# Next phase of the European Climate Change Programme: Analysis of Member States actions to implement the Effort Sharing Decision and options for further community-wide measures

## A report for DG Climate Action

## Waste sector – Policy case studies report

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# Executive Summary

This report has been prepared by AEA as the part of the study *Next phase of the European Climate Change Programme: Analysis of Member States actions to implement the Effort Sharing Decision and options for further community-wide measures.* The project has been funded by DG Climate Action of the European Commission (EC) with the aim of assisting the EC in the identification of policies and measures that enable the Member States to fulfil their national commitments under the Effort Sharing Decision (ESD).

The report focuses on emissions from the solid waste management sector, in particular, from the management of municipal solid waste (MSW). Precise definitions of what constitutes MSW vary from country to country, but for the purposes of this study MSW refers to solid waste produced by households and wastes of similar composition from commercial and industrial premises which are often collected and processed with household waste and subject to the same operational and regulatory mechanisms.

Disposing of waste on land has been the traditional low cost, low tech "dump and forget" means of getting rid of waste, with a history of causing serious pollution of water, air and land, both from the waste itself, its products of decomposition and combustion (as a result of fires, both accidental and deliberate), impacts on human health, disamenity and greenhouse gas emissions.

Greenhouse gas emissions from landfills are almost entirely dominated by methane, a powerful greenhouse gas that is formed when biodegradable wastes decay in anaerobic conditions in landfills. Some landfill gas can be captured and burnt, converting the $CH_4$ to $CO_2$, either in engines (for generating electricity, or as other fuel uses) or flared; some of the remaining methane is converted back to $CO_2$ by bacteria in the surface layers of the landfill, and the rest is emitted to the atmosphere where it contributes to global warming.

Thanks largely to the 1993 Landfill Directive, landfills used in Europe are now designed and operated to much higher environmental standards than the simple dumpsites of the past. The Landfill Directive also introduced increasingly stringent limits on the amounts of biodegradable waste that Member States are allowed to landfill, so reducing methane emissions at source, although landfills continue to produce methane from waste landfilled many years after disposal. This increasing stringency means that the Landfill Directive will continue to have a major role in reducing greenhouse gas emissions in Europe to 2020 and beyond.

In addition to measures that capture methane emissions produced from waste decaying in landfills, major reductions in greenhouse gas emissions can be achieved by reducing levels of waste production (and therefore the amount of biodegradable waste reaching landfills), and increasing the recovery of energy (including energy from waste incinerators, the use of refuse-derived fuel in industrial processes such as cement and paper manufacture) and recycling of materials. However, further action at a Member States level is required to encourage these alternative management options.

The report discusses a number of potential policy options that may be implemented at Member State level to reduce greenhouse gas emissions from solid waste management. The policies are complementary to the Landfill Directive (e.g. by helping to deliver the targets within the Directive at least cost), and not all emissions savings are necessarily additional to any savings that are assumed to arise from the implementation of the Landfill Directive itself. However, without these additional policies it is unlikely that Member States will be able to meet the requirements of the Landfill Directive in the first place.

The analysis focuses on two case study policy approaches that have been adopted in several countries. The first approach is the use of economic instruments that raise the cost of landfill for the waste producer. Two examples are considered in the first case study: a landfill tax, which has been implemented in a number of Member States. In addition, the case study also considers a trading scheme for permits to landfill biodegradable waste which was introduced in the UK (the Landfill Allowance Trading Scheme – LATS) between 2005 and 2013. In contrast to these economic

instruments, the second case study examines the implementation of a direct regulatory approach through the banning or restriction of certain materials or items from landfill, based on recent published analysis. The report concludes with a qualitative comparison of the strengths and weaknesses of the two types of approach, according to economic, social, environmental and cross-cutting issues.

The key **conclusions** with respect to the economic instruments assessed are:

- The UK landfill tax has proved effective in diverting waste away from landfill and towards the more sustainable options of recycling and energy and material recovery;
- Initial fears that the tax would increase the amount of illegally disposed waste appear to be unsubstantiated and can be controlled by effective regulation and enforcement;
- The announcement of the annual increase in landfill tax duty was broadly welcomed by the waste industry as it gives a higher degree of certainty for the planning of investment decisions;
- Linking the tax to the weight of waste disposed has prevented the tax from disproportionately increasing the cost of landfilling in more expensive sites (which may have a higher degree of environmental protection) than an *ad valorum* tax;
- The use of landfill tax credits for environmental projects has allowed further offsetting of the disamenity impacts of landfills, although the tax can no longer be seen to be revenue neutral for central government;
- The lack of variable charging in the UK for household waste management means that householders have no financial incentive to increase recycling or waste reduction;
- There remains the opportunity to reduce the tax rate on bio stabilised waste to reflect the environmental benefits of mechanical biological treatment (MBT) based systems;
- Landfill taxes alone do not necessarily increase recycling rates and other polices and measures, such as education, information, research and development programmes and direct regulation are also needed to ensure the desired outcome;
- The UK landfill tax appears to have been the major driver for the achievement of the UK landfill diversion targets, and more effective than the LATS scheme that also operated over the past 5 years.

Key **conclusions** with respect to landfill bans and restrictions are:

- Landfill bans/restrictions do have the potential to deliver net benefits (environmental and financial) to society.
- The greatest climate change and resource efficiency gains were most likely to be achieved where landfill bans are coupled with a requirement to sort materials, rather than through the imposition of waste-stream level bans/restrictions (in other words, for example, simply banning the landfilling of municipal or commercial wastes).
- The greatest benefits in these terms were delivered by the requirement to sort paper/card, food, textiles, metals, wood, green waste and glass.
- Additional benefits can be obtained through a ban on biodegradable waste sent to landfill, but the magnitude of these will depend on the landfill alternative used.
- Sufficient time must be allowed to implement the necessary changes in the waste processing infrastructure, including obtaining all the permits and planning consents required to develop major waste infrastructure projects.
- A ban alone is not usually sufficient to ensure that the waste diverted from landfill goes follows the path desired by policymakers, and steps are needed to ensure that additional instruments are in place around the time that the ban is announced.
- The requirement to sort is the key complementary measure for the ban on unsorted wastes, but this should be specified in such a way that the quality of recyclate is not adversely affected.
- Measures are needed to ensure sufficient deterrence against illegal disposal routes for banned/restricted materials.

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# 1 Introduction

## 1.1 Background

This report has been prepared by AEA as the part of the study *Next phase of the European Climate Change Programme: Analysis of Member States actions to implement the Effort Sharing Decision and options for further community-wide measures.* The project has been funded by DG Climate Action of the European Commission (EC) with the aim of assisting the EC in the identification of policies and measures that enable the Member States (MS) to fulfil their national commitments under the Effort Sharing Decision (ESD).

In earlier phases of the project an assessment was made of the projected emissions of greenhouse gases to 2020 in each of the main ESD sectors, the potential gap between the projected emissions and the ESD target, and the abatement measures that could be implemented to reduce the emissions gap. In addition, a high level review was provided of the policies and measures in place at Member State level. Further information on the ESD, on Member State's targets under the ESD, and analysis described above can be found in AEA/AlterraEcofys/Fraunhofer ISI (2012).

Building upon the earlier work, this report provides a more detailed examination of the policy options that could be implemented on a national or EU-wide level in order to deliver greenhouse gas emissions reductions. The focus of the analysis is on policies that could be implemented to support and complement existing EU-wide policies. This report is focused on policies targeting the **waste sector.**

The principal item of EU legislation that drives emission reductions from the waste sector is the EU Landfill Directive. Strictly speaking, the Landfill Directive is part of the policy baseline and will continue to drive reductions in greenhouse gas emissions within the sector to 2020 and beyond. However, in order to achieve its desired goals, the Directive is dependent on various national measures implemented by the Member States. On this basis, from a policy accounting perspective the savings from these policies are not "additional" to those assumed for the Landfill Directive as a whole, but they are necessary for the targets set out in the Directive to be realised.

This report explores national waste management policies in more detail, focussing on two case studies. The two case studies are based on the contrasting but complementary approaches of an economic instrument (landfill tax) and a regulatory approach (based on landfill restrictions and bans). The analysis concludes with a comparison of the effectiveness, costs and benefits of the two approaches.

The case study policies selected are not intended to be exhaustive. Other policies have been, and could be, implemented to deliver similar objectives. This report therefore presents just a sample of the policy available to decision makers looking to mitigate greenhouse gas emissions from the waste sector.

### 1.1.1 How the waste sector impacts on greenhouse gas emissions

All human activities produce waste and all wastes have the potential to harm human health and the environment. Materials become waste when they are considered to have no value. In fact, this usually means when the cost of recovering value from them outweighs the recovered value. In the absence of effective measure to control the production, treatment and disposal of waste materials, waste will inevitably follow the course of least cost to its producer, and harm to human health and the environment may result if the disposal route is not properly controlled.

Examples of these types of adverse impacts from waste are well-known: they include pollution of air, water and soil. In addition, a major impact of disposal of biodegradable wastes stems from emissions of methane, a potent greenhouse gas, which is formed when organic materials decay under airless (anaerobic) conditions in landfills and dumpsites.

But as well as greenhouse gas emissions from the waste itself, we also need to consider greenhouse gas fluxes that occur elsewhere in the economy and which are affected by how we produce, treat and dispose of waste. For example, prevention or minimisation of waste conserves resources and so avoids the emissions from producing the materials that would then become waste; making products out of recycled material recovered from waste often avoids the emissions of far larger amounts of greenhouse gases than if the same product were made from virgin materials; recovering energy from waste combustion can also avoid the greenhouse gas emissions that would have arisen elsewhere in the energy system had the same amount of energy been recovered from fossil fuels. As shown later in this report, these avoided emissions are at least as important in the overall emissions of greenhouse gases from the waste sector as emissions from landfills and dumpsites.

As stated above, all human activities produce waste. This includes human excreta, agricultural wastes such as crop residues, manure, slaughterhouse and other food processing wastes, forestry residues, inert industrial wastes such as ashes, dredging, mine tailings and quarrying wastes, hazardous and infectious wastes etc. The management of these wastes is considered within the relevant sectors. The focus of this report is on municipal solid waste (MSW).

Definitions of what constitutes MSW vary from country to country. Broadly speaking, MSW consists of solid waste produce by households and waste of similar composition from commercial and industrial premises, which is commonly collected and processed with household waste.

Up until relatively recently in much of western Europe, dumping wastes on land provided a cheap disposal outlet for waste, and all the time this was available there was no economic incentive to invest in more expensive alternatives to process waste and recover materials and energy from it. This situation persists in much of the developing world to this day.

Historically, landfilling[1] has been a low cost, low tech "dump and forget" means of disposing of waste, with a history of causing serious pollution of water, air and land, both from the waste itself, its products of decomposition and combustion (as a result of fires, both accidental and deliberate), impacts on human health, disamenity and greenhouse gas emissions.

The low cost of landfilling wastes is good example of market failure, in which the economic costs paid for disposal does not reflect the costs to society of the environmental impacts, loss of amenity and harm to human health (the so-called external costs) so caused.

Greenhouse gas emissions from landfills are almost entirely dominated by $CH_4$ in landfill gas that is formed when biodegradable wastes decay in anaerobic conditions in landfills. Methane has a global warming potential 21[2] times greater than that of carbon dioxide ($CO_2$) from fossil sources[3]. Some landfill gas can be captured and burnt, converting the $CH_4$ to $CO_2$, either in engines (for generating electricity, or as other fuel uses) or flared; some of the remaining methane is converted back to $CO_2$ by bacteria in the surface layers of the landfill, and the rest is emitted to the atmosphere where it contributes to global warming.

Emissions of methane from landfills can be eliminated by preventing the landfill of biodegradable wastes, which has become a recent feature of EU legislation and regulation. However, biodegradable waste already landfilled continues to decay over a period of years or even decades, and so collection of landfill gas, followed by combustion of the methane is needed to abate emissions from waste already in the ground. In addition, other measures such as the use of biofilter capping layers that increase the oxidation rate of residual methane, and air injection into landfills can also decrease emissions.

[1] Strictly speaking, the term "landfill" should be reserved for managed sites for disposal of solid waste on land, as distinct from informal, unmanaged dumpsites, but "landfill" is frequently used as a generic term for all sites where waste is disposed of to land. We will follow this convention, but where necessary distinguish between landfills proper and unmanaged dumpsites. Managed landfills should, as a minimum, have a plan in place for managing the reception and emplacement of specific types of waste, use compaction and coverage of waste to prevent fires occurring and to prevent problems with litter, dust blow, wash off of wastes to drainage channel and vermin. In addition modern landfills will also have measures to control the escape of leachate and landfill gas.

[2] Over a 100 year time horizon, according to the United Nations Framework Convention on Climate Change http://unfccc.int/ghg_data/items/3825.php

[3] In fact, $CO_2$ from either fossil or contemporary (biogenic) sources have the same radiative forcing effect in the atmosphere, but the UNFCCC treats emissions of biogenic $CO_2$ as though they have zero global warming potential. This is because annual emissions of biogenic $CO_2$ to the atmosphere are assumed to be approximately in balance with the uptake through photosynthesis of an equivalent amount of $CO_2$.

