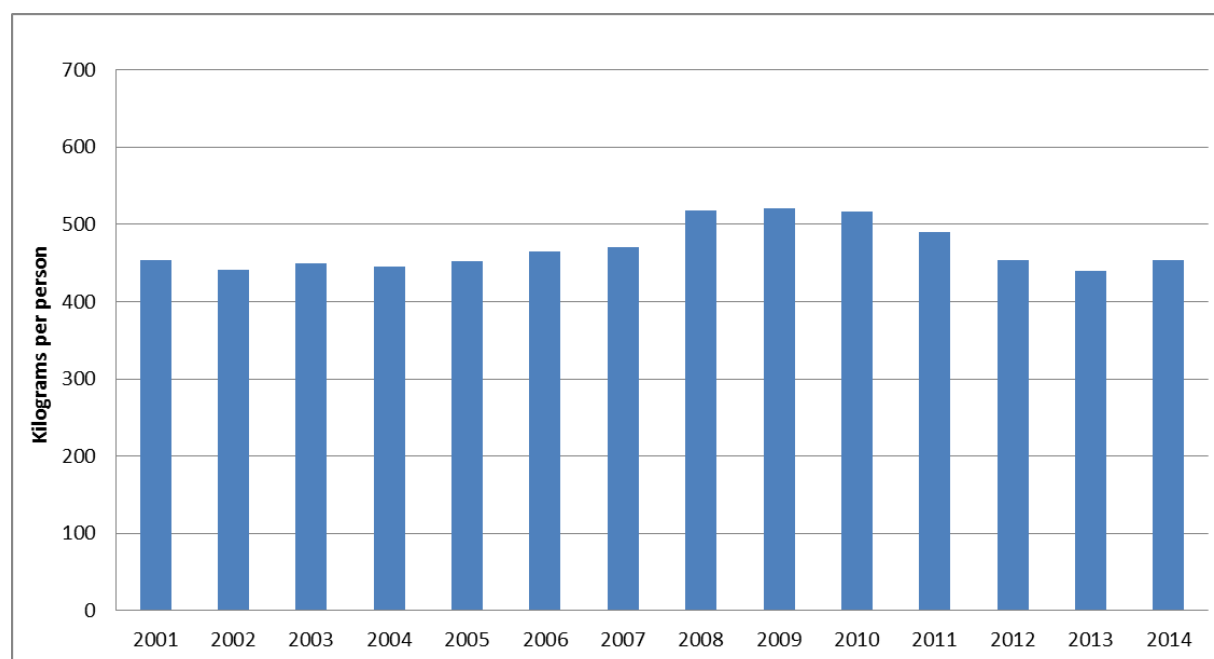
As for MSW treatment infrastructure, there are two waste incineration plants in continental Portugal, in Lisbon and Porto, both with energy recovery. In addition, there is an incineration plant on Madeira for the treatment of locally produced waste. By 2015 there was one anaerobic digestion plant and one composting plant for separately collected organic waste, and there were three green waste composting plants and 18 MBT plants, mostly with anaerobic digestion technology in operation. Further facilities for organic recycling are under construction or planned. In 2015 there were 31 landfill sites in operation and two units under construction. Four additional landfill cells are planned for the coming years. (APA, 2015a)

2.1 Municipal solid waste indicators

The following indicators illustrate the development of MSW management in Portugal for 2001–2014. All percentage figures have been calculated as proportions of generated waste, not managed waste.

Figure 2.0 shows the development of MSW generation per person in Portugal for 2001–2014. There was a slow increase from 441 kilograms per person in 2002 to 520 kilograms in 2009. There is a break in series in 2002, when the data collection method was changed: the statistical survey was replaced with administrative data sources. For 2001, the figure shows the amount of municipal waste collected (Eurostat, 2015c). Since 2009 the waste generation per person has been decreasing and in 2014 municipal waste generation in Portugal was 453 kilograms per person, which is below the EU-28 average of 474 kilograms.

Figure 2.0 Portugal, municipal solid waste generation per person, 2001–2014



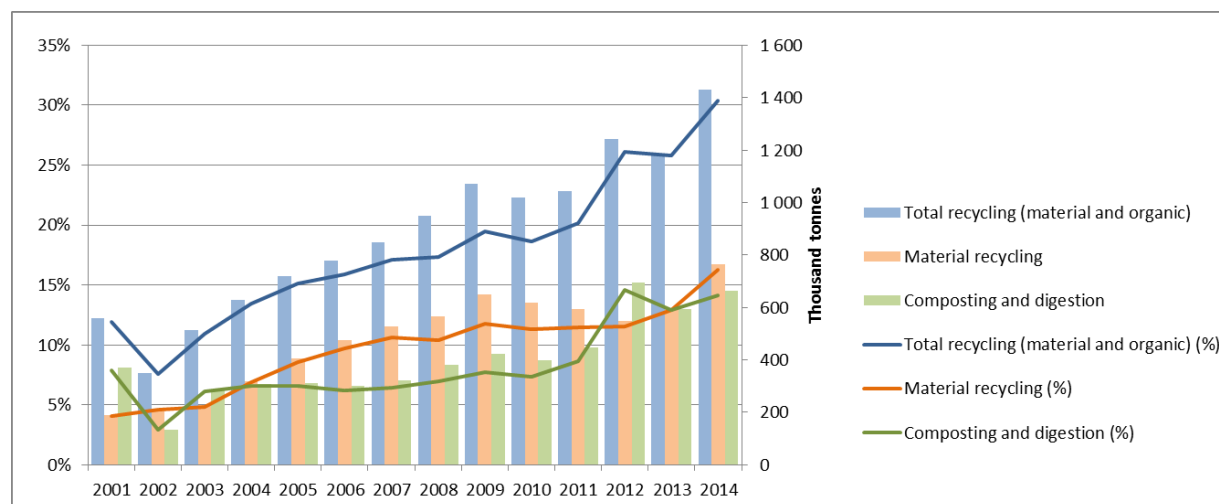
Source: Eurostat, 2016.

