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1. Defra Project code	<input type="text" value="WR1202"/>
2. Project title	<input type="text" value="Landfill bans and restrictions in the EU and US"/>
3. Contractor organisation(s)	<input type="text" value="Green Alliance
36 Buckingham Palace Road
London SW1W 0RE"/>
4. Total Defra project costs (agreed fixed price)	<input type="text" value="£ 62,500"/>
5. Project: start date	<input type="text" value="June 2008"/>
end date	<input type="text" value="August 2009"/>

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Executive Summary

7. The executive summary must not exceed 2 sides in total of A4 and should be understandable to the intelligent non-scientist. It should cover the main objectives, methods and findings of the research, together with any other significant events and options for new work.

Landfill bans and restrictions in the EU and US A Green Alliance project for Defra (ref WR1202)

Executive Summary Summary Evidence Review (final submission August 2009)

Introduction

The government's Waste Strategy¹ stated that landfill should be the option of last resort for waste. It announced the government's intentions, subject to further analysis, to consult on whether the introduction of further restrictions on the landfilling of biodegradable wastes or recyclable materials would make an effective contribution to the objectives set out in the strategy, which are to reduce greenhouse gas emissions and increase resource efficiency.

This report sets out how four EU countries (Austria, Germany, Sweden and the Netherlands), a region of an EU country (the Flanders region of Belgium) and a US state (Massachusetts) have implemented restrictions or bans on the landfilling of a range of waste materials and, in some cases, also their incineration. Drawing on in-depth interviews with key stakeholders both in government and the waste industry, the report examines what the restrictions and bans have meant, both in theory and in practice.

The report is by necessity a relatively short summary of the information contained in the six full case studies, and should be read alongside these case studies which contain a more nuanced assessment of each country's policy and its results. A draft version of the report was discussed at a seminar attended by members of Defra's waste stakeholders and landfill regulation groups in March 2009.

Objectives

Landfill was viewed as the least desirable option in the waste hierarchy by all interviewees, who cited reducing dependency on landfill, and reducing the environmental impacts associated with landfill, as the overarching objectives of a landfill ban or restriction.

Objectives tended to also reflect the nature or state of advancement of a country's waste policy: countries such as Germany with relatively high levels of material recovery before the introduction of bans tended to focus on residual waste, whereas those with lower levels of material recovery such as Massachusetts focussed bans on separately collected recyclable or compostable materials. Energy-from-waste was not seen as a significant driver in its own right.

Supporting instruments

In all the case study countries, landfill bans and restrictions had been deployed as one instrument in a range of fiscal, regulatory and other inventions aimed at moving waste away from landfill.

The most significant supporting measures used were:

- Landfill taxes and moratoriums
- Incineration bans and restrictions
- Incineration taxes and moratoriums
- Mandatory or incentivised separate collection for certain wastes

Results

Interviewees in all the countries studied believed that the landfill bans or restrictions had, to varying extents, succeeded in achieving their objectives. However, while countries shared the general objective of reducing dependency on landfill, there were differing emphases on what should replace landfill. Furthermore, many interviewees stressed the difficulties of attributing success to landfill bans or restrictions specifically, due to the wide range of supporting instruments employed and the interactions between them.

¹ Waste Strategy for England 2007

Summary of results across countries, showing percentage share of treatment technologies before and after the introduction of landfill ban/restriction initiatives

Share of treatment	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	35	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	1 RU 2 MBT		8 TR 5OTR						

Notes: R = recovery, TR = thermal recovery, MBT = mechanical biological treatment, OTR = other pre-treatment, RU = reuse. '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.

Impact on recycling, composting and incineration

All of our case study countries had relatively high recycling and composting rates before or shortly after bans and restrictions were introduced, which makes it difficult to make a strong statement about effects on alternate treatment. However, in all cases the combined effect of landfill (and in Flanders' and Massachusetts' cases, incineration) bans and restrictions, as well as the package of supporting measures, resulted in increases in both recycling and composting rates and, in most cases, incineration rates.

Practicalities

Key elements of the implementation of landfill bans and restrictions were lead times to allow businesses and local authorities to prepare; and a system of exemptions used in the transition period between the introduction of the bans or restrictions and the deadline for total compliance. In practice, responsibility for compliance rests largely on landfill operators, but compliance and enforcement systems also related quite closely to the nature of each country's bans or restrictions.