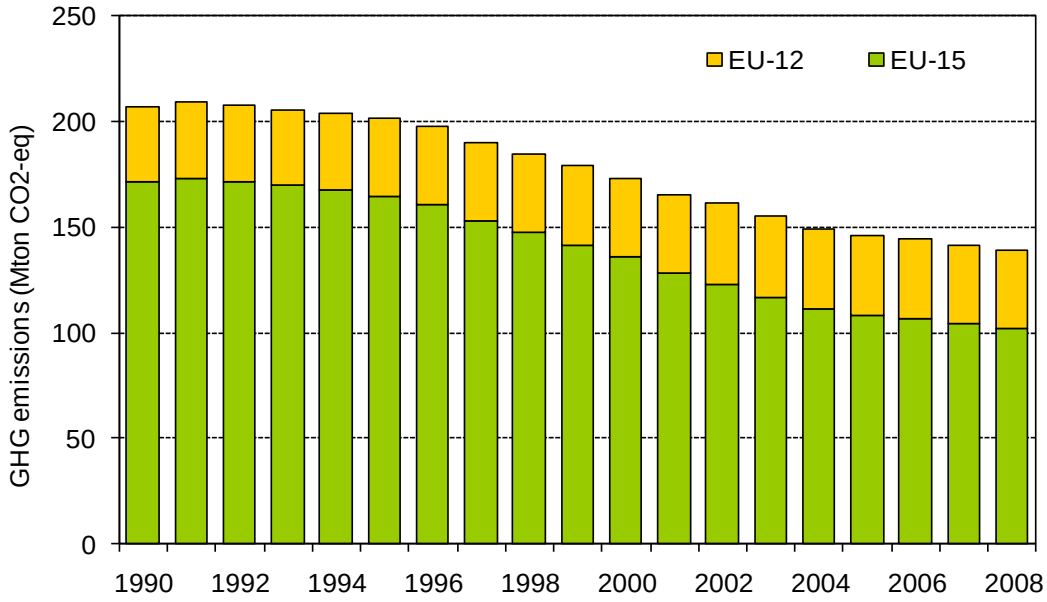
Modern landfills are now designed and operated to much higher environmental standards than in the past, largely because of the 1993 Landfill Directive (more on which below). However, even with the costs of higher environmental standards built into the disposal fee charged to waste producers, as a low-tech option, landfill still remains significantly cheaper than more sustainable solutions, such as prevention, reuse, recycling and recovery. Further measures are therefore required to drive more waste towards these preferred options. Some of these are discussed below.

### 1.1.2 Methane emissions from the waste sector

In the EU-27, the waste sector emissions (IPCC category 6[4]) have declined by 40% between 1990 and 2008 (Figure 1-1). The decline has not been consistent over this period, emissions decreased relatively slowly between 1990 and 1995, accelerated between 1996 and 2004 and since then the decline has slowed down again. $CH_4$ emissions account for the majority of the emissions from the waste sector (88%) therefore the emission reductions in the waste sector so far have been from the managed waste disposal on land sector (IPCC category 6A1). The main driver for $CH_4$ emission reduction from this sector is the amount of biodegradable waste going to landfills, total municipal waste disposal on land declined by 37% between 1990 and 2008. The second major determining factor for the decrease is from the increasing methane recovery rate from landfills. These changes have been strongly driven by the landfill Directive (1999/31/EC) which sets reduction targets of the total amount of biodegradable municipal waste going to land fill against 1995 levels and introduces encourages $CH_4$ recovery technology at landfill sites.

All emissions from the waste sector are considered to be in the non-traded sector.

**Figure 1-1: GHG emissions arising from waste across the EU-27 (source: EEA Greenhouse gas data viewer)**




Reducing emissions of methane from landfills is an important goal of policy in the waste sector, but in addition, further emission reductions are achieved by avoiding waste in the first instance and by recycling and recovering materials and energy, rather than disposing of material as waste. These contributions are discussed later.

### 1.1.3 Municipal waste sector key actor characteristics

Apart from policymakers and regulators, the key actors in the municipal waste sector are those producing the waste and those responsible for its management. To understand the key drivers for these key groups of actor, it is convenient to consider the management actors first, and then to discuss the waste producers' characteristics.

[4] Intergovernmental Panel on Climate Change

Across the EU, the collection, treatment and disposal of municipal waste is generally a responsibility of the local authority (government), at municipality, county, region or group of authorities' level. The local authority may either provide and operate the waste management services directly, or as is increasingly common, procure the waste management infrastructure and/or services from the private sector.

Since the 1990s[5], the European waste management industry has undergone a period of dramatic change resulting from

- Improved environmental standards driven by EU legislation
- Privatisation (in its various forms) of both collection and disposal of municipal waste services
- Enlargement of the EU and the development of the waste market in Central and Eastern Europe as new member states implement EU waste directives.

As noted by the above reference in 2003, companies have increasingly been offering customers (both municipal and industrial/commercial) an integrated waste management service (encompassing collection, recycling and disposal elements, as opposed to just landfilling) and this has had the effect of prolonging a period of consolidation and concentration in the sector.

Since then, this consolidation has resulted in the sector being dominated by a few very large international players plus a large number of smaller companies. According to FEAD[6], the federation of national waste management trade associations in Europe, its 4,000 member companies share approximately 70% of the household waste market and handle some 75% of industrial waste, and have a combined annual turnover of €50bn.

A further assessment[7] reporting for the European Federation of Public Service Unions (EPSU) in 2010 listed the 15 largest European waste management companies in terms of sales. These companies had combined sales of over €31Bn (some of which came from non-waste activities). The "big three" companies (Veolia, Suez Environnement and Remondis) together reported sales of over €19Bn in 2008.

Competition for municipal waste management contracts, in areas where the service is put out to commercial tender, is intense and there is significant downward pressure on the disposal fees that companies charge to the local authority client. Strong regulation and its effective enforcement are therefore essential to deter illegal practices that unscrupulous operators could be tempted to take to increase profitability.

Waste management is usually regulated by the competent environmental authority of the member state or region, although lower tiers in the administrative hierarchy may have responsibility for specific areas of regulation, such as for closed landfills.

Turning now to the waste producers, householders generally pay for the collection and treatment of waste collected from them by the local authority (or its contractors) through local taxation, levied at a flat rate that does not directly reflect the quantity of waste disposed of at the level of the producer (i.e. the household). Costs for waste management have low visibility at the household level, being paid for along with other major items of local authority expenditure such as schools, roads, social and emergency services etc. There is therefore no market mechanism at work to drive waste away from landfill under these conditions. In other words, householders pay irrespective of how much waste they send for disposal.

But increasingly, member states are introducing variable charging schemes to charge householders according to the amount of waste disposed, so incentivising participation in source-segregation of recyclable materials and waste minimisation. This has become possible through new technology that allows for automatic bin recognition, weighing and recording at the point of collection. This approach is particularly popular in Flanders, Netherlands and Germany.

[5] European waste management: background to a discussion on EWCs. A PSIRU report for EPSU, Steve Davies. March 2003.
[6] FEAD is the European Federation of Waste Management and Environmental Services. http://www.fead.be/index.php?page=who-we-are
[7] "Waste management companies in Europe 2009" David Hall. A report commissioned by the European Federation of Public Service Unions (EPSU) www.epsu.org. February 2010.

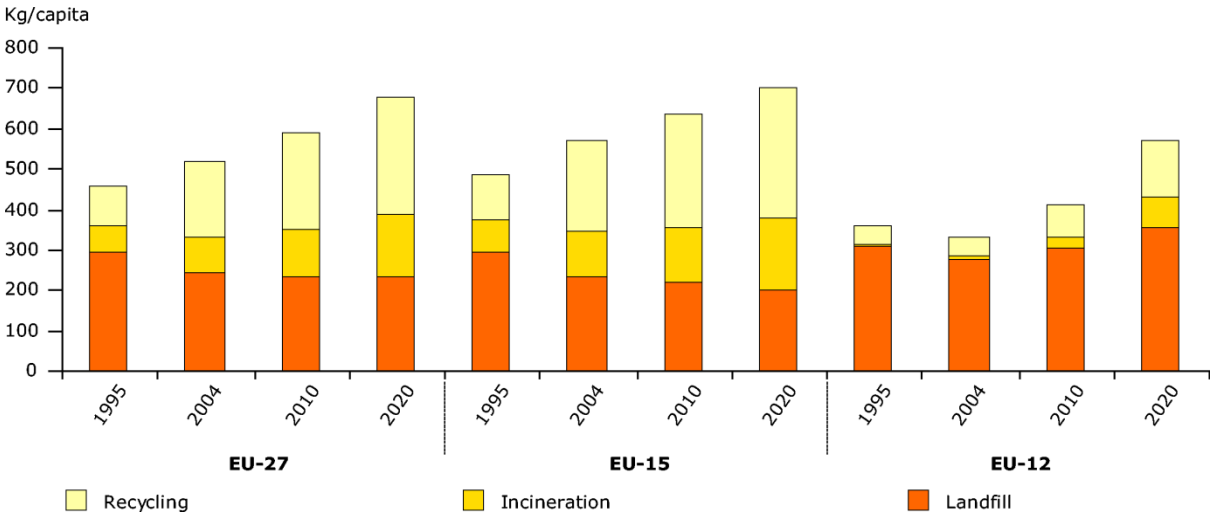
In contrast, commercial and industrial waste producers generally contract directly with the private sector, or local authority operator service, for waste collection and disposal, which is frequently charged according to the amount of waste collected, although some may charge by container, irrespective of how full it is. A market mechanism therefore exists in this case to drive waste away from landfill which is absent in the case of householders paying a fixed charge for waste management, although its strength is obviously limited for many businesses where waste disposal costs are a tiny fraction of turnover. Commercial waste comes within the Landfill Directive definition of municipal waste[11] if it is similar in nature or composition to household waste. (It should be noted that there are differences in what wastes are counted as municipal wastes by different member states, an issue that is too complex to go into here.)

## 1.2 Emissions, policy gaps and abatement potential

Emissions from the waste sector depend both on the amount of waste produced and how that waste is managed. According to the European Environment Agency (EEA)[8], on average each European generated 450 kg municipal waste in 1995 (Figure 1-2). This increased to 524 kg in 2004 and a further increase to 680 kg is expected in 2020, assuming a sustained growth in private final consumption of 2% and 4% per year in the EU-15 and EU-12[9] countries to 2020, and a continuation of current consumption patterns.

Figure 1-2 also shows significant differences in waste production between the EU-15 and EU-12 member states, with considerably higher waste production per capita waste in the EU-15 than in EU-12, and a higher dependence on landfill, rather than incineration and recycling in these latter countries. However, a greater increase in waste production is expected in EU-12 countries, which is expected to grow by 50% by 2020, compared with a growth of 25% in the EU-15, assuming the economies of the EU-12 develop and consumption patterns begin to converge with those in the EU-15.

**Figure 1-2: Generation and management of municipal waste in Europe (per capita) - Reproduced from EEA 2008[8].**




Increasing recovery of waste and diverting it away from landfill are playing a key role in reducing the environmental impacts of the growing waste volumes. Total EU municipal waste landfilled represented about 47% of per capita production in 2004 and this is expected to decrease further to about 35% in 2020, against a background of rising waste production. Both recycling and other forms of recovery and waste incineration are also expected to increase up to 2020. These trends in part come about as a result of EU policies to increase recovery and recycling of packaging waste (e.g. 1994 Packaging Directive) and to divert biodegradable waste away from landfill (eg 1999 Landfill Directive).

[8] Better management of municipal waste will reduce greenhouse gas emissions. EEA Briefing 01-2008.
[9] EU-15: Austria, Belgium, Denmark, Finland, France, Germany, Greece , Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom. EU-12: Bulgaria, Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuanian, Malta, Poland, Romania, Slovenia and Slovakia.

### 1.2.1 Projected emissions

In Figure 1-3 the baseline emissions for waste are shown. These emissions are based on the most recent projections from the GAINS model (Höglund-Isaksson et al., 2010) therefore $CO_2$ emissions from the waste sector have not been accounted for. The baseline emissions projections show a significant decline, from 147 $MtCO_2$ eq in 2005 to 83 $MtCO_2$ eq. in 2020, which is a decrease of about 44%.