2.1.1 The recycling of municipal solid waste, 2001–2014

Figure 2.1 shows the development of MSW recycling in Portugal in terms of the total recycling level, material recycling and organic recycling (composting and other biological treatment). After a sharp decrease in 2002, recycling in Portugal significantly increased up to 2009. The driver behind this was mainly material recycling, which grew faster than organic recycling. The dip in organic recycling in 2002 was probably caused by changes in data collection rather than an actual decrease in composting (Magrinho *et al.*, 2006).

In 2009–2011 progress stagnated and the recycling rate remained at 19–20 % of MSW. This may have been caused by the economic downturn, which can also be noted in the generation of MSW. In 2012–2014 the total recycling rate increased to 30 %, mainly due to rising organic recycling. This can be attributed to the introduction of several new MBT plants in the country, as compost from the treatment of mixed municipal waste in MBT plants is reported as composted MSW. In 2014 there was also an increase in the material recycling rate from 13 % in 2012 to 16 %. Overall, recycling in Portugal is relatively low compared to other EU countries, but nevertheless shows an increasing trend.

Figure 2.1 Recycling of municipal solid waste in Portugal, 2001–2014, per cent and tonnes



Source: Eurostat, 2016.

The EU's 2008 WFD includes a target for certain fractions of MSW: 'by 2020, the preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households shall be increased to a minimum of overall 50 % by weight'. EU Member States may choose between four different methodologies to calculate compliance with the target¹. Portugal has chosen calculation method 2 (Gibbs *et al.*, 2014). The recycling rates shown in this paper correspond to method 4, the only method for which time series data exist. In 2015, the European Commission has proposed new targets for municipal waste of 60 % recycling and preparing for reuse by 2025 and 65 % by 2030, based on only one calculation method, and with the option of time derogations for some countries (EC, 2015b).

2.1.2 Landfill of biodegradable municipal waste

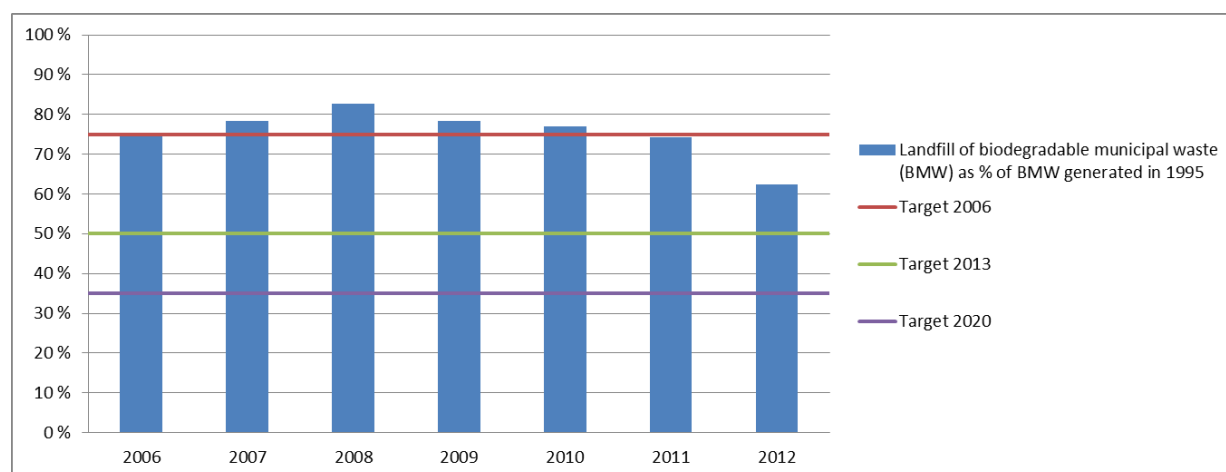
According to the EU Landfill Directive, Member States have to reduce the amount of biodegradable municipal waste (BMW) going to landfill by specific percentages by 2006, 2009 and 2016. However, Portugal obtained a four-year derogation period for the last two targets owing to delays that occurred in the construction and operation of new strategic infrastructure (APA, 2012). Thus the target years for Portugal are 2006, 2013 and 2020. The targets relate to the amount of BMW generated in 1995, which in Portugal was 2.25 million tonnes (EC, 2014a).