Conclusions and considerations for UK policy

Our research has highlighted a number of considerations for policymakers going forward, both in terms of commissioning further work in this area and in developing a similar policy for the UK. In particular the research highlighted the importance of the following points in achieving a successful outcome:

- Clear signals that there will be a ban or restriction.
- Sufficient lead times.
- A simple compliance system.
- A clear view of the overall objectives of a ban or restriction.
- Effective supporting instruments.
- Resources to enforce.
- Public support.

Project Report to Defra

8. As a guide this report should be no longer than 20 sides of A4. This report is to provide Defra with details of the outputs of the research project for internal purposes; to meet the terms of the contract; and to allow Defra to publish details of the outputs to meet Environmental Information Regulation or Freedom of Information obligations. This short report to Defra does not preclude contractors from also seeking to publish a full, formal scientific report/paper in an appropriate scientific or other journal/publication. Indeed, Defra actively encourages such publications as part of the contract terms. The report to Defra should include:
- the scientific objectives as set out in the contract;
 - the extent to which the objectives set out in the contract have been met;
 - details of methods used and the results obtained, including statistical analysis (if appropriate);
 - a discussion of the results and their reliability;
 - the main implications of the findings;
 - possible future work; and
 - any action resulting from the research (e.g. IP, Knowledge Transfer).

Landfill bans and restrictions in the EU and US A Green Alliance project for Defra (ref WR1202)

Summary Evidence Review

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I. Introduction

1. The purpose of this summary report

The government's waste strategy for England 2007 was clear that landfill should be the option of last resort for waste. The strategy noted that several EU member states have found that imposing restrictions on the types of waste that can be landfilled, or indeed outright bans on the landfilling of particular waste streams, has encouraged higher rates of recycling and recovery in these countries. It announced the government's intentions, subject to further analysis, to consult on whether the introduction of further restrictions on the landfilling of biodegradable wastes or recyclable materials would make an effective contribution to the objectives set out in the strategy, which are to reduce greenhouse gas emissions and increase resource efficiency. Of particular interest is the extent to which bans or restrictions in other countries have targeted what the government sees as 'priority' materials, whose diversion from landfill realises significant environmental benefits: paper, food and green waste, glass, aluminium, wood, plastic and textiles.

The aim of this report is to make a useful contribution to this analysis. It sets out how four EU countries, a region of an EU country, and a US state have implemented restrictions or bans on the landfilling of a range of waste materials, and, in some cases, also their incineration. Drawing on in-depth interviews with key stakeholders both in government and the waste industry, the report examines what the restrictions and bans have meant, both in theory and in practice. We have looked at the rationale for the bans and restrictions, the analysis of alternatives, and their effects and interactions with other policy instruments. We also questioned interviewees on their reception by stakeholders, the extent to which their impact had been evaluated and what direction such policy will take in future.

This report is by necessity a relatively short summary of the information contained in the six full case studies, and as a result we recommend that it be read alongside the case studies, which contain a more nuanced assessment of each country's policy and its results. A draft version of this summary report was disseminated to members of Defra's waste stakeholder and landfill regulation groups in early March 2009, ahead of a Chatham House Rules seminar on the subject. This seminar collated feedback on the report and also set a forward-looking agenda, identifying further research and priority considerations should such a policy be taken forward in the UK.

We feel that this project and report is particularly timely. Despite an impressive increase in household recycling rates in recent years, the UK is still heavily reliant on landfill, the final destination for 54 per cent of municipal waste, 41 per cent of commercial and industrial waste and 31 per cent of construction and demolition waste. The landfill tax escalator is making landfill increasingly expensive, reinforced by the announcement in Budget 2009 to continue increase landfill tax by £8 per tonne on 1 April each year from 2011 to 2013. However, it is not clear that landfill tax will be sufficient on its own to attract the necessary investment in alternatives.

There is particular concern over the continued landfilling of large quantities of materials with high levels of embedded carbon over their life cycle, such as food waste and aluminium, for which good composting and recycling markets have existed, although the recent economic downturn has caused prices to fall for some materials. As we concluded in past Green Alliance publications on waste and resource policy such as *Creative policy packages for waste: lessons for the UK*² and *A Zero Waste UK*,³ countries that have much higher rates of recycling and recovery than the UK tend to have employed a wide range of fiscal, regulatory and informational instruments throughout the supply chain, from virgin material levies through to pay-as-you-throw and restrictions or bans on landfill. The latter could well prove to be an effective addition to our existing mix of instruments.