**Figure 1-3: Baseline GHG emissions and composition from waste, as projected by GAINS**

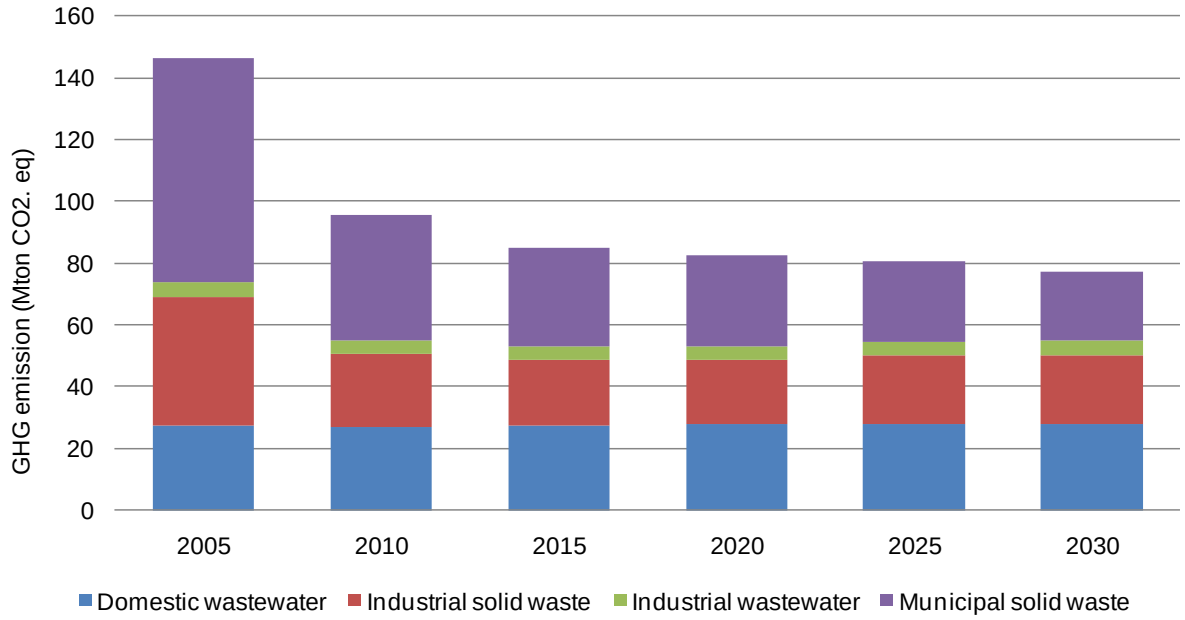



Figure 1-3 above shows the reduction in GHG emissions from MSW in landfills, but this is only part of the system, albeit an important one. To assess the overall impacts on greenhouse gas emissions from the whole municipal waste management system, we need to take into account all significant greenhouse gas fluxes from the entire system. In practice, this means including direct emissions from transporting and processing waste and waste-related materials as well as emissions from landfills, and, importantly, emissions avoided elsewhere as a result of recycling and material and energy recovery (recycling waste-derived materials into products usually results in much lower overall greenhouse gas fluxes than manufacturing the same products from virgin materials).

Further details of how the direct and avoided emissions are divided between various waste management options have been provided by a further report to the EEA on emissions from municipal solid waste management in the EU (excluding Cyprus) plus Norway and Switzerland[10]. Landfilling remains the largest contributor to direct emissions in both 2005 and 2020 (Table 1-1). The table also shows the increase in emissions avoided by energy recovery through incineration and especially recycling between 2005 and 2020. By 2020, avoided emissions are expected to be slightly greater than direct emissions, giving and overall negative net emission of 8.2 Mt $CO_2$ equivalent.

[10] Modelling GHG emissions from MSW management in the EU (excluding Cyprus) plus Norway and Switzerland – business-as-usual scenario. EEA report. http://www.eea.europa.eu/data-and-maps/figures/modelled-ghg-emissions-from-msw

**Table 1-1: Direct and avoided emissions of greenhouse gas (in Mt $CO_2$ equivalent) from MSW management in the EU.**

| Year | Direct - Landfilling | Direct - Incineration | Direct - Recycling | Direct - Transport | Direct - Total | Avoided - Landfilling | Avoided - Incineration | Avoided - Recycling | Avoided - total | Net GHG emissions |
|---|---|---|---|---|---|---|---|---|---|---|
| 2005 | 90.9 | 15.6 | 25.4 | 2.4 | **182.9** | -4.4 | -18.4 | -62.8 | **-85.6** | **48.6** |
| 2020 | 56.8 | 19.7 | 33.3 | 2.7 | **104.3** | -5.6 | -23.6 | -91.6 | **-120.7** | **-8.2** |

These emissions will be distributed between industrial sectors within and outside the scope of the Effort Sharing Decision. A detailed consideration of this topic is not possible within this report. However, it may be expected that an increased diversion of waste from landfill to energy recovery facilities (including energy from waste incinerators, the use of refuse-derived fuel in industrial processes such as cement and paper manufacture) and recycling will result in an increase in interactions between waste management and ETS-regulated sectors in the future.

### 1.2.2 Abatement potential

Key to achieving the emissions reductions described above is the Landfill Directive. The evaluation of the EU policy landscape is described further below. As the Landfill Directive is already an existing policy measure, these emissions reductions are already part of the baseline emissions projections. Therefore, the additional abatement potential that is available from MSW management by 2020 is limited; the Landfill Directive is assumed to deliver most of the available potential.

However, in practice the Landfill Directive alone will not deliver emission reductions. Extensive work on implementation and support measures in the Member States will be essential if the Directive targets are to be achieved. It is therefore the effectiveness and efficiency of national policies that are important for the uptake of the abatement potential and the delivery of the emissions reductions that are expected from the Landfill Directive.

### 1.2.3 EU policy landscape

Partly in recognition of the huge potential for pollution from landfilling wastes and also by the need to improve the efficient use of finite resources, waste management became a priority area for EU environmental policy in the 1970s. This led to the formulation of a number of waste management directives in the 1980s and 1990s which have produced a vast improvement in the environmental performance of waste management systems and services. Building on this progress, the Sixth Environmental Action Programme (2002-2012) has set out an ambitious path of evolution of European waste management policy, which includes a decoupling of environmental pressure from economic growth and a significant reduction in i) volumes of waste generated, ii) quantity of waste going to disposal (i.e. landfill or incineration with little or no energy recovery), and iii) volumes of hazardous waste produced.

One of the main pillars of EU waste policy is the waste management hierarchy, which sets as its highest (most preferred) tier the reduction and prevention of waste as far as possible, followed by reuse, then recycling, then recovery (including energy recovery from waste) and finally as the lowest tier optimised final disposal of wastes from which no further value can be recovered. Waste management policy aims to push waste management towards the higher tiers of this hierarchy and away from disposal of raw wastes.

The most important waste management directive aimed directly at reducing the adverse impacts of landfill disposal is the 1999 Landfill Directive. Implemented in 2001, this directive aims to prevent or reduce as far as possible the negative effects on the environment associated with the landfilling of wastes. Amongst other measures, the Landfill Directive required member states to develop a strategy to reduce the quantity of biodegradable waste sent to landfill to achieve a series of targets to reduce

the amount of biodegradable municipal waste[11] sent to landfill, to achieve a reduction compared with the base year (1995) of 25% (2006), 50% (2009) and 65% (2016). Twelve countries with a heavy reliance on landfill were granted a derogation of four years for the achievement of each of these target reductions[12]. Other requirements introduced by the directive include the following:

- Banning landfilling of certain materials and objects, including liquid waste, hospital and clinical waste, explosive, inflammable and oxidising substances and tyres (except for engineering purposes).
- Requirement for separate categories of landfills for hazardous, non-hazardous and inert wastes;
- Types of waste allowed at the three landfill categories;
- Scope and conditions of issue of the permits to be issued for landfilling by the competent member state authorities;
- Full costs, including aftercare, must be included within the disposal fee charged;
- Procedures for waste acceptance, monitoring, closure and aftercare, reporting ;
- Operation of existing landfills.

An important aspect of the Landfill Directive was to require technical improvements in the design, management, operation and regulation of landfills throughout the EU, such that their impacts on the environment were reduced, with the improvements paid for by the waste producers through significantly increased disposal fees. The increased disposal costs of landfilling have, at least to some extent, internalised the costs of environmental protection into the fee charged to waste producers.

The reduction in greenhouse gas emissions from landfills described above have to a large extent been driven by policies and measures used by member states to comply with the requirements of the Landfill Directive, in particular to achieve the targets set for the diversion of biodegradable municipal waste and for the collection of landfill gas.

But reducing biodegradable waste to landfill and the improved management of landfills do not in themselves lead to reductions in waste production nor the development of alternative outlets for waste through more sustainable options of reuse, recycling and recovery. When these factors are also taken into account, considerably greater overall reductions in greenhouse gas emissions from the waste management sector as a whole can be realised, as discussed below.

In addition to the Landfill Directive there are numerous other European polices and directives aimed at reducing waste, stimulation recycling and reuse as well as reducing and eliminating the harmful effects of waste. These are too extensive to detail here. However, an overview of the policies and directives is provided by the European Commission[13]. Delivering these requirements will present significant challenges, particularly in view of the current economic difficulties facing the EU, especially to the EU-12 countries which start from a lower base.

A key element of the Commission's approach to waste management in the future is the resource efficiency "roadmap"[14]. The roadmap aims to identify the changes needed to achieve the EU's transition to a Resource-Efficient Economy. It will and set out a range of policies to improve resource-efficiency for 2020, defining the plans for introduction of these policies at EU and Member State level. This aims at an absolute decoupling of resource use from economic growth; and of environmental degradation from resource use.

This present report examines the characteristics of the European municipal waste sector, considering the nature of the industrial actors, the prevailing trends and the policy measures that member states have adopted to reduce greenhouse gas emissions from the waste management system. It concludes with two case studies, dealing with 1) market-based instruments (landfill tax and landfill allowance

[11] "Municipal waste", according to the Landfill Directive, means waste from households, as well as other waste which, because of its nature or composition, is similar to waste from households.
[12] They are Bulgaria, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia and United Kingdom
[13] Summary of EU waste legislation. http://europa.eu/legislation_summaries/environment/waste_management/index_en.htm
[14] Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions Roadmap to a Resource Efficient Europe Brussels 20.9.2011 COM(2011) 571 Final http://ec.europa.eu/environment/resource_efficiency/pdf/com2011_571.pdf

trading scheme), and 2) the banning of biodegradable wastes from landfills, as contrasting examples of a direct regulation-based approach.

It is anticipated that by 2020 a range of abatement measures will continue to be required, depending on the progress in reducing emissions made by particular member states. In the EU-12 and parts of the EU-15, which still have a heavy reliance on landfill, measures to divert waste away from landfill and towards higher tier options of recycling and reuse will be needed, as well as improving standards of landfill operation to reduce emissions from waste already in the ground. In countries where reliance on landfilling has already been significantly reduced, further measures aimed to increase waste prevention, recycling, reuse and recovery will also be needed. These may include measures such as further R&D to develop markets and processes for recovering a greater range of materials from the residual waste stream, accompanied possibly by greater use of outright bans on the landfill disposal of selected materials.

### 1.2.4 Barriers and market failures

As mentioned above, even with the costs of improvements in landfill design and operation needed to comply with the Landfill Directive, landfilling remains the cheapest disposal option. If further waste is to be diverted from landfill towards more sustainable options (and indeed avoided altogether) then other measures will be needed. Furthermore, waste management is a minor budget cost for many businesses in the municipal waste sector, which helps to insulate them from increases in landfill disposal costs. For most householders too, the cost of waste management is largely invisible, unless they live in an area with variable charging, so that there is usually no economic incentive to reduce waste sent for disposal.

Where landfilling is restricted, alternative outlets are needed for the waste that would otherwise have gone to landfill (notwithstanding any decrease in amount due to waste minimisation). These alternatives centre largely on recycling (where materials recovered from the waste are used to replace material produced from virgin sources) and energy recovery, as heat and or power. This in turn requires investment in facilities and other infrastructure and access to markets for the recycled/recovered products.

To ensure that such investment is made, businesses need confidence that there will be a market for the recycled material, at the required quality and with long-term price stability. This confidence is needed both by developers of the highly sophisticated technology developed to remove and process materials for recycling, and for the use of recyclate in place of virgin material. Most importantly, a proven record of success is needed to ensure confidence on the part of lenders, so that developments can go ahead at affordable interest rates. Quite clearly, this is an iterative process – some initial level of investment and a successful outcome is needed to build confidence for further development.

Major infrastructure project such as those needed for energy from waste recovery are also subject to detailed regulatory, public consultation and planning consents. In some countries, such as the UK, securing all the necessary consents and permits for an energy from waste plant may add around 5 years to the development time, which may prove a major deterrent to potential investors.

Thanks to economic instruments such as the landfill tax, recycling may now be no costlier, or even cheaper than landfill disposal, yet waste producers still send recyclable material to landfill. Such behaviour can in part be attributed to lack of awareness of the environmental benefits and cost savings that can result, as well as a certain degree of inertia to overcome.

Lack of awareness has proven to be a major barrier to the adoption of sustainable waste management measures, even when these can be implemented at either zero or negative cost. In industry, for example, managers may not be aware of the types of material they discard, and the potential for minimising or reusing discarded materials (such as scrap plastics and metals). As well as incurring costs for disposal, business could also save raw material costs and reduce emissions. In the UK, the government's flagship environmental programme Envirowise[15] has done much to raise awareness of the economic, as well as environmental benefits to business of improving resource use efficiency.

[15] http://envirowise.wrap.org.uk/

Lack of awareness and knowledge is also a barrier to persuading householders to participate in recycling and waste prevention schemes. Engagement with the public to encourage and reward such participation has been shown to be absolutely key for the success of any household waste recycling or composting scheme. To ensure the highest participation rates, simplicity is a key requirement. Systems also have to be designed to fit into the type of property where they are used, not least in ensuring that householders have space for the required containers. As mentioned above, in many countries, there is no direct link between the costs of household waste disposal and the amount of waste disposed of. However, even in the absence of this link, many householders may be unaware of how much the local authority spends on waste disposal and would be willing to participate in recycling schemes if the money saved were used to reduce charges elsewhere. They may also be unaware of the environmental impacts of waste disposal and how they can be avoided by prevention, recycling and reuse. Local authorities clearly have a role in raising awareness to drive up participation in their areas.