¹ Commission Decision 2011/753/EU allows countries to choose between four different calculation methods to report compliance with this target. Member States have the option of considering four alternative waste streams and fractions:

1. paper, metal, plastic and glass household waste;
2. paper, metal, plastic, glass household waste and other single types of household waste or of similar waste from other origins;
3. household waste;
4. municipal waste (the method used in this document).

Portugal has reported BMW landfill quantities to the European Commission for the years 2006-2012, (Figure 2.2) (EC, 2015; EC, 2014a).

Figure 2.2 Landfill of biodegradable municipal waste in Portugal, 2006–2012



Source: EC, 2015; EC, 2014a.

According to Figure 2.2, Portugal achieved the target for 2006. The amount of BMW going to landfill increased in 2007 and 2008 but has since diminished. If the recent trend is maintained, Portugal could be close to achieving the 2013 target, mainly by treating MSW in MBT plants, although the decrease in MSW also probably contributed to this.

2.1.3 Regional differences in municipal solid waste recycling, 2002–2013

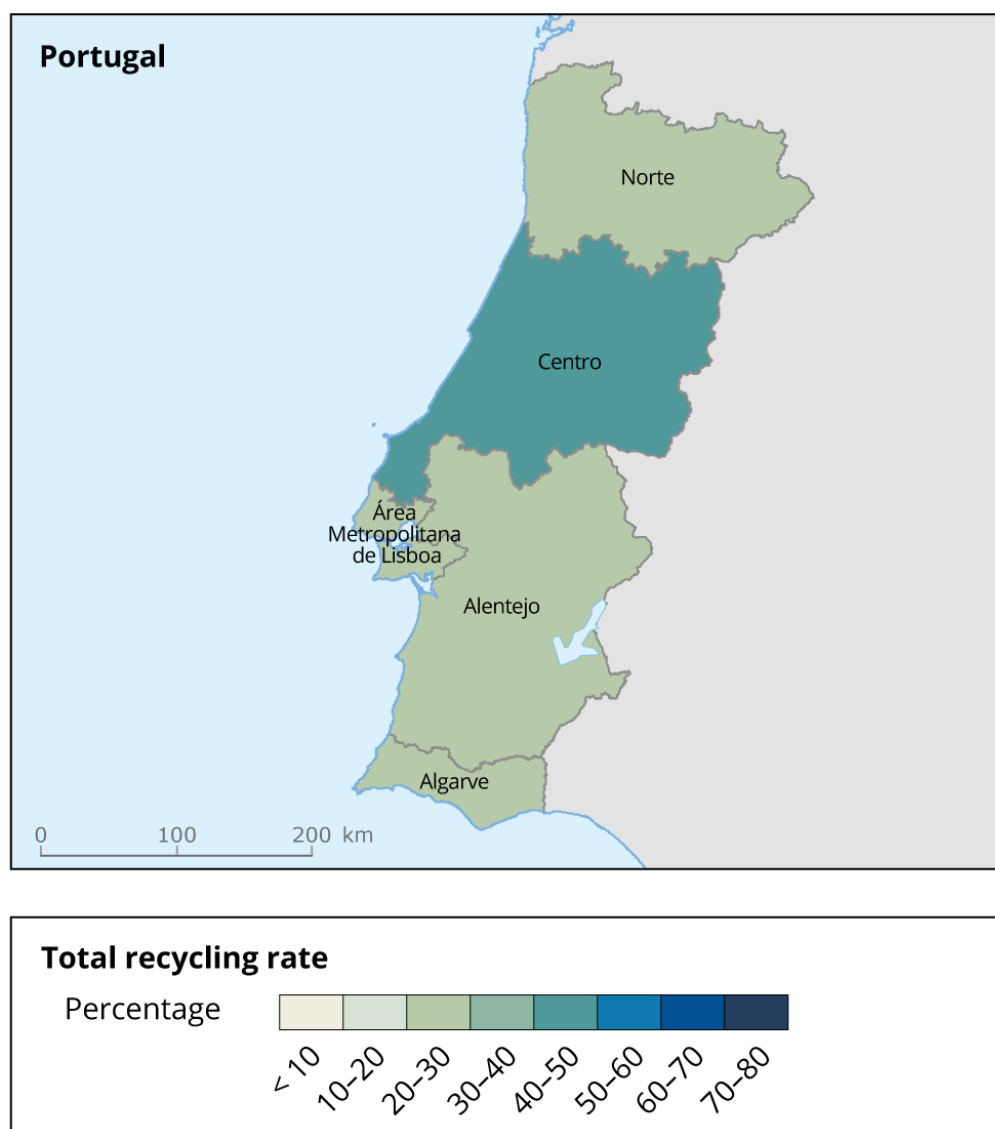
Eurostat's database includes regional data on recycling of MSW for some countries, including Portugal. Analysing it provides an overview of regional performance; regional differences could indicate good practice in some places that could serve as examples for others.