2. Methodology and choice of examples

Initial discussions about the scope of the work were held with Defra officials representing the policy and evidence work streams of the Waste Programme in June 2008. Extensive desk research was then carried out during July and August to identify countries that had implemented bans or restrictions on landfill. Six countries (including a region of an EU country and one US state) were then selected for more in-depth study. Their selection was a function both of the availability of largely web-based information and relevant stakeholders willing to be interviewed, as well as the fact that they offered a diverse selection of approaches, targets and results. Furthermore, all had implemented restrictions or bans during the 1990s or early 2000s, which meant that enough time had lapsed since the policy was implemented to draw at least initial conclusions about its effectiveness.

The six case studies are of Austria, the Flemish region of Belgium, Germany, Massachusetts, the Netherlands and Sweden. Each one is based on desk research and telephone interviews with at least two waste 'actors',

² Green Alliance (2002) *Creative policy packages for waste: lessons for the UK*

³ Green Alliance (2006) *A Zero Waste UK*

including one from government and/or the agency responsible for implementing the bans or restrictions, and one from the waste industry, to give as rounded a picture as possible. Detailed profiles of each country were compiled from literature and Internet sources, and sent for comment to key people identified in each country, together with a request for interview. Those who agreed to be interviewed were sent twelve key questions (see appendix), tailored to each country based on existing information, ahead of the interview which typically lasted between 60 and 90 minutes. The notes from each interview were sent to the interviewees for checking, and their subsequent comments incorporated into the final case study. We feel this approach has in general yielded detailed, accurate and candid accounts of each country's experience, and have flagged up where we feel further information, or more detailed and/or recent quantitative data, might be necessary to fully understand a particular issue or area.

3. Cross-country comparability

As far as possible, we have tried to extract similar types of information from each country in order to build up a 'story' of the country's experience implementing bans or restrictions that is compelling and useful in its own right, but also allows comparison between examples. To help such comparison, for each country we have adapted a generic diagram (see section II, figures 1 and 2) reflecting the situation before and after the landfill bans/restrictions. We hope this analysis tool enables the reader to extract the essence of what each country has tried to do but in a way that is comparable with the other countries studied. Adapting this tool for each country has also required a rigorous understanding of exactly what is targeted and for what purposes.

Similarly, while in general the case studies use the terms employed by the stakeholders themselves and in other relevant information, in section II we set out our interpretations of these terms to help the reader transcend the specificities of the terminology used in each example.

II. Discussion

1. Definitions used

This table aims to give a comprehensive explanation of the terms used by us and by stakeholders throughout this report and the case studies. While some terms have country-specific interpretations of their exact meanings, we found that most were broadly comparable across all the case studies.

Term	Definition
Anaerobic digestion	Anaerobic (oxygen-free) treatment method for biowaste where biogas is formed (see composting).
Biodegradable waste	Waste comprised of organic substances that will decay relatively quickly as a result of the action of bacteria and break down into elements such as carbon that are recycled naturally. Waste that is suitable for composting or anaerobic digestion.
Biogenic	Produced from living organisms or biological processes.
Biological treatment	Treatment of biowaste with or without access to/supply of oxygen e.g. composting, anaerobic digestion (see biowaste).
Biowaste	Waste that is easily broken down biologically, i.e. the proportion of organic waste that in a limited time may be broken down in biological processes. e.g. food and garden waste (see organic waste).
Combustible waste	Waste that burns without additional energy following the start of the incineration process. Same as flammable. Opposite to non-combustible, inert (see inert waste).
Composting	Biological treatment where biological waste is broken down with the use of oxygen (see anaerobic digestion).
Energy recovery	The recuperation of electricity, heating or gas that is generated through the thermal or biological treatment of waste (may also include methane collection at landfill sites). Same as energy-from-waste. Depending on the country and type of waste, treatment with energy recovery may or may not be accounted as a waste recovery operation. This will change with the implementation of the EU's Waste Framework Directive.
High calorific value waste	Waste that will release a high amount of heat if subjected to combustion. Usually waste with a calorific value of 6,000kJ/kg or more but may depend on country. (See RDF)
Inert waste	Waste that does not undergo any significant physical, chemical or biological transformations when in contact with other waste, e.g. stone and gravel (see stable waste).
Inorganic	Composed of minerals rather than living material. Examples of inorganic carbon include oxides of carbon, carbon disulfide, cyanides, and their associated acids and salts (see TOC).
Material recovery	Process by which a waste material is turned into a valuable material. Material recycling and composting are the main examples of material recovery. Refurbishment and reuse may also be accounted as material recovery.
MBT (mechanical biological treatment)	Mechanical-biological treatment combines a sorting facility with a form of biological treatment. MBT plants are designed to process mixed household waste as well as commercial and industrial wastes. The sorting component of a MBT facility resembles a materials recovery facility. This component is either configured to recover the individual elements of the waste (metals, plastics, glass) or produce a refuse-derived fuel (high calorific fraction) that can be used for the generation of power. (See biological treatment).