In some countries, fines and other penalties have been established to deter householders from putting the wrong materials in recycling containers and other undesirable behaviours, and are widely accepted. In other countries, such measures have proven to be deeply unpopular. In the UK, for example, central government has recently allowed local councils in England to impose penalties for infringements of waste recycling arrangements but, largely because of a shrill campaign waged by sections of the popular press, such powers may soon be revoked.

### 1.2.5 Policy options

A wide range of policy options have been adopted by member states to improve the environmental performance and resource efficiency of the waste management industry. Some examples of these are given in Table 1-2.

**Table 1-2: Examples of generic policy measures in the wastes sector**

| Type of measure | Barrier addressed | Description | Examples |
|---|---|---|---|
| Research, Development and Demonstration Programmes (RD&D) | Lack of experience and unknown performance. | Programmes aimed at overcoming barriers to implementing alternatives to landfill disposal. | • Development of new markets for recycled materials and new technologies for recycling and energy recovery;<br>• Scaling up and demonstrating new technologies to build confidence of investors and developers and so stimulate commercial uptake. |
| Information provision, education and public engagement | Lack of awareness | Programmes aimed at raising awareness of waste as an issue and changing consumer behaviour. | • Information provision about location and availability of recycling facilities, source segregation and collection systems, waste reductions measures (e.g. reusable shopping bags), promotion of environmentally sound alternatives to disposal, such as home composting, nappy laundering and re-use; inclusion of waste-based issues in schools' curricula; development of charitable groups for furniture refurbishment.<br>• Development of standards for recycled materials to provide confidence in potential users (e.g. standards for waste derived composts and soil additives); information targeted at specific sectors (e.g. industrial and commercial sectors, local and central government and households.<br>• Awareness raising of resource efficiency issues in business – e.g. through programmes like Envirowise, which provide information to businesses and site surveys to identify savings. |
| Voluntary or incentivised negotiated agreements | Landfill still cheaper than preferred options | Agreements between government and the private sector on increasing diversion of waste from landfill. | • Commitment from the newspaper and magazine industry to increase the proportion of recycled paper in their product; agreement to increase the use of recycled paper and increase recyclability of direct mail (i.e. junk mail) items and improve targeting.<br>• Commitment from retailers to halt or reverse the growth of packaging waste ("Courtauld Commitment" in the grocery sector, voluntary agreement in the home improvement sector to reduce packaging waste in the sector).<br>• Voluntary agreements with retailers on reducing free, one-trip shopping bags. |
| Market-based instruments | Landfill still cheaper than preferred options | Instruments that increase the cost of landfill disposal relative to more sustainable, but more costly, alternatives, or conversely | • Landfill tax (increases the cost of landfill disposal);<br>• Landfill allowance trading scheme (LATS) – tradable permits available to waste disposal authorities in England;<br>• Subsidies on energy (heat and/or electricity) generated from non-fossil (including waste-derived) fuels; |

| Type of measure | Barrier addressed | Description | Examples |
|---|---|---|---|
| | | subsidise a more sustainable alternative. | • Packaging Waste Recovery Note (PRN) system to allow companies to offset their own obligations for recycling packaging wastes by purchasing the recycling and recovery of an equivalent quantity undertaken elsewhere;<br>• Recycling credits. |
| Direct regulation | Landfill still cheaper than preferred options | "Command and control" based approach that sets legal requirements on compliance with statutory limits, enforceable through the courts. | • Bans on the use of hazardous materials in products; bans on the landfilling of certain wastes (e.g. various types biodegradable wastes, hazardous materials or potentially recyclable materials such as metals and glass). Legally prescribed practices for managing waste. |

One of the main drivers for reducing greenhouse gas emissions from landfills has been Landfill Directive's targets to divert biodegradable municipal waste away from landfill, and member states have relied on a combination of market-based instruments (such as landfill tax) and using direct regulation to ban various forms of waste from landfill. The importance of reducing direct emissions from landfills and in increasing avoided emissions through recycling and energy recovery has been illustrated in the discussion of abatement potential in section 1.2.2

But simply increasing the cost of landfilling or outlawing it directly will not in itself ensure the development of more sustainable alternatives such as prevention, reuse, recycling and energy recovery. Without the availability of these alternatives, there is the danger that the landfill tax would simply increase disposal costs and landfill bans in the absence of suitable alternatives may encourage an increase in illegal fly-tipping and other behaviours.

## 1.3 Case Study Policies

The first three options mentioned in Table 1-1 are intended to address these issues. Research, development and demonstration (RD&D) programmes play a vital role in facilitating the uptake of new technologies, helping to develop the track record of performance needed to secure investment under affordable terms. Examples here include RD&D programmes on anaerobic digestion, composting and advanced thermal conversion technologies[16]. A recurrent problem with some forms of material recycling has been in establishing a secure outlet for the recyclate – especially against a background of considerable price volatility and competition with virgin materials. Methods of converting polymers used in plastic bottles into textile for use in clothing is a good example of developing a use, and thence a market, for recycled material. Another would the development of plasterboard (gypsum) recycling. A major impetus for this came in the UK with the introduction of a ban on gypsum from active waste landfills, prompting the need to find an alternative outlet for plasterboard waste that would otherwise have been landfilled[17].

Information provision, education and public engagement also have important roles to play. For example, organic treatments of food and garden wastes through composting or anaerobic digestion (AD) offer significant means of diverting biodegradable waste away from landfill, yet potential users of the compost products from these processes need to be sure that the materials are of a consistent standard and are free from harmful materials and pathogens. The development of standards for waste derived composts and fuels has been crucial to the widespread acceptance of composts from source

[16] The UK government's New Technologies Demonstrator Programme (NTDP) was a prime example of this. The NTDP ended 31 March 2009. It was set up to provide £30 million of assistance to new waste treatment technology demonstration projects. The programme was intended to overcome the real and perceived risks of introducing alternative technologies in England through the provision of accurate and impartial technical, environmental and economic information to key decision makers in local authorities and the waste industry in general. http://archive.defra.gov.uk/environment/waste/residual/newtech/index.htm

[17] The problem with plasterboard and other forms of gypsum (calcium sulphate) in landfills with biodegradable waste is that the calcium sulphate is converted under anaerobic conditions to highly toxic hydrogen sulphide. The hydrogen sulphide is corrosive to landfill gas engines and flares and is converted to sulphur dioxide, an important air pollutant, by combustion.

separated organic matter and has allowed the use of these materials to be managed outside the waste management regulations. Other information-based approaches have proved invaluable in stimulating the participation of householders in source-segregation of recyclables, increasing home composting, reducing food wastage, and reducing the nappies sent to landfill by adopting washable reusable nappies.

Voluntary agreements between government and industry also have a valuable role to play in reducing waste and stimulating recycling. Although sometimes criticised for lacking the element of compunction of direct regulation, voluntary agreements, sometimes backed-up by the threat of regulation, have proved useful in some areas where regulation may be difficult to draft or enforce. With many large and famous companies now reporting their social and environmental footprints alongside financial performance, failure to live up to environmental commitments, albeit voluntary, would reflect very badly on such company's public image. It remains to be seen how well voluntary agreements fare in the currently difficult economic climate.

Market-based instruments include taxes and subsidies that are intended to influence the market either against (in the case of taxes) or in favour of (subsidies) the relevant option. Landfill tax is a widely used example of the former, which will be discussed in further detail in the first case study (see below). Incineration tax is also levied in some countries, usually those with low reliance on landfill, to push wastes further towards recycling, re-use and prevention. Examples of subsidies include measures to stimulate recycling and recovery, including energy recovery from the non-fossil derived organic matter in waste where it contributes to renewable energy objectives. A further example of market-based instruments is the use of tradable permits to carry on a particular polluting activity, such as emitting a pollutant. The European Union Emission Trading Scheme is the largest multinational emission trading scheme in the world. It applies to large industrial emitters of $CO_2$, who receive an allocation of emission permits free of charge from the member states that must per returned against $CO_2$ emissions. If more $CO_2$ is emitted than are covered by permits, then the operators may purchase addition permits, or alternatively sell any surplus to requirement. The UK has also developed a unique tradable permit scheme applied to biodegradable municipal waste, which is also discussed as part of case study 1.

The main advantage of market-based instruments over direct regulation (considered next) is that they set the desired direction of travel (e.g. a decrease in landfilling or incineration; and increase in recycling or renewable energy recovery), but then leave the means of achieving it to the skills and enterprise of the private sector to find a solution that minimises business costs.

The final example of policy measures listed in Table 1-1 is direct regulation – the traditional command and control approach to environmental policy, which is familiar across all spheres of human activity. In the direct regulation approach, government defines a particular activity that it wishes to control (e.g. the emission of a particular pollutant etc), sets a limit that must not be exceeded and proposes penalties enforceable through the legal due process for transgressions. Examples of direct regulation in the waste management sector are numerous and cover nearly all types of activity. Examples include controls on the use of hazardous substances in products, enforcement of environment permit conditions through the courts and banning of certain wastes and objects from landfills. This latter option has proved effective for several countries that have a low reliance on landfilling, and examples are given in case study 2.

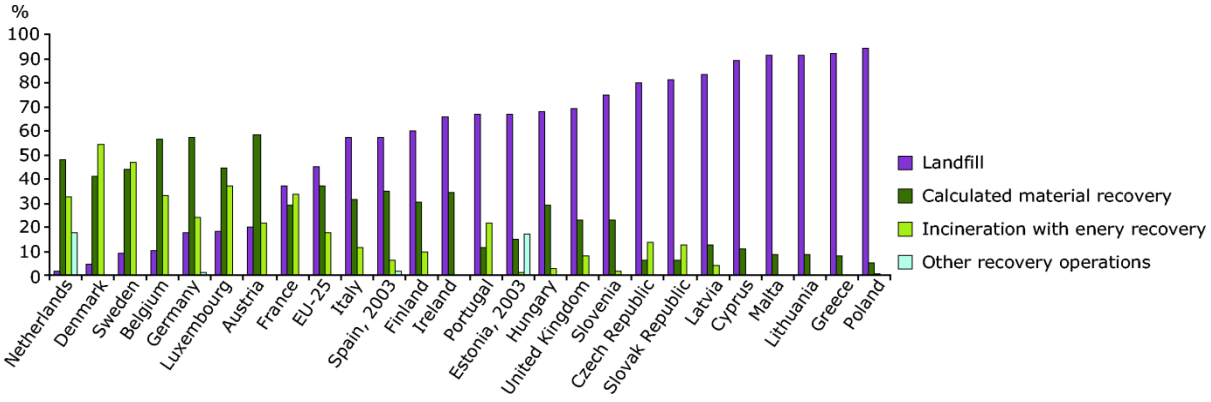
Although of proven effectiveness in a wide range of environmental policy, direct regulation can have several disadvantages. The costs of ensuring compliance, through inspections and enforcement activity may be high and not fully recoverable from the sectors regulated. Enforcement action is often dependent on securing a conviction in a court of law, which may be highly time consuming and costly, and in some instance the penalties may not be of sufficient severity to deter potential offenders.

One further measure not included in Table 1-1 is the use of variable charging, so that fees for the amount of waste disposed of vary with the quantity, as opposed to fixed price charging, where a flat rate fee independent of waste quantity is charged. As mentioned above, the use of fixed fees is widespread for the collection and disposal of household waste, so that the householder pays the same no matter how much waste he minimises or recycles. Modern waste collection systems, with bin weighing and automatic recognition allows householders to be billed directly according to how much waste they produce, and the technology is now in use in Germany, Denmark, Italy and other countries.

Although the technology works well, one of the main difficulties in rolling out variable charging for household waste in some countries has been political acceptance, exacerbated by intense hostility from some sections of the popular press.

The EU level-trends in waste treatment shown in Figure 1-2 conceal major differences between individual member states. Further work for the EEA[18] published in 2007 has identified three country groupings, based on the differences in the level of recycling, incineration and landfilling, shown in Figure 1-4.

**Figure 1-4: Uses of landfilling, incineration and material recovery as treatment options in 2004 (reproduced from EEA 2007[18].**




The categorisation reflects the member states' strategies for diverting waste from landfill, the current situation and recent trends:

**Group 1:**
High material recovery and high incineration: Incineration and material recovery each account for more than 25% of municipal waste generated. **Countries**: Flanders Region of Belgium; Wallonia Region of Belgium; Denmark, France; Luxembourg; Netherlands and Sweden.

**Group 2:**
Countries with high material recovery and low incineration rates. **Countries**: Austria; Finland; Germany; Hungary; Italy; Ireland; Spain.

**Group 3:**
Countries with low material recovery and low incineration. **Countries**: Cyprus; Czech Republic; Estonia; Greece; Latvia; Lithuania; Malta; Poland; Portugal; Slovakia; Slovenia and United Kingdom.

Note that the categorisation was published in 2007. Since then, several countries will have changed grouping. For example, if the assessment were undertaken today, UK would be in group 2, rather than 3, having significantly increased its recycling rate.