The regions are illustrated in Map 2.1. The region with the highest population is Norte with 3.7 million inhabitants followed by Lisboa with 2.8 million and Centro with 2.3 million. These three regions cover about 84 % of the total Portuguese population (10.5 million). In 2013 MSW generation followed the population pattern, being highest in Norte at 1.5 million tonnes a year, followed by Lisboa at 1.3 million tonnes, and Centro at 0.9 million. Total MSW generation for the country was 4.6 million tonnes in 2013.

Lisboa is by far the most economically developed region: its GDP in EUR per person is 85 % of the EU average while the six other regions reach between 50 % (Norte) and 61 % (Algarve) of the EU average according to Eurostat data for 2013 (Eurostat, 2015b).

Map 2.1 shows regional differences in the MSW recycling for 2013 (the latest year with available regional data) related to total recycling.

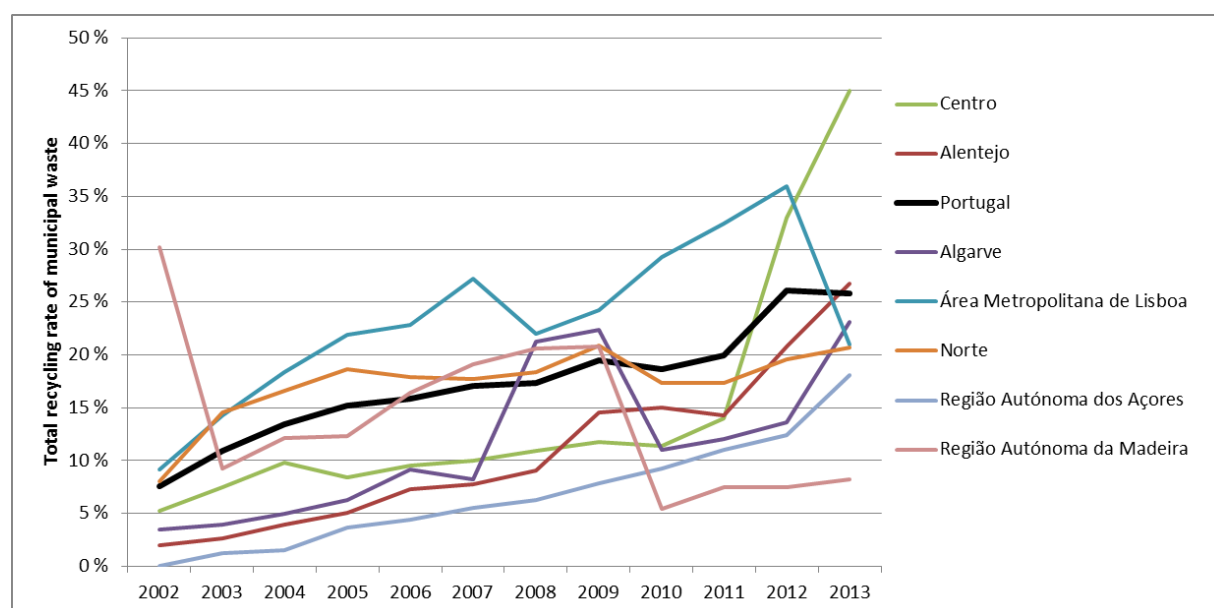
Map 2.1 Portugal, regional differences in municipal solid waste recycling, 2013



Source: Eurostat, 2015a.

Portugal has reported regional data to Eurostat since 2002. Figure 2.3 shows regional differences in MSW recycling for 2002–2013 related to total recycling – the sum of material and organic recycling – based on data reported to Eurostat.

Figure 2.3 Regional differences in municipal solid waste recycling in Portugal, 2001–2013



Source: Eurostat, 2015a.

The figure shows significant differences between regions: Centro and Região Autónoma dos Madeira have a 37 percentage point of difference, 45 % and 8 % respectively, in total recycling in 2013.

The region with highest MSW generation (Norte) follows national trends. The recycling rate shows significant fluctuations in the Região Autónoma dos Madeira over the years but it seems that, together with Região Autónoma dos Açores, the region is lagging somewhat behind national development. In 2012–2013 there was a remarkable increase in the total recycling rate in Centro whereas the rate decreased significantly in Lisboa. The increase in recycling in Centro can be explained by the fact that in 2013 two MBT plants with high treatment capacities started operation, contributing significantly to the increase in material and organic recycling rates. In Lisboa, an important MBT plant is considered to be only a mechanical treatment plant from 2013, since the organic phase of the treatment is not in operation (APA, 2015a).