Organic	Belonging to a family of compounds characterised by chains or rings of carbon atoms that are linked to atoms of hydrogen and sometimes oxygen, nitrogen, and other elements. These carbon-based compounds were originally limited to compounds that are the natural products of living things, but now also include synthetic carbon compounds such as plastics. Opposite to inorganic. (See TOC and organic waste).
Organic waste	Waste that contains organic carbon, e.g. biological waste and plastic waste.
Recoverability	Potential for 'value' extraction. Ability to be recovered.
Recoverable waste	Waste from which useful substances may be extracted. In practice, recoverable waste would normally include separately collected waste materials (for recovery) and by extension, unsorted wastes. Opposite to non-recoverable.
Recyclates	Waste materials separately collected and/or sorted for the purpose of material recovery.
Refuse derived fuel (RDF)	A fuel prepared from municipal solid waste by removing non-combustible materials such as rocks, glass and metals, and then chopping or shredding the remaining combustible portion.
Residual waste	Waste that remains after a sorting or treatment operation.
Separately collected waste materials	Waste materials are separated at source on the basis of their recoverability (recyclates and biowaste), their potential harm to the environment (hazardous wastes), or because they are too big to be collected with normal waste (bulky wastes). The list of such materials usually varies across countries. Opposite to residual waste.
Source separation	Sorting or separation of waste at the point of production, e.g. in the household, factory etc.
Stable	Steady and not liable to change/not subject to changes in chemical or physical properties.
Thermal treatment	Treatment of waste using heat. Includes various technologies such as incineration, pyrolysis, and gasification.
TOC value (total organic carbon)	Total organic carbon (TOC) is the amount of carbon bound in an organic compound. It is typically measured by subtracting the inorganic carbon (TIC: carbonate, bicarbonate and dissolved carbon dioxide; a material derived from non-living sources) from the total carbon present (TC: all the carbon in the sample, both inorganic and organic). See organic waste.
Treated residual waste	Waste that is left after a thermal or biological treatment operation and which should have become inert, or at least stable. Same as secondary residual waste and also pre-treated waste.
Unsorted waste	Waste that is presented for collection in an unsorted state.
Untreated residual waste	Residual waste that has received no thermal or biological treatment, e.g. black bin waste. Same as primary residual waste.
Untreated waste	Waste that remains unchanged from the point of production (e.g. no sorting, screening, thermal or biological transformation etc). Opposite to treated waste and pre-treated waste.
Waste recovery	Material recovery and in certain cases also energy recovery (country dependent). See definitions of both above.

2. Interpreting the bans/restrictions

Targeting material for landfill bans/restrictions

A landfill ban or restriction can be based on either one or a combination of the following three criteria:

Criterion 1) Source

Some countries (Germany, Flanders and the Netherlands) will specify the source of the banned/restricted waste stream, for example, household waste, while others may not.

Criterion 2) Type of waste, defined by its degree of recoverability

Most countries will specify the type of waste that is banned/restricted from landfill using some notion of recoverability. This will also tend to correlate with where wastes are flowing to and from within the waste treatment chain. A landfill ban or restriction based on this criterion should normally have a direct impact on material recovery, and on energy recovery (to the extent that it is also counted as recovery and not simply disposal).

For example, unsorted waste at the beginning of the waste treatment chain may be targeted because it has a high recoverability potential. Separately collected waste materials are also considered highly recoverable and so can be targeted by this criterion. Residual waste that has low potential for material recovery may be targeted for energy recovery, or to reduce its environmental impact when eventually landfilled.

Germany, Flanders, the Netherlands and Massachusetts all have established landfill bans based on the recoverability of certain waste streams. The level of prescription of such ban/restriction can greatly differ among countries. For instance, the Netherlands and Massachusetts give a detailed list of recoverable waste materials that should not be landfilled. On the other hand, Germany chose a less prescriptive approach by designating banned waste streams through more generic terms such as 'waste that is recoverable'.

Criterion 3) Physical and biological properties of a particular waste stream

In some cases bans or restrictions are based on specific properties of the waste stream, in particular physical or biological properties such as the combustibility, biodegradability, or total organic carbon (TOC) value. In the majority of cases the use of such a criterion targets the residual waste stream, to ensure alternative treatment and/or a reduction in the environmental impact associated with its landfilling. One exception to this rule is Sweden, which has imposed a landfill ban on separately collected combustible waste materials.