Table 1-3 shows how two policy measures have been deployed across the three groups of countries. Countries with high material recycling rates (groups 1 and 2) have generally relied upon a combination of both landfill taxes and landfill bans, whilst those in group 3 (with a low rate of material recycling) have mostly employed neither landfill tax nor landfill bans, or one or the other.

[18] Diverting waste from landfill – effectiveness of waste management policies in the European Union. EEA Report no 7/2009. http://www.eea.europa.eu/publications/diverting-waste-from-landfill-effectiveness-of-waste-management-policies-in-the-european-union

**Table 1-3: Landfill tax and bans on biodegradable waste according to EEA 2009 study[18].**

| Country | Landfill Tax | Landfill bans |
|---|---|---|
| Group 1<br>Countries with high material recovery and incineration rates | | |
| Belgium (Flanders) | ✓ | ✓ |
| Belgium (Wallonia) | ✓ | ✓ |
| Denmark | ✓ | ✓ |
| France | ✓ | ✓ |
| Luxembourg | × | × |
| Netherlands | ✓ | ✓ |
| Sweden | ✓ | ✓ |
| Group 2<br>Countries with high material recycling rates and low incineration rates | | |
| Austria | ✓ | ✓ |
| Finland | ✓ | ✓ |
| Germany | × | ✓ |
| Hungary | × | ✓ |
| Italy | ✓ | ✓ |
| Ireland | ✓ | × |
| Spain | × | × |
| Group 3<br>Countries with low material recycling rates and low incineration rates | | |
| Cyprus | × | ✓ |
| Czech Republic | × | ✓ |
| Estonia | × | × |
| Greece | × | × |
| Latvia | × | × |
| Lithuania | × | × |
| Malta | × | × |
| Poland | × | × |
| Portugal | × | × |
| Slovakia | × | × |
| Slovenia | ✓ | ✓ |
| United Kingdom | ✓ | × |

# 2 Case study 1: Landfill Tax and Landfill Allowance Trading Scheme

In this case study, we provide an overview of the landfill tax focusing on the UK and also of the landfill allowance trading scheme, the world's first trading scheme of tradable permits for landfilling. We shall examine the landfill tax first.

## 2.1 Landfill Tax deployment across the EU

As shown in Table 1-3 above, some form of landfill tax is widely deployed in various member states throughout the EU. As part of a study to assess the effectiveness of policies in the EU to divert waste from landfill, the EEA published a comparative study of policies and measures in six countries with diverse waste management traditions and conditions. The role of landfill tax in landfill diversion was assessed as part of this study. The six countries were Estonia, Finland, the Flemish Region of Belgium, Germany, Hungary and Italy. The study's conclusions are summarised below.

**Table 2-1: Landfill diversion policies and measures summarised from EEA 2009[18].**

| Country | Landfill rate and landfill tax | Other measures introduced | Comments |
|---|---|---|---|
| Estonia | • In 1999 virtually all waste was landfilled. However, since 2006, landfilling of biodegradable municipal waste has decreased to about 60%.<br>• The pollution charge (also known as a landfill tax) was introduced in 1990;<br>• Charge is paid by landfill operators – 75% to the waste management function of the municipality where the waste was generated, the rest to the state budget;<br>• Up to 2005, tax rates were very low (€0.1-0.2/tonne), increased to 7.8 €/tonne in 2006 and 10 €/tonne from 2009. Higher rates (2-3x higher) apply for landfill sites that do not comply with the Landfill Directive | • Charge for waste collection by municipalities introduced in 1991;<br>• Ban on landfilling untreated waste introduced in 2004, but with limited implementation;<br>• Separate collection of kitchen waste began in Tallin in 2007. | • The decision to allocate 75% of the pollution charge (i.e. landfill tax) to the municipality disposing of the waste from 2004 was made to provide a steady source of funding for local management functions.<br>• This created a disincentive to municipalities to reduce landfilling as this would reduce their revenue. The charge is also relatively rigid and cannot be adjusted by the municipalities.<br>• The 25% paid to central government is used to fund the Environmental Investment Centre, which in turn funds environmental projects, including those on waste. |
| Finland | • Landfills about 60% of biodegradable municipal waste since 1995.<br>• Landfill tax was introduced for municipal landfills in 1996 at 15€/tonne;<br>• It has since been increased and reached 30 €/tonne (in 2005). | • Producer responsibility for paper waste introduced in 1999;<br>• Landfill ban applied to biodegradable waste "from which the major part of the biodegradable waste was not properly | • It is noted that more waste may have been diverted from landfill had the government introduced regulations on separate collection or more incentive-based instruments. |

| | | | |
|---|---|---|---|
| | | implemented until 2006 | |
| Flemish Region of Belgium | • Landfilling of household waste has decreased from about 50% in 1991 to almost zero in 2006.<br>• A waste disposal levy (i.e. tax) was introduced at a low rate in 1990 but increased to 54€/tonne by 1997.<br>• A lower rate applies for incineration without energy recovery and a far lower rate for incineration with energy recovery.<br>• The levy also differentiates between household and industrial waste streams and separately collected materials for recycling are exempt.<br>• The revenue enters the Flemish Region budget and part is used to fund municipal waste projects. | • Since the 1980s, households and other waste producers have paid their municipality a charge for waste management;<br>• Costs not covered by the charges are funded by the regional government;<br>• Virtually all households now pay a variable charge ("pay as you throw") as well as a flat rate for waste management;<br>• A system of subsidies are in place to support recycling and energy recovery from waste. The subsidy is only payable if targets are exceeded;<br>• Widespread separate collection of garden and kitchen biowaste with active promotion of home composting;<br>• No new landfill sites have been permitted since 1993 because of land shortage;<br>• Waste that cannot be prevented, recycled or incinerated is banned from landfills;<br>• Producer responsibility implemented for waste paper. | • The Flemish Region has one of Europe's highest recycling rates;<br>• It is noted that there is broad public acceptance of the need for segregating, recycling and composting waste, and some of the initiative are more far reaching than those seen elsewhere in Europe;<br>• The Landfill Directive did not play a significant part in catalysing the introduction of most of the policy measures in place in Flemish waste management policy, since most were introduced in the 1990s before the directive was introduced in 1999. |
| Germany | • Landfilling of untreated municipal waste in Germany has decreased from about 40% in 1995 to 1% in 2006.<br>• There is no landfill tax in Germany. | • A key element of German policy is limiting the amount of organic matter sent to landfills and this has been achieved through bans on the landfilling of organic waste;<br>• The implementation of these measures was problematic, but earlier problems have been largely resolved such that residues from waste incineration and | • Germany was among one the first member state to introduce policies for limiting landfilling, well before the Landfill Directive was introduced in 1999;<br>• Measures included schemes for separate collection of packaging, biowaste and waste paper;<br>• The federal government committed itself in 1999 to recovering all municipal waste completely by 2020, so that landfilling will no longer be necessary. |

| | | | |
|---|---|---|---|
| | | mechanical biological treatment can be landfilled under strictly controlled conditions;<br>• Separate collection systems for household biowaste and garden waste from public parks has been required nationally since 1993;<br>• Producer responsibility for packaging waste has been in place since 1993 and producers and retailers have to take back used packaging and contribute to its further management. | |
| Hungary | • Prior to 1989, municipal waste management was not subject to extensive regulation – most municipalities simply dumped waste. 85% of municipal waste was landfilled in 2004 and this has decreased to 77% in 2007.<br>• There is no landfill tax in Hungary. | • Collection of recyclables is commonly based on bring systems (in which the householder takes the material to the centre), but garden waste is collected by some waste service providers, sometimes on a seasonal basis;<br>• Ecotaxation is applied to certain products deemed to have a deleterious effect the the environment, such as packaging materials, advertising brochures and tyres. If a producer or importer of these items meets the recycling or recovery target then the charges are returned. Some of the revenue raised is used for waste and environmental projects;<br>• The landfilling of organic waste has been partially banned since 2003; | • Most municipalities do not charge residents for waste services but collect the costs through taxation;<br>• There is concern that direct charging could lead to an increase in illegal dumping;<br>• State and municipality resources for waste management facilities are extremely limited and modernisation will be dependent on EU structural funding for 50-85% of the project costs;<br>• Separate collection of biowaste has increased substantially but this alone is unlikely to achieve the landfill diversion targets. The government was reported to begin implementation of co-incineration of MBVT residues at two or three power plants;<br>• Securing sites for new modern landfills and energy from waste plants is proving very problematic because of public opposition and overlapping jurisdictions. |
| Italy | • The country has traditionally had a heavy reliance on landfill, landfilling 85% of biodegradable municipal waste in 1995. Although eligible for a derogation of the Landfill Directive | • Policy instruments are often introduced at the national level and then left to the lower level of administration to determine implementation; | • A landfill tax was introduced in 1996 but left to the regions to determine the level within an upper and lower limit. Regions can decide how to use the revenue and up to 20% van be spent on environmental and waste projects; |

| | | | |
|---|---|---|---|
| | targets for diversion, Italy did not apply. BMW increased by 20% over the following decade, so making achievement of the diversion targets harder, since these are based on 1995 as the reference year;<br>• Italy has steadily increased its separate collection of biodegradable wastes, the largest fractions collected being paper, food and garden waste;<br>• There are large differences in separate collection between the north, centre and south of Italy;<br>• Italy introduced a landfill tax in 1996. | • Charges for waste management levied by municipalities typically depend on floor space of the accommodation. About 90% of householders now pay municipalities for waste management. Variable charging are being introduced by some municipalities. | • Wastes with a calorific value over 13 MJ/kg were banned from landfills in 2008 |

Overall, it can be seen that those countries that introduced a landfill tax did so along with a range of other associated measures, therefore landfill tax can be seen as part of the solution, not the whole answer, to the challenge of diverting waste from landfill.

### 2.1.1 UK Landfill Tax Scheme

The UK makes an interesting case study, since the country has a tradition of heavy reliance on landfilling, and much lower levels of material recovery than countries such as Germany were achieving in the 1990s. The Landfill Tax was introduced in the UK on 1st October 1996 and is the first of this county's explicitly environmental taxes. Its stated objectives[19] are:

> *To ensure that landfill waste disposal is properly priced, which will promote greater efficiency in the waste management market and in the economy as a whole, and to apply the "polluter pays" principle and promote a more sustainable approach to waste management in which we produce less waste and reuse or recover value from more waste.*

The tax is collected from landfill site operators and charged at two levels: The higher level (applied to "active waste" containing organic materials) and a lower rate (applied to "inactive" wastes – such as rubble). The rates at which the tax was set on introduction were £7[20] and £2 per tonne for active and inactive wastes, respectively. The standard rate has been increased steadily since 1996 and in 1999 a "duty escalator" was introduced, providing for annual increases in the standard rate of landfill tax. The present standard rate (in financial year 2010/11) stands at £48/tonne. This will increase by £8 a year, reaching £80/tonne in 2014/15. Note that VAT is chargeable on payments of the landfill tax.

The lower rate for inactive waste is currently (2010) £2.5/tonne. Details of the history and background of the UK landfill tax have been described by Seeley (2009)[21] and is outlined below. The tax raised £420m in its first year of operation and was estimated to raise £1bn in 2008/09.

It was originally intended that the landfill tax would achieve the twin objectives of raising money and protecting the environment, without imposing new costs on business. To achieve the qualifying part of this statement, the tax revenues were to be used to reduce the level of employers' national insurance contribution. The initial standard landfill tax rate (£7/tonne) was set at the upper end of the range of

[19] HM Customs and Excise, 1995. Landfill Tax - A consultation paper
[20] The current exchange rate is about 1.12 € per British Pound (£).
[21] Landfill Tax: introduction and early history, by Antony Seeley Standard Note SN/BT/237 updated 6th October 2009. House of Commons Library. http://www.parliament.uk/briefingpapers/commons/lib/research/briefings/snbt-00237.pdf

environmental costs associated with landfill. This work, undertaken by CSERGE et al in 1993[22] which had determined a range of net environmental costs of landfilling of £3 to £8/tonne, based on emissions of air pollutants, greenhouse gases, transport, leachate as the principal costed environmental impacts, and whether or not the sites recovered energy from the landfill gas. Significantly, disamenity costs of landfilling (such as visual intrusion, odour, noise, pests such as rodents and scavenging birds and windblown dust and litter) although significant were not included in the variable environmental costs. The increasing rate of landfill tax since its introduction has captured an increasing proportion of these disamenity impacts.

The UK landfill tax is charged on the amount of waste landfilled rather than on the landfill disposal fee – an *ad valorum* approach. The argument for an *ad valorum* charge was essentially one of administrative convenience and ease of enforcement.

The principal argument in favour of an alternative weight-based tax prevailed in the consultation. Apart from the obvious problem of an *ad valorum* tax weakening the link between cost of landfilling and quantity of waste disposed, the main concern was that it would favour disposal at the cheapest landfills, which would be likely to have the lowest environmental standards, and disproportionately affect local authorities with areas where landfill capacity is scarce. In accepting these arguments and opting for a weight based tax, the government also adopted a two-level tax, the lower rate for inactive waste.