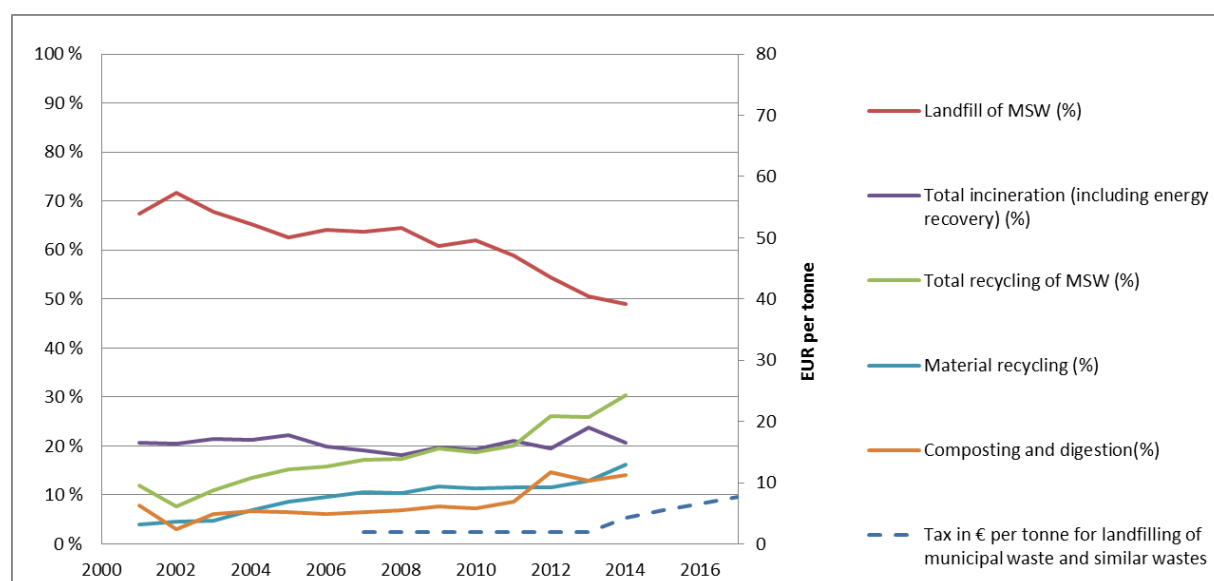
The large differences between regions show that there are lessons to be learned by the Portuguese regions. However, the specific conditions of each region, such as the structure of housing stock, have to be taken into consideration when transferring experience from one region to another.

2.1.4 Recycling and landfill taxes

In this section, the relationship between landfill tax and the level of MSW landfill is examined. Portugal introduced a landfill tax in 2007 of EUR 2 per tonne that was increased to EUR 4.28 per tonne, with an additional 50 % for recyclable waste, in 2014. The tax is supposed to provide an economic incentive to waste producers to divert waste from landfill and towards more sustainable solutions such as recycling or incineration with energy recovery (APA, 2015a; Gibbs *et al.*, 2014a).

In Figure 2.4 the level of landfill tax is plotted against the shares of MSW recycled, incinerated and sent to landfill. The tax seems to have had only a weak effect on MSW management. Recycling has increased since the introduction of the tax but it continues the trend observed before, with no extra stimulus noticed due to the tax.

Figure 2.4 Portugal, landfill tax and the development of recycling, landfill and incineration of municipal solid waste ⁽²⁾, 2000–2016



Sources: Eurostat, 2016; APA, 2015a.

Until 2014 there was also an incineration tax in place which was applied to all waste incinerated. The tax rates were as follows (APA, 2015a):

- EUR 1.14 per tonne for municipal waste incinerated (with an additional 50 % for recyclable waste);
- EUR 1.14 per tonne if the output of MBT incinerated exceeds 25 % of the waste sent to MBT or if the incinerated output exceeds 30 % of the waste sent to the sorting plant.

Compared to other EU countries, the landfill tax is very low in Portugal and is not likely to provide a strong incentive for diverting waste from landfill.

In 2015, the legislation on waste management tax changed (Law n.º 82-D/2014), and the tax level was increased in 2015 is EUR 5.5 per tonne. Further increases will take place – to EUR 6.6 per tonne in 2016, EUR 7.7 in 2017, EUR 8.8 in 2018, EUR 9.9 in 2019 and EUR 11 per tonne in 2020. The current tax levels for incineration and energy recovery are 70 % and 25 % of the landfill tax, respectively (APA, 2015a).

2.1.5 Environmental benefits of better municipal solid waste management

Figure 2.5 shows a scenario for the development of greenhouse gas emissions from MSW management in Portugal. The scenario assumes a yearly decrease/increase rate ranging from -1.0 % to 0.2 % for municipal waste generation for the years 2011–2016 followed by an annual increase rate of