The following table shows how each of the countries examined in the case study work used the criteria identified.

Table 1: Approaches to landfill bans and restrictions identified in the case studies

	Criterion 2 (type)	No criterion 2 (type)
Criterion 3 (properties)	<ul style="list-style-type: none">• Germany• Flanders• Sweden	<ul style="list-style-type: none">• Austria
No criterion 3 (properties)	<ul style="list-style-type: none">• Massachusetts• Netherlands	

Note: Criterion 1 (source) represented in blue.

Landfill ban or restriction?

We use the term **landfill ban** when the measure under consideration applies to *all* (in terms of quantity and in terms of every aspect) of the *targeted* waste stream. Examples:

- The interdiction to landfill unsorted waste is a landfill ban;
- The interdiction to landfill paper and cardboard is also a landfill ban.

We use the term **landfill restriction** when the measure addresses only a fraction of the targeted waste stream. Examples:

- The interdiction to landfill waste with a TOC of more than five per cent is a landfill restriction when the measure targets *all wastes* previously landfilled in the country (some construction and demolition waste is inert and therefore will not be affected by the measure);

- However the same restriction will become a landfill ban when this measure only targets *municipal waste* (because municipal waste will generally have a TOC above five per cent and so will all fall within the scope of the ban).

Table 2 shows how this has been applied in each of the case study countries.

Table 2: Summary of landfill bans and restrictions in the six case study countries

Country	Targeted waste streams			Ban or restriction?	Additional details
	Source	Type	Properties		
Flanders	All sectors	Unsorted		Ban	:
		Separately collected		Ban	:Φ
		Residual/untreated	Combustible	Restriction	
Netherlands	All sectors	Unsorted			4
		Separately collected		Ban	Φ
		Residual/untreated			
Germany	Municipal waste ⁴	Unsorted		Ban	
		Separately collected		Ban	Φ
		Residual/untreated	TOC<3%	Ban	
Austria	All sectors	Unsorted			4
		Separately collected			4
		Residual/untreated	TOC<5%	Restriction	
Sweden	All sectors	Unsorted			4
		Separately collected	Combustible	Restriction	
		Residual/untreated	TOC<10%	Restriction	
Massachusetts	All sectors	Unsorted			
		Separately collected	Specific list	Ban	
		Residual/untreated			

⁴ Municipal waste in Germany regroups all wastes similar to domestic waste. Other sector specific wastes are usually handled under producer responsibility regulations.

Legend

4: These waste materials were already de facto excluded from landfills at the time the landfill ban/restriction was introduced

:: There is also an incineration ban on this waste stream

Φ: Thermal recovery is very small compared to material recovery

Table 3: Comparison of bans and restrictions with UK's priority materials

UK priority waste material	Austria	Flanders	Germany	Massachusetts	Netherlands	Sweden
Paper/card						
Food and garden waste				Garden waste only		
Glass						
Aluminium				In some forms		
Wood						
Plastic				Single resin, narrow-necked plastics		
Textiles						

Legend

Dark green: UK priority waste material is not covered in this country's landfill ban/restriction but is already considered to be diverted from landfill as a result of other instruments (e.g. producer responsibility obligations, deposit refund schemes)

Green: UK priority waste material is covered in this country's landfill ban/restriction

Yellow: UK priority waste material is covered in this country's landfill ban/restriction to a certain extent (see notes)

Orange: UK priority waste material is not covered in this country's landfill bans/restriction

Analysing and comparing landfill bans and restrictions in the six countries

We decided to analyse the landfill bans and restrictions of our six case study countries using a generic and simplified waste treatment chain diagram. Such a diagram sets out the main operations (sorting, treatment, recovery, disposal), represented in the boxes, of a typical waste treatment chain and highlights the waste streams that come from one to the next operation. We have used different colours to show the types of waste streams circulating between the operations. The box labelled incineration can be labelled treatment or recovery depending on a country's own definitions and the degree of energy recovery that takes place.