However, considerable concern was raised by local authorities about the new tax, which focused on the following issues:

- Potential increase in illegal dumping of waste ("fly tipping");
- Concern over the net financial impact of the tax and how its cost would be met;
- Whether the local authorities would be able to pass on the cost of the tax;
- Lack of incentive given by the tax to householders to change their behaviour.

In its response the government reiterated the role of strong and effective regulation to deter and penalise those involved in fly tipping, requesting the Environment Agency to give high priority to this area of enforcement and wrote to the courts to draw attention to the issue and the financial gains that can be made by those engaged in illegal waste disposal.

The government also proposed that the rebate on employers' national insurance contribution that was to have been funded through the landfill tax revenues would be replaced by a new mechanism for using the tax revenue for environmental improvement. This led to the establishment of the Environmental Trusts. The Environmental Trusts are not-for-profit private sector bodies that make grants for the improvement of closed landfills and financing research into sustainable waste management. Tax rebates were announced in November 1995 for landfill operators for making payments for specified environmental improvement projects. In return, they would get a 90% rebate off their landfill tax liability, up to a maximum of 20%.

The system was criticised for being overly complex and too lightly regulated. As a result, it was substantially reformed in 2003. Further details are provided by ENTRUST[23], the regulatory body for the Landfill Community Fund. So far, some £892m has been spent on projects undertaken by the environmental bodies regulated by ENTRUST.

The ability of local authorities in England to pass the costs of waste treatment, including the landfill tax, to householders is currently limited by law, so that direct and variable charging (DVC) for household waste cannot be implemented in the UK as a whole. However, since devolution of certain powers to the governments of the three smaller constituent countries that make up the UK (Northern Ireland, Scotland and Wales) there may be scope for introducing DVC in these countries under devolved powers.

[22] CSERGE, Warrens Spring Laboratory & EFTEC (1993). Externalities from Landfill and Incineration, London: HMSO
[23] http://www.entrust.org.uk/home

This is certainly an area of considerable interest. For example, the Welsh Assembly Government (WAG) published a report in 2008[24] examining DVC, having concluded from previous work that achievement of the 2013 Landfill Directive target of 50% diversion of biodegradable municipal waste from landfill would only be achieved through significant development of recycling/composting of household waste. Direct and variable charging has been discussed throughout the UK for a number of years and several local authorities, particularly in England, have stated that they would be keen to be provided with the power to introduce this scheme[25]. However at present there exists no legislative power to introduce direct charging for waste collections. The benefits of DVC systems (and there are various alternative systems that can be used) hinge on their supposed ability to influence household behaviour in favour of waste prevention, recycling and composting in a manner consistent with the polluter pays principle. One of the downsides is its potential to have a disproportionate impact on poor families, and this is one of the main reasons for its political unpopularity.

Eunomia[26] have examined some of these issues in a comparative study of household waste charging schemes from various countries. The key messages in their detailed report are that variable charging does indeed increase the amount of waste being recycled or composted, but the evidence for a similar impact on waste minimisation, whilst generally positive, was less clear cut. They also concluded that it many schemes it was difficult to see where the "prevented" waste had gone, although they concluded that there was no support for the hypothesis that variable charging led to an increase in illegal dumping.

### 2.1.2 Effectiveness of the UK Landfill Tax scheme

So even in the absence of direct and variable charging, has the UK landfill tax assisted in diverting municipal waste away from landfill and into recycling and composting instead? The UK government's view (as given in the 2007 Waste Strategy for England), is an unqualified "yes". This is evidenced by a fall in the overall quantities of waste sent to landfill from 96 million tonnes in 1997/98, to about 72 million tonnes in 2005/06, a reduction of around 25%. The strategy states that for commercial waste, the landfill tax could tip the balance between recycling and landfill, making recycling the most cost effective option. Since the publication of the Strategy in 2007, the rate of standard landfill tax has increased to £35/tonne. It now (in 2010) stands at £48/tonne will increase to £80/tonne in 2014/15, adding more weight behind the cost effectiveness of recycling.

Whilst the duty escalator was broadly welcomed by the waste industry in giving more incentive to invest in sustainable alternatives to landfill, the current two-rate systems for active and inert wastes has been criticised as failing to incentivise treatments that produce a biostabilised residue from bio-treatment of waste, which has a very much reduced capacity to produce methane or leachate when landfilled[27]. These treatments are usually known as mechanical biological treatment (MBT). They combine sorting and shredding of waste, producing a refuse derived fuel from combustible materials and a compost-like output (CLO) from the biological stage, which may be composting, anaerobic digestion or a combination of the two. The CLO produced from residual waste treatment is still treated as waste and so subject to waste management regulation and hence cannot be used on agricultural land, so most is destined for landfill. The failure to recognise the lower environmental impacts of CLO when landfilled through a reduced rate of landfill tax is said to be deterring investment in the UK this well established technology, and encouraging diversion of waste to incineration based technologies.
The costs and benefits of applying a differential landfill tax rate to biostabilised waste have been analysed[28] and the authors conclude that as well as incentivising the uptake of biostabilisation, this would result in lower overall costs (including carbon costs) for business and local authorities, although reducing tax revenue for the government, and reiterate their call for the benefits of this option to be recognised through the landfill tax rate.

[24] Direct and variable charging for waste from householders. A report to the Welsh Assembly Government by Fehily Timoney and Co and BRASS, December 2008. http://wales.gov.uk/docs/desh/consultation/090429wastechargingen.pdf
[25] Partial Regulatory Impact Assessment – Consultation on incentives for recycling from households. Department for the Environment, Food and Rural Affairs. May 2007. http://www.defra.gov.uk/environment/waste/strategy/incentives/documents/waste-incentives-ria2007.pdf
[26] Modelling the Impact of Household Charging for Waste in England Final Report to Defra by D Hogg et al December 2006. http://www.defra.gov.uk/environment/waste/strategy/incentives/documents/wasteincentives-research-0507.pdf.
[27] 'Biostabilisation' of Wastes: Making the Case for a Differential Rate of Landfill Tax by report by D Hogg et al, Eunomia Research and Consulting, january 2008 http://www.eunomia.co.uk/shopimages/Eunomia%20Landfill%20Tax%20Paper%20Final.pdf
[28] Impact Assessment of the Landfill Tax Escalator. A report by D Hogg et al, Eunomia Research and Consulting, June 2008. http://www.eunomia.co.uk/shopimages/Eunomia%20-%20LfT%20Impact%20Assessment%20Final.pdf

### 2.1.3 Landfill Allowance Trading Scheme (UK)

The UK landfill tax applies to all waste sent to landfill. To further incentivise the diversion of biodegradable municipal wastes (BMW) from landfill to meet the Landfill Directive diversion targets, the government has introduced into England the world's first trading scheme for municipal waste, which came into force in April 2005. The Landfill Allowance Trading Scheme (LATS) was designed to help local authorities implement the most cost-effective way to make their contribution to the achievement of England's share of the UK's landfill diversion targets.

Similar schemes have been introduced by the devolved administrations of the UK, and these differ from that developed for England. Scottish local authorities have had a landfill allowance trading scheme in operation since 2008, although no trading takes place. In Wales, an allowances scheme began in 2004 but the allowances are not tradable. There is also a scheme in Northern Ireland, where unused allowances, although not tradable, are transferable to other authorities.

The LATS arrangements for England are broadly as follows. Each waste disposal authority has been issued with a LATS allocation, which sets the maximum amount of biodegradable municipal waste that it may landfill in a year. The allocation decreases in time in step with the Landfill Directive targets. There is a penalty of £150/tonne payable for any exceedences of the allowance. In developing their plans for managing waste, the authorities may, for example, decide to invest in collection and treatment facilities that will divert waste from landfill or alternatively purchase unused allowances from another authority.

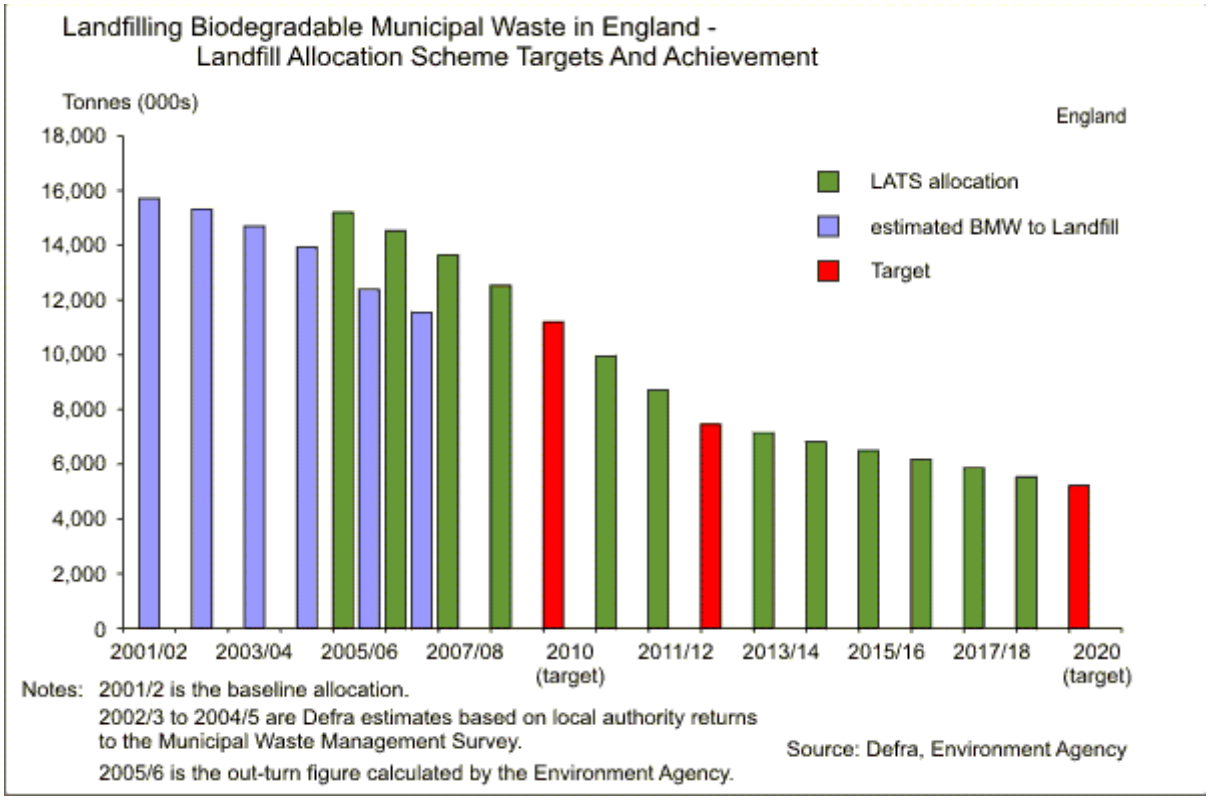
The details of the scheme are given in a Defra guidance note[29]. In essence, within each scheme year authorities are able to landfill BMW up to the level of allowances held. A single landfill allowance permits an authority to landfill one tonne of BMW. Authorities need to ensure that they hold sufficient allowances to cover the actual amount of BMW they intend to landfill over a given period. Should an authority not need or expect not to need all of its allowances in one or more scheme years because of actual or planned diversion of waste away from landfill, the authority can sell them, or bank (save) them into the following year (subject to certain restrictions). Equally, an authority which does not hold enough allowances to cover the amount of BMW it intends to landfill would need either to increase its rate of diversion, purchase additional allowances or borrow forward up to 5% of its following year's allocation (note that banking and borrowing are not allowed in certain key years). Local authorities do not have to trade allowances provided they do not exceed their limit on the amount of BMW they may send to landfill. Authorities can choose to meet their targets through diversion alone. Similarly, authorities may wish to co-operate to meet their targets. For example, two authorities can pool their allowances in order to invest in a shared waste management facility, but each individual authority would remain responsible for ensuring that its own targets are met.

### 2.1.4 Effectiveness of the UK LATS

Figure 2-1 shows a steady reduction in BMW to landfill in England to 2006, below the combined LATS allocation. The government has recently confirmed that the 2010 target of reducing BMW to landfill to 75% of the 1995 level has been achieved[30] and BMW to landfill should fall to under 5.2 million tonnes in 2020. Note that UK was one of twelve countries to be granted a four-year derogation for the achievement of the Landfill Directive's BMW diversion targets.

[29] Beginners' Guide to the Landfill Allowance Trading Scheme. Published by Defra
http://www.defra.gov.uk/environment/waste/localauth/lats/documents/lats-leaflet-0405.pdf
[30] http://www.energysavingtrust.org.uk/Resources/Energy-saving-news/Waste-recycling/UK-will-meet-landfill-diversion-targets

**Figure 2-1: Landfilling of biodegradable municipal waste in England (Defra, 2010)[31]**




But how much of this welcome diversion of BMW away from landfill can actually be attributed to LATS, as opposed to the landfill tax, which was operating of the same time period? Whilst LATS penalties of £150 per tonne seem high, they only apply to tonnages of BMW landfilled in excess of the local authority's allowance, and only apply to local authority controlled waste. Trading of LATS permits has been relatively modest, suggesting that councils are able to meet their allowances through other means. On the other hand, the landfill tax applies to all waste (commercial and industrial as well as that controlled by local authorities) and applies to every tonne of waste landfilled.