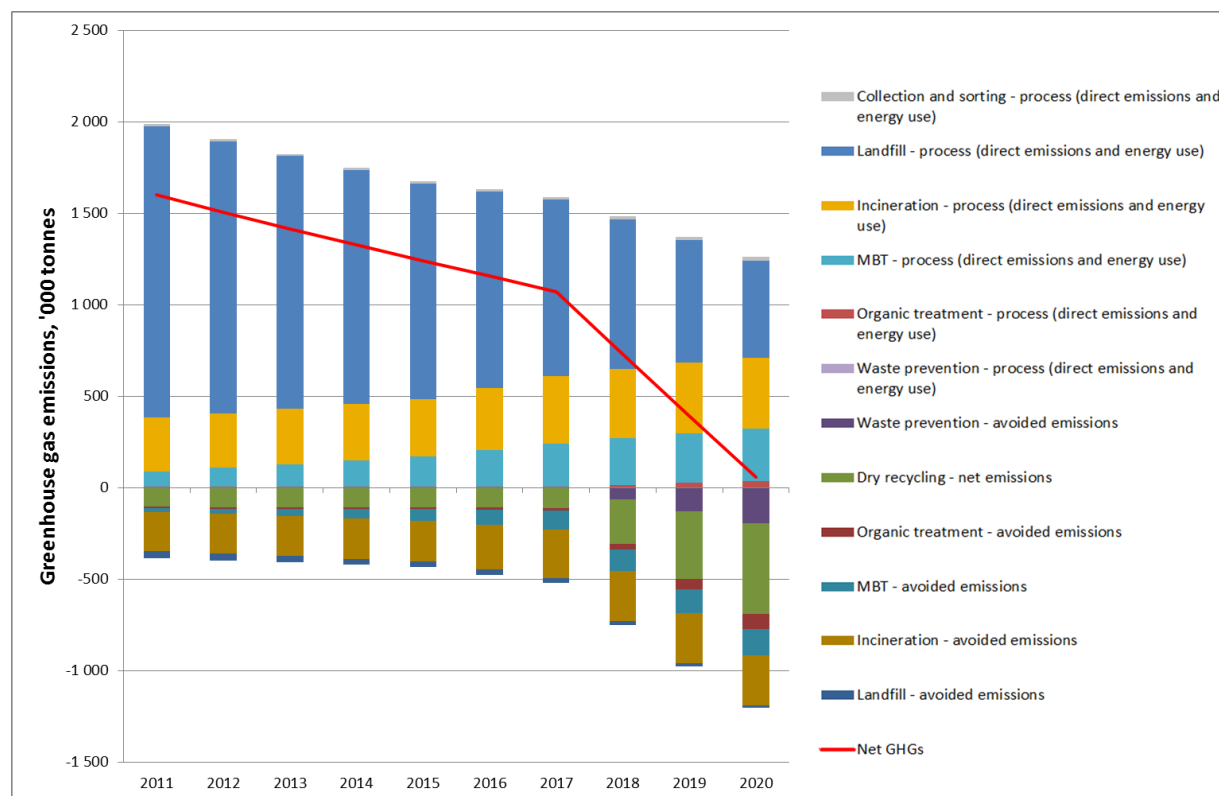
⁽²⁾ For the period 2002–2004, landfill, incineration and recycling figures relate to the amount of municipal waste collected. As part of the population is not covered by a municipal waste collection scheme – about 6 % of city inhabitants and 26 % of the inhabitants of rural regions in 2000 – the total amount of waste generated is underestimated.

1 %. The scenario also assumes that EU legislation for municipal waste is fully implemented. The calculation of emissions is based on data and assumptions contained in the European Reference Model on Municipal Waste Generation and Management. The approach taken in the model is rooted in life-cycle thinking, in that it considers not only direct emissions, but also avoided emissions associated with the recycling of materials and the generation of energy from waste management processes. The more detailed methodology is described in Gibbs *et al.* (2014b). The level of emissions depends on the amount of waste generated and the treatment it undergoes each year.

Figure 2.5 shows direct emissions, avoided emissions and net emissions resulting from the management of MSW. All the emissions (positive values) represent direct operating emissions for each waste management option. The phases of the waste management chain covered include waste prevention; material recycling; composting and anaerobic digestion; MBT and related technologies; collection and sorting; and incineration and landfilling.

For avoided emissions (negative values), the calculations integrate the benefits associated with the energy recovery and material recycling of paper, glass, metals, plastics, textiles and wood, and bio-treatment of food and garden waste from MSW.

Figure 2.5 Portugal, scenario for greenhouse gas emissions from municipal solid waste management, 2011–2020



Source: ETC/WMGE, calculation based on the European Reference Model on Waste

Note: results presented in this figure should not be used for the compilation of greenhouse gas reporting for the Intergovernmental Panel on Climate Change (IPCC) national inventory report, or be compared with IPCC figures, as the methodology employed here relies on life cycle thinking and, by definition, differs substantially from the IPCC methodology. MBT means mechanical-biological treatment.

Based on the scenario with full policy implementation, net greenhouse gas emissions from the treatment of municipal waste in Portugal are expected to decrease in the period 2011–2020 and to arrive at a small net saving in 2020 when the benefits of better waste management are expected to be higher than the direct emissions from collection and treatment operations. In the first years of the scenario direct greenhouse gas emissions related to municipal waste management are caused almost exclusively by landfill, while the benefits of recycling are relatively low.

Greenhouse gas emissions from landfill are caused by the breakdown of organic waste accumulated over past decades. In the model, which calculates landfill impacts over a 100-year period, the longer-term emissions from any given waste are attributed to the year in which that waste is deposited (Gibbs *et al.*, 2014b). Therefore, the positive effect of diverting BMW from landfill shows in the figures as an immediate reduction in greenhouse gas emissions from landfill. According to the model, towards 2020 direct greenhouse gas emissions arising from waste management will increasingly come from MBT operations and waste incineration.

2.2 *Uncertainties in the reporting*

Some uncertainties or differences in how countries report recycling of MSW can result in different recycling levels. This applies, for example, to the following issues:

- the extent of packaging waste from households and similar packaging from other sources included or not included in the MSW recycling reported;
- the definition of municipal waste used by the country, such as the inclusion or exclusion of home composting;
- the methodology used to report the inputs and outputs of MBT and sorting plants.