Figure 1: Flow of waste streams in a traditional waste treatment chain

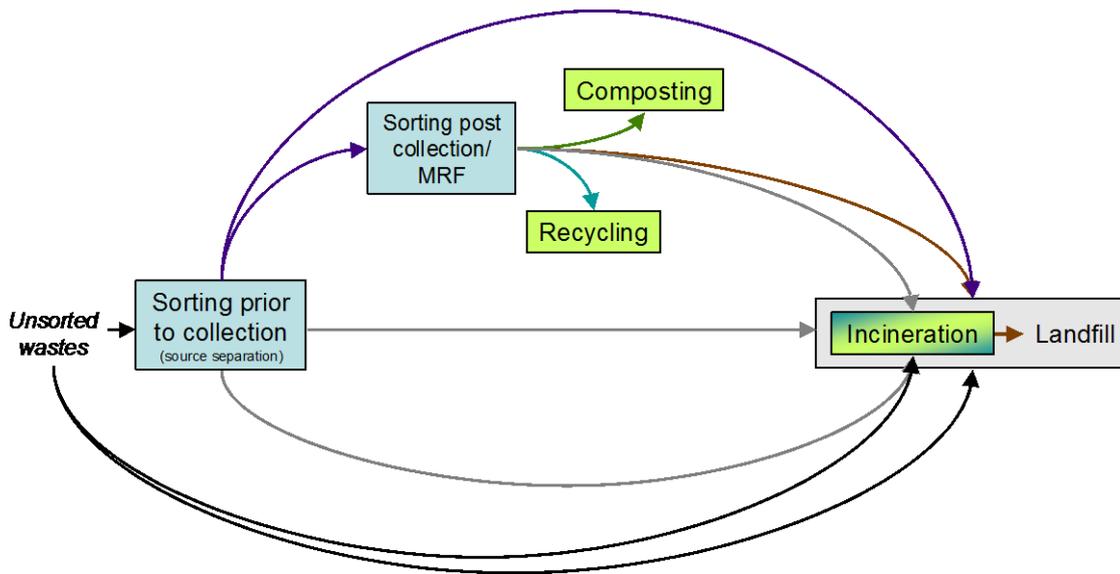
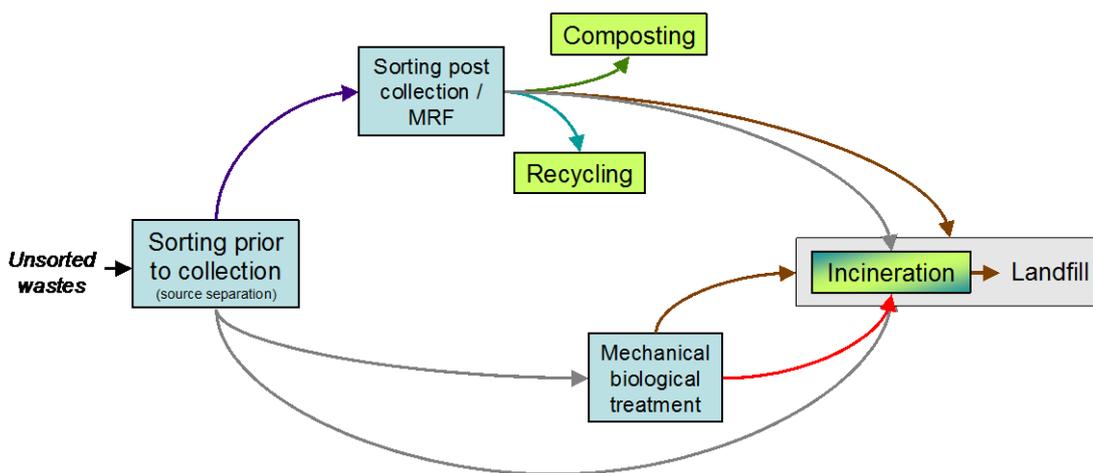


Figure 2: How landfill bans or restrictions may alter the waste treatment chain



Types of waste streams

	Untreated residual waste
	Separately collected waste materials (biowastes and recyclates)
	Recyclates (paper and cardboard, glass, metals, plastics, bulky waste, textiles, WEEE)
	Biowaste (food waste, garden waste)
	Treated residual waste
	High calorific fraction

Composting includes anaerobic digestion and other biological treatment

Types of operations

	Disposal
	Treatment
	Recovery
	Treatment and/or recovery

How we used the diagram

For each country, we have adapted the generic diagram to reflect the situation before and after the landfill bans or restrictions and take into account the particularities of each country's waste management situation. This enables easier comparison across case studies.

What happens to separately collected waste materials in the diagram?

We show, in a very simplified way, that separately collected waste materials usually go to a sorting facility where the unsuitable/contaminated fractions are removed and sent for disposal, either to landfill or incineration. The useful fraction is then sent for actual recovery in a recycling or composting facility. In practice, this two-step operation may be performed in a single facility. There may also be many more than just one stream of recyclates.