In undertaking the review[32] of the 2007 Waste Strategy for England, which was published in 2011, the government announced its intention to phase out LATS in 2013. The review noted that the main driver for reducing landfilling would continue to be the landfill tax, which will increase to £80/tonne in 2014/15, and that LATS was no longer considered an effective tool for delivering EU diversion targets.

## 2.2 Key conclusions

- The UK landfill tax has proved effective in diverting waste away from landfill and towards the more sustainable options of recycling and energy and material recovery;
- Initial fears that the tax would increase the amount of illegally disposed waste appear to be unsubstantiated and can be controlled by effective regulation and enforcement;
- The announcement of the landfill tax escalator was broadly welcomed by the waste industry as it gives a higher degree of certainty for the planning of investment decisions;
- Linking the tax to the weight of waste disposed has prevented the tax from disproportionately increasing the cost of landfilling in more expensive sites (which may have a higher degree of environmental protection) than an *ad valorum* tax;
- The use of landfill tax credits for environmental projects has allowed further offsetting of the disamenity impacts of landfills, although the tax can no longer be seen to be revenue neutral for central government;

[31] Department for the Environment, Food and Rural Affairs, 2010.
[32] Government Review of Waste Policy in England 2011. http://www.defra.gov.uk/publications/files/pb13540-waste-policy-review110614.pdf

- The lack of variable charging in the UK for household waste management means that householders have no financial incentive to increase recycling or waste reduction;
- There remains the opportunity to reduce the tax rate on biostabilsed waste to reflect the environmental benefits of MBT-based systems;
- Landfill taxes alone do not necessarily increase recycling rates and other polices and measures, such as education, information, R,D&D programmes and direct regulation are also needed to ensure the desired outcome;
- The UK landfill tax appears to have been the major driver for the achievement of the UK landfill diversion targets, and more effective than the LATS scheme that also operated over the past 5 years.

The European Commission (DG Environment) is finalising a comprehensive study on the use of economic instruments covering all Member States, so, once published, it could be a good source of information for readers[33].

[33] Use of economic instruments to implement the waste hierarchy. European Commission DG Environment. http://ec.europa.eu/environment/waste/use.htm

# 3 Case study 2: Landfill Bans and restrictions

Bans and restrictions on the sorts of waste that can be sent to landfill are part of the suite of policies and measures used by numerous countries to divert waste from landfills. In this context, landfill bans and restrictions are taken as those that apply to other waste beyond those banned under the 1993 Landfill Directive, such as liquids, infectious, hazardous and explosive materials and tyres.

The effectiveness of landfill bans and restrictions have recently been the subject of an analysis by Green Alliance[34], undertaken for the UK government to inform its policy development in this respect. The 2007 Waste Strategy for England notes that several EU member states has imposed legally-enforced restrictions on the types of waste that can be landfilled and that this has encouraged higher rates of recycling and recovery. The Green Alliance study was based on a series of case studies of landfill bans and restrictions in five European countries (Austria, Germany, Sweden, Netherlands and the Flanders region of Belgium) and one US state (Massachusetts) and interviews with key actors in each country. Further work, building on the Green Alliance study has recently been completed by Eunomia[35] to inform the feasibility of the introduction of landfill bans in the four countries that make up the UK. The reader is referred to these sources for further analysis and information since only a brief overview of the key issues is possible within the confines of this case study.

The Green Alliance study draws a distinction between landfill *bans* and landfill *restrictions*. Landfill bans apply to all aspects of the chosen waste stream (e.g. a prohibition on the landfilling of untreated waste; prohibition on landfilling of paper or cardboard). On the other hand, a restriction only targets part of the particular waste stream (e.g. prohibition of landfilling waste with a total organic carbon (TOC) content is greater than 5%) when the measures is targeted at all waste landfilled. Some of the waste (e.g. construction and demolition waste) is already below the 5% threshold and so would not be affected by the measure.

Landfill bans/restrictions are generally implemented according to three broad categorisations:

**Source:** Some countries have targeted wastes by source, e.g. Flanders and Netherlands have imposed bans on the landfilling of household waste.
**Type of waste – defined by its degree of recoverability:** Bans/restrictions are frequently related to the degree of recoverability – e.g. sorted waste streams usually have a high potential for material recovery, residual waste streams for energy recovery, or to reduce its impacts when landfilled. Germany, Flanders Netherlands and Massachusetts have established bans/restrictions based on recoverability.
**Physical and biological properties:** Examples include bans/restrictions based on combustibility, biodegradability and TOC. This approach is often used to target residual waste streams to reduce the impacts from landfilling and to stimulate diversion to preferred options.

The objectives for bans/restrictions also vary between countries, as shown in Table 3-1.

[34] Landfill bans and restrictions in the EU and US A Green Alliance project for Defra (ref WR1202)August 2009. http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=16103
[35] Landfill bans – feasibility research. A report by Eunomia Research and Consulting to WRAP, March 2010. Project code EVA130. http://www.wrap.org.uk/downloads/FINAL_Landfill_Bans_Feasibility_Research.3e940ff5.8796.pdf

**Table 3-1: Objectives of landfill bans/restrictions (Green Alliance, 2009)[34]**

| Country/Region/State | Reduce landfill dependency | Reduce environmental damage from landfill | Material Recover | Energy recovery from waste |
|---|---|---|---|---|
| Flanders | ✓ | ✓ | ✓ | |
| Netherlands | ✓ | ✓ | ✓ | |
| Germany | | ✓ | ✓ | |
| Austria | | ✓ | | ✓ |
| Sweden | | ✓ | | ✓ |
| Massachusetts | ✓ | | ✓ | |

The Green Alliance study observed that the focus of a countries landfill bans/restrictions tend to reflect the degree of advancement in waste management. For example, the focus in Germany, with its high level of material recovery achieved before bans, focuses on residual waste, whereas those with a lower level of material recover, such as Massachusetts, focus on separately collected materials or compostables. The main driver was usually the desire to reduce landfilling and its environmental impacts and to favour material recovery, particularly for biodegradable wastes. Energy recovery was generally viewed as a secondary benefit.

A key conclusion from Green Alliances' analysis is that landfill bans/restrictions are necessary for diverting wastes from landfills, but are not in themselves sufficient: other policies and measures are also required. Examples of these in the countries studied are shown in Table 3-2.

**Table 3-2: Range of instruments used to support landfill bans/restrictions (Green Alliance, 2009)[34]**

| Instruments | Austria | Flanders | Germany | Massachusetts | Netherlands | Sweden |
|---|---|---|---|---|---|---|
| Landfill taxes | ✓ | ✓ | | | ✓ | ✓ |
| Moratorium on landfill | | | | | ✓ | |
| Incineration bans/restrictions | | ✓ | | ✓ | | |
| Incineration taxes | ✓ | ✓ | | | Tax exists but set at zero | ✓ |
| Moratorium on incineration | | | | | ✓ | |
| Producer responsibility measures | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Mandatory separate collection | ✓ | ✓ | ✓ | Some municipalities only | ✓ | ✓ |
| "Pay-as--you throw"/ variable charging | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

With the exception of Germany, for which the Green Alliance study noted a strong preference for direct regulation rather than market-based instruments, all the other European countries had a landfill tax alongside landfill bans/restrictions. It was noted that in most countries with a landfill tax, it was seen as having a transient role, where banned or restricted waste could continue to be landfilled provide the landfill tax was paid, if alternative facilities did not yet exist. With an increasing rate of landfill tax, it eventually becomes cheaper to comply with the ban, rather than to negotiate an exemption and to pay the landfill tax. It was noted that all the European countries studied had a high rate of landfill tax, at least €75/tonne in 2008.

How effective were the landfill bans/restrictions examined by Green Alliance? All the keys actors interviewed by Green Alliance in the countries they studies believed that landfill bans/restrictions had been effective in achieving the policy goals adopted. However, and as noted above, the countries had

different objectives as to where the wastes now banned/restricted from landfill should go and also the difficulty of saying how much any observed change was due just to the ban/restrictions rather than any of the other policy measures adopted at the same time.

The overall results of the study are reproduced in Table 3-3, which compares the treatment of municipal solid waste (or national equivalent) in the year prior to the introduction of the landfill ban/restriction (or the earliest ban/restriction if there was more than one) and comparing it with the latest year for which Green Alliance had data.

**Table 3-3: Summary of results across countries, showing percentage share of treatment technologies before and after the introduction of landfill ban/restriction initiatives (Green Alliance, 2009)[34]**

| | Austria | | Flanders | | Germany | | Mass. | | Netherlands | | Sweden | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1999 | 2006 | 1997 | 2007 | 2000 | 2006 | 2004 | 2006 | 2005 | 2006 | 2001 | 2007 |
| Landfill | 29 | 4 | 25 | 3 | 27 | 1 | 26 | 22 | 23 | 10 | 23 | 4 |
| Incineration | 6 | 24 | 25 | 25 | 22 | 24 | 45 | 37 | 25 | 38 | 38 | 47 |
| Material recovery | 34 | 35 | 27 | 45 | 36 | 45 | 20 | 32 | 40 R | 51 R | 28 | 37 |
| Biological treatment | 15 | 17 | 20 | 23 | 15 | 17 | 9 | 9 | | | 10 | 12 |
| Other | 15 MBT | 18 MBT | 1 RU | 1RU 2 MBT | 8TR | 5 OTR | | | | | | |

Notes: R = recovery, RU = Re-use, TR = thermal recovery, MBT = mechanical biological treatment, OTR = other pre-treatment. „Before" dates for Austria and Massachusetts are actually 1-2 years after the initial introduction of the bans, due to a lack of data before these dates, so for these countries the effect of the bans may have been slightly more significant than presented here. In 2004 Massachusetts had a net import of four per cent of total waste, in 2006 the state had a net export of ten per cent total waste.

All the countries studied had high rates of recycling and composting before the landfill bans/restrictions were introduced which makes it hard to be definite about the impacts of landfill bans/restrictions and, in the case of Flanders and Massachusetts, incineration restrictions as well. However, all the countries studied did show an increase in recycling and composting, and in most cases incineration rates, after the introduction of landfill bans/restrictions.

The Green Alliance noted that mechanical biological treatment (MBT) did not seem to be viewed as a desirable treatment option and as a result was not mainstream. The mains concerns were related to cost, the end markets for its products and the potential for MBT to lock-in large quantities of biowaste which would be better collected separately and treated through composting or anaerobic digestion. The report goes on to note that in the Netherlands MBT has only ever been seen as an interim solution, while in Austria materials that were banned from landfill were allowed to go to MBT for political rather than technical reasons – politicians and municipalities feared that local opposition to incineration would require alternative options.

Some unforeseen results were also reported. A lack of alternative treatment capacity was the main reason for unforeseen impacts of landfill bans and restrictions. In some cases such shortages were geographical, rather than absolute: in Austria there were regional disparities, where some provinces had too much capacity while others did not have enough. Massachusetts, by contrast, has had to rely on a steady net export of waste to neighbouring states with 45 per cent of the total generated construction and demolition waste being exported to neighbouring states in 2007. The timetables of neighbouring European countries landfill restrictions had unforeseen impacts on the implementation of others regulations. For example, the long time period leading up to Germany's landfill restrictions resulted in a flow of Dutch waste to Germany due to comparatively lower incineration prices and delayed the development of alternative capacity in the Netherlands.

Interestingly, illegal disposal of waste was not cited as a significant problem by stakeholders. This is positive, but is of course the subjective view of a small sample. This was therefore identified as an area where further research and exploration may be valuable.

Since publication of the Green Alliance study, Eunomia have completed a detailed feasibility assessment of the impacts of introducing landfill bans in the UK. Key objectives of the UK

administrations are to reduce the greenhouse gas impacts from landfilled waste and to improve resource use efficiency. Additional aims of the study included seeking to understand how landfill bans / restrictions could help meet Landfill Directive targets for biodegradable municipal waste (in support of existing policy instruments); increase economic and business opportunities; and increase market certainty regarding the development of collection, reprocessing and treatment infrastructure.

The study found that the greatest climate change and resource efficiency gains were most likely to be achieved where landfill bans are coupled with a requirement to sort materials, rather than through the imposition of waste-stream level bans/restrictions (in other words, for example, simply banning the landfilling of municipal or commercial wastes). The greatest benefits in these terms were delivered by the requirement to sort paper/card, food, textiles, metals, wood, green waste and glass. Eunomia estimated a median greenhouse gas saving of 189 million tonnes $CO_2$ eq for the period 2009-2024 for the UK, with a net present value of just over £8 billion. Additional benefits can be obtained through a ban on biodegradable waste sent to landfill, but the magnitude of these will depend on the landfill alternative used.

The key conclusions from the study were that landfill bans/restrictions do have the potential to deliver net benefits (environmental and financial) to society, but that blanket bans on landfilling certain materials without a requirement to sort would be unwieldy and probably inefficient to implement. Furthermore, a restriction on unsorted waste – introducing a requirement to sort – would provide the greatest environmental and resource efficiency benefits. The conclusion is that there is a strong case for restricting the landfilling of paper & card, textiles, metals, wood and food wastes.