Municipal packaging waste treated by the urban waste management system (SGRU) is included in reported MSW data and thus no uncertainty remains on this issue. For the MBT plants the material recycling data reported corresponds to MBT outputs (recyclable materials recovered), whereas organic recycling data are based on inputs (APA, 2015a).

Data on MSW in Portugal includes only MSW collected by municipalities or on behalf of municipalities and it does not include waste from producers generating more than 1 100 litres of waste daily and that use private operators to treat their wastes (APA, 2015a). This might cause some uncertainty in the MSW statistics.

2.3 *Important initiatives for improving municipal solid waste management*

The first NWMP, PERSU I, set both quantitative and qualitative targets for Portugal's MSW management system following the targets set in the EU waste directives. The main objective of PERSU I was to eliminate open dumps and divert the waste, according to specific quantified targets, to recycling, incineration and composting. This has been a difficult task, as in 2001 more than 340 dumps were yet to be closed (Magrinho *et al.*, 2006). Despite the plan's success in eradicating the open dumps, most of the targets set were not achieved (Ribeiro *et al.*, 2011).

Taking into account the need to modernise the MSW management system, the second NWMP, PERSU II covering the period 2007–2016 was ratified in 2006. The plan aims to eliminate the inefficiencies observed in the implementation of the previous plan and incorporate the EU legislation's objectives into national law. It focused on the following elements:

- adapt EU legislation to Portuguese reality;
- rationalize the costs;

- encourage participation of all stakeholders, based on input from all of them;
- support incineration with energy recovery and MBT as solutions for MSW treatment;
- introduce separate collection of organic wastes and other measures to divert them from landfill;
- maximize by-product utilisation.

The quantitative targets included in PERSU II were adopted from EU legislation. The plan introduced a target of 50 % separate collection of bio-waste by 2016. However, studies concluding that introducing separate collection of bio-waste in Portugal was too costly led to the target being dropped (Gibbs *et al.*, 2014a).

The most important initiatives in Portugal in the past years refer to BMW. The legislation addressing BMW was updated in the 2000s with various decrees aligning Portuguese legislation with EU Directives (Magrinho *et al.*, 2006).

Portugal has invested in MBT plants and to a smaller extent in composting and separate collection, and has eradicated all uncontrolled landfill within its territory. The introduction of MBT technology especially helped to reduce direct BMW landfill.

Although the principles of PERSU II clearly promote recycling and recovery in general, its observable effect on the MSW management situation – for example on recycling rates – until 2010 was small. According to an evaluation of PERSU II by Arcadis (2014), the waste management plan also had some deficiencies with regard to concrete information on future waste management and how this would contribute to reaching the targets.

A new version of the NWMP, PERSU 2020, was approved in September 2014 (Ministry of Environment, Planning Territory and Energy, 2014). The plan puts forward the possibility of increasing the landfill tax as well as establishing pilot projects for pay-as-you-throw systems. Legal instruments mentioned in the plan include EPR with regard to packaging waste, WEEE and batteries; guaranteed legal framework for improved economic valorisation of compost/biogas; and enhanced sanctions for lack of compliance on waste management. Several awareness-raising campaigns, for example on food waste and the promotion of eco-labelling schemes, are planned as informative instruments (BiPRO, 2014).

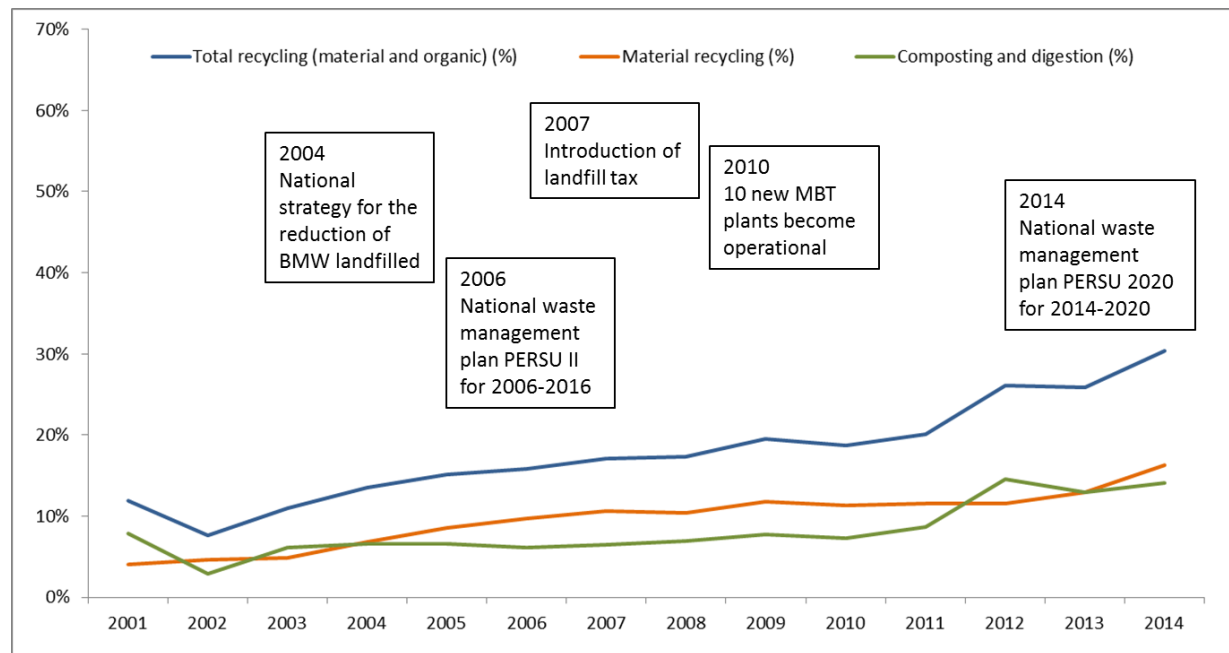
PERSU 2020 defines four national targets, two corresponding directly to the EU Directive targets of 50 % recycling, and landfilling of BMW, one relating to waste prevention and another one for packaging recycling. In addition, there are three individual targets established for each SGRU: 50 % recycling, targets for BMW landfill and recycling through separate collection of certain materials. Furthermore, PERSU 2020 intends to improve the monitoring and control mechanisms of the 23 SGRUs and promotes the sharing of infrastructure between the systems.