What the diagram does not show

Because this would become too complex in a single diagram and also because it does not appear relevant to our analysis, the diagram does not represent certain intermediate operations such as collection and storage nor does it detail what actually goes on in the recycling and composting operations. In addition we have not represented the myriad of available treatment technologies (pyrolysis, anaerobic digestion) or the output of each one (biogas, energy, compost) because we wanted to focus only on the technologies that had been mentioned to us during our interviews.

3. Objectives

Table 3 sets out the main objectives of the bans and restrictions in each country, as explained to us by the stakeholders interviewed. To an extent, this was of course a subjective assessment that reflects their professional role (e.g. a technical expert was more likely to cite specific environmental problems associated with landfill; a chief executive of a waste association or department head, to focus on public pressure for alternatives). Objectives were also, understandably, not viewed as mutually exclusive and often a range was cited without a particular emphasis placed on any one factor.

Table 3: Objectives of landfill bans and restrictions in the six countries studied

	Reduce dependency on landfill	Reduce environmental impact of landfill	Material recovery	Recover energy from waste
Flanders	λ	λ	λ	
Netherlands	λ	λ	λ	
Germany		λ	λ	
Austria		λ		λ
Sweden		λ		λ
Massachusetts	λ		λ	

We did find that the objectives cited for the bans or restrictions tended to reflect the nature or state of advancement of a country's waste policy. Countries such as Germany with relatively high levels of material recovery before the introduction of bans tended to focus on residual waste, whereas those with lower levels of material recovery such as Massachusetts focussed bans on separately collected recyclable or compostable materials.

In all cases however, the main rationale behind landfill bans and restrictions studied was reducing dependency on landfill and its environmental impacts, although their design reflects the differences in specific objectives referred to above. This rationale was expressed in different ways: some interviewees emphasised the problem of water and soil contamination and the cost to the taxpayer of remediation activities, while others emphasised methane emissions from biodegradable waste. Without exception, landfill was viewed as the least desirable option in the waste hierarchy and all interviewees believed that a shift away from landfill was a good thing for biodegradable waste in particular.

Energy policy considerations did not feature strongly in the initial motivations cited for the bans and restrictions, despite many countries experiencing an increase in energy-from-waste as a result of bans and restrictions, as well as other supporting measures. Stakeholders mentioning energy as a current driver tended to make the point that energy-from-waste is a by-product, or 'nice to have' aspect of landfill diversion, not a significant driver in its own right, and even with high levels of energy efficiency, energy-from-waste is not necessarily categorised as a recovery operation in a number of countries.

We did detect a difference in approach between the European countries and the US: the European approach seemed to be more principles/values driven, with many interviewees citing the concept of the waste hierarchy and avoiding remediation costs as the main rationale for the bans or restrictions, while the US example seemed more pragmatic, focused on developing markets for recycled materials.

4. Supporting instruments

One message emerging from the research very strongly was that landfill bans and restrictions had been deployed as one instrument in a range of fiscal, regulatory and other interventions aimed at moving waste away from landfill: in other words, bans and restrictions were necessary, but not sufficient.

Table 4 summarises the range of supporting measures employed by our six case study countries, and we explore the most significant supporting measures in more detail below.

Table 4: Range of instruments used to support landfill bans/restrictions

Instruments	Austria	Flanders	Germany	Massachusetts	Netherlands	Sweden
Landfill taxes	Green	Green	Blue	Yellow: High disposal fees	Green	Green
Moratorium on landfill	Blue	Blue	Blue	Blue	Green	Blue
Incineration bans/restrictions	Blue	Green	Blue	Green	Blue	Blue
Incineration taxes	Green	Green	Blue	Blue	Yellow: Tax exists but set at zero	Green
Moratorium on incineration	Blue	Blue	Blue	Green	Blue	Blue
Producer responsibility measures	Green	Green	Green	Green	Green	Green
Mandatory separate collection	Green	Green	Green	Yellow: Some municipalities only	Green	Green
'Pay-as-you-throw'/variable charging	Green	Green	Green	Green	Green	Green

Legend

Green: Instrument has been fully applied in this country

Yellow: Instruments exists but is limited in its use (see notes)

Blue: Instrument has not been used.

Landfill taxes/moratoriums

All but one of the countries studied also use landfill pricing in some way, either in the form of taxes or high disposal fees.