Eunomia[35] also make a number of observations on the practicalities of implementing landfill bans/ restrictions. They note that sufficient time must be allowed to implement the necessary changes in the waste processing infrastructure, including obtaining all the permits and planning consents required to develop major waste infrastructure projects. The amount of time usually required will vary from country to country but could be up to 10 years in some cases where delays in major infrastructure projects are common, as in the UK. Furthermore, a ban alone is not usually sufficient to ensure that the waste diverted from landfill goes follows the path desired by policymakers, and steps are needed to ensure that additional instruments are in place around the time that the ban is announced. The requirement to sort is the key complementary measure for the ban on unsorted wastes, but this should be specified in such a way that the quality of recyclate is not adversely affected.

# 4 Evaluation of the measures

This section evaluates the impacts of the policy in terms of Economic, Environmental and Social factors, indicating if the impacts are positive, neutral or negative and if the impact is High or Low.

(++) High Positive Impact
(+) Low Positive Impact
(n) Neutral
(-) Low Negative Impact
(- -) High Negative Impact

**Landfill Tax**

| | | |
|---|---|---|
| | **Economic impacts** | |
| **What was the cost to deliver the outcome, was it value for money?** | (++) | Proven effectiveness in diverting waste from landfill, especially when based on waste quantity, as opposed to *ad valorum*. Good value for money |
| | (+) | Marginal cost to administer is relatively low for tax-based schemes, as the arrangements were already in place. |
| **What wider economic impacts does the policy have?** | (++) | Revenues collected may be used to off-set other tax liabilities eg UK business national insurance payments. |
| | (++) | Revenues collected may be used for environmentally beneficial projects and programmes. |
| | (++) | Once established, the tax rate can be programmed to rise year on year, so giving businesses a longer planning horizon in which to implement landfill alternatives. |
| | (n) | Must be backed up by effective regulation and enforcement to ensure waste destined for (legal) landfills is not fly-tipped or otherwise disposed of illegally. |
| | (-) | Makes a small overall contribution to increasing business cost which is passed on to consumers. |
| | **Environmental impacts** | |
| **Did the policy deliver the desired outcome?** | (++) | Yes – landfill taxes are effective in raising the cost of landfill and driving waste towards more sustainable alternatives. |
| | (++) | Reduced greenhouse gas emissions from landfills, and, indirectly, from elsewhere in the economy by stimulating recycling over use of virgin materials. |

| | | |
|---|---|---|
| | (+) | The strongest driver for environmental improvement is achieved if the landfill tax is based on quantity of waste landfilled, rather than *ad valorum.* |
| | (-) | *Ad valorum* based landfill tax may increase waste flows to cheapest and lowest standard landfills. |
| | (++) | Reductions in other pollutant emissions and disamenity effects by diverting waste from landfill and increasing recycling. |
| **What other impacts has the policy had?** | (++) | Increased rates of waste prevention, recycling and reuse and overall improvement in resource use efficiency. |
| **Are there impacts on emissions from other sectors?** | (++) | Reducing availability of landfill forces more reliance on waste prevention, recycling and energy recovery from waste, reducing greenhouse gas and other pollutant emissions from these sectors. |

## Social impacts

| | | |
|---|---|---|
| **Was the policy well received, were there issues in gaining acceptability, what did they relate to?** | (++) | The Landfill Tax is almost invisible to voters and is a tax largely paid by businesses and by local authorities on behalf of the waste they manage for their residents. |
| | (-) | The low visibility of Landfill Tax to voters reduces its impact as a driver for behaviour change, such as increasing waste reduction. |
| **What are the distributional impacts?** | (-) | Limited distributional impacts, although measures that increase the cost of waste disposal, even if less visible to the tax payer, may affect the poor disproportionately. |

## Cross-Cutting

| | | |
|---|---|---|
| **Are there interactions with policies in other sectors?** | (++) | Other measures to increase recovery of materials by recycling and recovery of energy from waste (as renewable heat or electricity) benefit from the reduced availability of low-cost landfill. |
| **Timeframe – is there anything to note about the timing of policy implementation and expected impacts?** | (n) | Businesses and local authorities need sufficient time to plan and adapt to any changes in the tax rate as this has a major bearing on investment decisions. |
| | (n) | A landfill tax can be introduced relatively rapidly and is not dependent on infrastructure availability. |

**Landfill bans and restrictions**

## Economic impacts

| | | |
|---|---|---|
| **What was the cost to deliver the outcome, was it value for money?** | (++) | Can be effective where properly targeted (eg at unsorted waste or at particular types of material) and alternative infrastructure exists for treating the banned/restricted materials |
| | (-) | Requires effective regulation and enforcement mechanism. Establishing this may be relatively costly in administrative terms. |
| | (-) | May require enforcement through the justice system, hence possibility of delays. Penalties for infringements may not provide sufficient deterrence. |
| | (n) | May work best when introduced with a landfill tax. |
| **What wider economic impacts does the policy have?** | (++) | Bans and restrictions create opportunities for businesses to offer treatments for the materials in question. |
| | (-) | May require local authority investment at household waste sites to provide separate facilities for receiving banned materials. |
| | (-) | Alteration to existing long-term waste management and disposal contracts to change processing for banned materials. |
| | (n) | Must be backed up by effective regulation and enforcement to ensure waste destined for (legal) landfills is not fly-tipped or otherwise disposed of illegally. |
| | (-) | Makes a small overall contribution to increasing business cost which is passed on to consumers. Cost increases are needed to pay for implementation of the ban and increased administrative burden for inspection and enforcement, recovered through charges for permits. |

## Environmental impacts

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|---|---|---|
| **Did the policy deliver the desired outcome?** | (++) | Yes – landfill bans and restricts can be very effective in removing the target material / products from the waste stream. |
| | (++) | Reduced greenhouse gas emissions from landfills, and, indirectly, from elsewhere in the economy by stimulating recycling over use of virgin materials. |

| | | |
|---|---|---|
| | (++) | Reductions in other pollutant emissions and disamenity effects by diverting waste from landfill and increasing recycling. |
| | (-) | May lead to long-haul of waste to other jurisdictions where bans are not in place. |
| **What other impacts has the policy had?** | (++) | Increased rates of waste prevention, recycling and reuse and overall improvement in resource use efficiency. |
| **Are there impacts on emissions from other sectors?** | (++) | Changes in manufacture to avoid the use of materials/products that may be subject to a landfill ban or restriction. This may increase the use of recycled ingredients which frequently have a lower environmental footprint than continued reliance on virgin materials. |
| | (--) | Emissions from industries processing materials diverted from landfill may increase as a result of greater throughput of material. |

## Social impacts

| | | |
|---|---|---|
| **Was the policy well received, were there issues in gaining acceptability, what did they relate to?** | (-) | Landfill bans need to be implemented in parallel with changes to waste site infrastructure and procedures. In the case of household waste, measures may prove unpopular with the public if alternative arrangements are not put in place on a timely basis and the public is given adequate warning. |
| | (-) | Acceptability is generally dependent on the availability of alternative arrangements for accepting the banned material at the same or similar cost to landfilling. |
| **What are the distributional impacts?** | (-) | Limited distributional impacts, although measures that increase the cost of waste disposal, even if less visible to the tax payer, may affect the poor disproportionately. |

## Cross-Cutting

| | | |
|---|---|---|
| **Are there interactions with policies in other sectors?** | (++) | Other measures to increase recovery of materials by recycling and recovery of energy from waste (as renewable heat or electricity) benefit from the reduced availability of low-cost landfill. |
| **Timeframe – is there anything to note about the timing of policy implementation and expected impacts?** | (n) | Businesses and local authorities need sufficient time to plan and adapt to proposed bans and restrictions as this has a major bearing on investment decisions and the provision of alternative facilities. |
| | (-) | Landfill bans may require investment in alternative facilities that have a long lead time. |

# References

AEA/Alterra/Ecofys/Fraunhofer ISI (2012): *Greenhouse gas emissions projections, emissions limits and abatement potential in ESD sectors*. Next phase of the European Climate Change Programme: Analysis of Member States actions to implement the Effort Sharing Decision and options for further community-wide measures, Oxford, AEA Group.

Bio Intelligence Service et al (2012) *Use of economic instruments to implement the waste hierarchy*. European Commission DG Environment. http://ec.europa.eu/environment/waste/use.htm

*Communication From The Commission To The European Parliament, The European Economic And Social Committee And The Committee Of The Regions Roadmap to a Resource Efficient Europe Brussels 20.9.2011 COM(2011) 571 Final* (2011) European Parliament, The Council .

CSERGE, Warrens Spring Laboratory & EFTEC (1993). *Externalities from Landfill and Incineration*, London: HMSO

D Hogg et al, December 2006. *Modelling the Impact of Household Charging for Waste in England Final Report to Defra ,* London: DEFRA.

D Hogg et al, January 2008. *Biostabilisation' of Wastes: Making the Case for a Differential Rate of Landfill Tax,* Eunomia Research and Consulting.

D Hogg et al, June 2008. *Impact Assessment of the Landfill Tax Escalator ,* Oxford: Eunomia Research and Consulting.

Davies, S., 2003. *European waste management: background to a discussion on EWCs. A PSIRU report for EPSU,* London: Public Services International Research Unit (PSIRU) .

Department for the Environment, Food and Rural Affairs (DEFRA), 2005. *Beginners' Guide to the Landfill Allowance Trading Scheme.* [Online]
Available at: http://www.defra.gov.uk/environment/waste/localauth/lats/documents/lats-leaflet-0405.pdf
[Accessed 2012].

Department for the Environment, Food and Rural Affairs (DEFRA), May 2007. *Partial Regulatory Impact Assessment – Consultation on incentives for recycling from households,* London: DEFRA.

Department for the Environment, Food and Rural Affairs (DEFRA), August 2009. *Landfill bans and restrictions in the EU and USA Green Alliance project for Defra (ref WR1202),* London: DEFRA.

Department for the Environment, Food and Rural Affairs (DEFRA) 2010. *Landfilling Biodegradable Municipal Waste in England - Landfill Allocation Scheme Targets And Achievement*

Department for the Environment, Food and Rural Affairs (DEFRA), 2011. Government Review of Waste Policy in England 2011, London: DEFRA.

Entrust, 2007. *Home.* [Online]
Available at: http://www.entrust.org.uk/home
[Accessed 2012].

Envirowise, 2009. *Envirowise Wrap home page.* [Online]
Available at: http://envirowise.wrap.org.uk/

Eunomia Research and Consulting on behalf of WRAP, March 2010. *Landfill bans – feasibility research. Project code EVA130,* London: WRAP.

European Commission by DG Environment, 2011. *Review of the Thematic Strategy on the prevention and recycling of waste.* [Online]
Available at: http://ec.europa.eu/environment/waste/use.htm
[Accessed 2012].

European Environment Agency (EEA), 2009. *Diverting waste from landfill – effectiveness of waste management policies in the European Union. EEA Report no 7/2009.* [Online]
Available at: http://www.eea.europa.eu/publications/diverting-waste-from-landfill-effectiveness-of-waste-management-policies-in-the-european-union
[Accessed 2012].

European Environment Agency (EEA), 2012. *Modelling GHG emissions from MSW management in the EU (excluding Cyprus) plus Norway and Switzerland – business-as-usual scenario.* [Online]
Available at: http://www.eea.europa.eu/data-and-maps/figures/modelled-ghg-emissions-from-msw
[Accessed 2012].

European Environment Agency (EEA), 27 May 2012. *Annual European Union greenhouse gas inventory 1990–2008 and inventory report 2010, Technical report No /2010, Submission to the UNFCCC Secretariat by European Environment Agency.* [Online]
Available at: http://unfccc.int/national_reports/annex_i_ghg_inventor
[Accessed 2012].

European Union (EU), 2011. *Summary of EU waste legislation.* [Online]
Available at: http://europa.eu/legislation_summaries/environment/waste_management/index_en.htm
[Accessed 2012].

Fehily Timoney and Co and BRASS, December 2008. *Direct and variable charging for waste from householders. A report to the Welsh Assembly Government ,*
http://wales.gov.uk/docs/desh/consultation/090429wastechargingen.pdf: Timoney, F and Co & BRASS.

Hall, D., February 2010. *Waste management companies in Europe 2009,* London: commissioned by European Federation of Public Service Unions (EPSU).

Höglund-Isaksson L, Winiwarter W, Wagner F, Klimont Z, Amann M, 2010. *Potentials and costs for mitigation of non-CO2 greenhouse gas emissions in the European Union until 2030*. Report to the European Commission, DG Climate Action. IIASA.

Prognos, in cooperation with University of Dortmund 2008, 2008. *Resource savings and CO2 reduction potential in waste management in Europe and the possible contribution to the CO2 reduction target 2020.* [Online]
Available at: http://www.prognos.com/CO2-study.609+M5d61c852d66.0.html
[Accessed 2012].

Seeley, A., 1995, updated 6th October 2009. *HM Customs and Excise, 1995. Landfill Tax - A consultation paper, Landfill Tax: introduction and early history by Antony Seeley, Standard Note SN/BT/237,* London: House of Commons Library.

UNFCC, 2012. *Over a 100 year time horizon, according to the United Nations Framework Convention on Climate Change.* [Online]
Available at: http://unfccc.int/ghg_data/items/3825.php
[Accessed 2012].

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