Portugal has adopted an Urban Waste Prevention Programme for the years 2010–2016 aiming at reducing the intensity of natural resource use and the presence of hazardous substances. The new NWMP, PERSU 2020, integrates the Prevention Program within the broader plan (BiPRO, 2014).

According to Portuguese law, the entities responsible for waste management will be charged an extra waste management tax in 2016, 2018 and 2020 if they do not meet their own individual targets. This extra tax cannot be passed on to consumers and therefore is a real cost for the operators. The amount of tax is proportional to the deviation from the targets and increases progressively from 2016 to 2020. The achievement of national targets related to MSW is encouraged by the law by defining that a fraction, up to EUR 1.5 million, of the waste management tax paid by an SGRU to the administration can be regained by the SGRU if it performs well on recycling. Legislation regarding tariffs paid by the consumers also provides benefits to the SGRU that meets or overcomes its individual targets. (APA, 2015a)

An EPR scheme is in place in Portugal for packaging waste. Sociedade Ponto Verde (SPV) plays a major role in managing this specific waste stream, with a scheme based on fees paid by the producers, ranging from EUR 18.30 per tonne for glass to EUR 228.20 per tonne for plastic packaging (EC, 2012). The system reportedly supports nearly 80 % of the costs of separate collection, transport and sorting of recyclables as well as the operation of civic amenity sites (Gibbs *et al.*, 2014a). For other specific waste streams included in municipal waste there are several other management organisations, as described in Section 2.

Figure 2.6 Portugal, municipal solid waste recycling and important policy initiatives, 2001–2014



Source: Eurostat, 2016.

2.4 Future possible trends

The NWMP includes a forecast on future municipal waste generation. Under a business-as-usual scenario an increase of 0.2 % per year until 2020 is expected in the total amount of municipal waste generated. (BiPRO, 2014)

Recycling has been increasing at a more or less constant pace except for the sharper rise in the last two years. Together with the decrease in the percentage sent to landfill, recent development indicates a positive trend in Portuguese waste management.

The new NWMP, PERSU 2020 identifies separate collection as a weak area in municipal waste management. Evaluation of the existing collection schemes is planned after which it will be possible to define new schemes. At this stage, changes are expected regarding the frequency and type of collection. Some of the larger cities have increased door-to-door collection but the national authorities currently impose no obligations on municipalities to introduce door-to-door separate collection schemes. Door-to-door collection could be one tool for aiming at higher recycling rates. The main barrier is the overall poor economic situation in the country. (BiPRO, 2014; Gibbs *et al.*, 2014a)

Portugal is investing in MBT technology: there are multiple MBT units under construction and the Portuguese Environment Agency expects more plants to be developed in the future. Under PERSU

2020 the construction of four or five more organic recycling units is expected. This could well have a dramatic effect on recycling figures once the new plants become fully operational. An increase in recycling – especially of organic material – can already be observed in the statistics for 2012 and 2013. The MBT plants also play a key role for the country to meet its BMW landfill diversion targets. Total treatment capacity of the recently built MBT plants amounted to approximately 400 000 tonnes per year in 2012 (Gibbs *et al.*, 2014a; APA, 2012). High MBT capacity might risk decreasing the incentive for further investment in separate collection systems, which usually deliver better-quality recyclables if designed well. However, to minimise this risk PERSU 2020 created a target for recycling from separate collection (APA, 2015a).

Refuse-derived fuel that is generated as output from MBT is mainly intended for use in cement kilns. Additionally, increased incineration capacity is being considered to ensure demand for such fuel. Thus, the output from MBT is expected to switch from primarily going to landfill and instead to be largely incinerated, although a large share is still expected to go to landfill. (BiPRO 2014; Gibbs *et al.*, 2014a)

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