Germany stands out in our selection of case studies for having a strong preference for command and control measures over fiscal instruments, and as a result has not implemented a landfill tax. One of our interviewees from the Federal Environment Ministry commented: “A tax would have to be set high enough to have any effectiveness, and yet low enough to be politically acceptable.” Instead of fiscal instruments to steer waste away from landfill, Germany uses a combination of regulatory and voluntary measures: producer responsibility ordinances for household packaging and mandatory separate collection and recovery of commercial recyclable waste. Instead, local authorities in Germany are encouraged to separately collect and recover household biowaste but this is not a legally binding obligation.

All the other European examples studied used landfill taxes in combination with bans and restrictions. In most cases landfill taxes were described as playing a key role in the transition phase, during which municipalities and/or companies could continue to landfill banned or restricted waste if alternative capacity did not yet exist, subject to the tax being paid. As the landfill tax increased, it became cheaper to comply with the ban rather than negotiate an exemption and pay the tax. In this way, landfill taxes contributed to the compliance and enforcement regimes for the landfill bans and restrictions. In all the cases studied, the landfill tax was set at a high rate: none of four EU countries studied had landfill taxes lower than €75/tonne in 2008.

“It was decided in 1999 that the tax for landfilling untreated organic waste should be dramatically increased. The tax rate was set as €87/tonne, against seven euros/tonne in previous years. This meant that a landfill operator who was not yet complying with the landfill ordinance (i.e. still accepting untreated organic waste) now had low prospects of making money anyway.”

Christian Holzer, Lebensministerium, Austria

“The tax initially played a very important role in establishing alternatives to landfill. Given that exemptions were being granted relatively freely for banned waste based on lack of alternative capacity, it was important to also have an economic driver steering waste away from landfill.... We’d now like to see a discussion about the extent to which a high landfill tax is still needed, now that landfilling has declined to a very low level.”

Anders Hedenstedt, Avfall Sverige, Sweden

“The landfill and incineration bans are flanked by a well-considered policy of levies. Their aim is to alter the costs of waste disposal and treatment in order to reflect the waste hierarchy philosophy. Since 2007, the landfilling of combustible wastes has been made more expensive than incineration. Only landfilling of residual wastes, i.e. wastes that result from incineration and recycling, get a lower tax treatment.”

Jan Verheyen, OVAM, Flanders

In addition to a landfill tax, the Netherlands has had a moratorium on new landfills, and the expansion of existing landfills, since 1994.

Incineration bans/restrictions

Two out of our six case study countries have taken measures to ban or restrict recyclable waste from being incinerated as well as landfilled.

- In Flanders, separately collected waste materials have been banned from incineration (as well as from landfill) since 1998. Unsorted household and industrial waste has been banned from incineration since 2000 (they were banned from landfill in 1998). Some separately collected waste materials may go to energy-from-waste plants for the purpose of renewable energy, but only if their calorific content is 11,500kJ/kg or more.

“The incineration ban was adopted to provide a counter-balance to the landfill ban, by ensuring that incineration doesn’t become the only way of dealing with waste and that efforts in waste prevention and recycling still get continuous support.”

Jan Verheyen, OVAM, Flanders

- All the waste materials that are banned from landfill in Massachusetts are also banned from incineration, with the exception of tyres and wood.

Incineration taxes/moratoriums

Only three out of the six examples had implemented an incineration tax alongside a landfill tax, and only one had implemented a moratorium on new incineration capacity.

- Austria and Flanders have low incineration taxes of €7/tonne and €6.8/tonne respectively, compared to landfill taxes of €87/tonne and €75/tonne respectively.
- The Netherlands' legislation has the provision for an incineration tax, but it is currently set at zero and it is unlikely to be increased to any significant sum in the near future. There was a moratorium on new incineration capacity in 1994, but this was lifted in 2000.
- Sweden has had a tax on the incineration of household waste since 2006, its level dependent on the combustible content of the waste, whether the facilities produce electricity, and if so, how efficiently. The tax on incinerating household waste in a facility that does not produce electricity is SEK487 (£40)/tonne, slightly more than the landfill tax of SEK435 (£35.50)/tonne, but drops to only SEK83 (£6.75)/tonne for electricity production at 20 per cent efficiency. The incineration tax is viewed by the waste industry as successful in terms of diverting waste to more efficient energy-from-waste plants, but unsuccessful in terms of ensuring that recyclable waste is not incinerated in the first place.
- Massachusetts has no incineration tax but has enforced a moratorium on the expansion of incineration capacity in the state since 2000, due to concerns about incineration emissions and the desire not to undermine the state's recycling industry.

Mandatory/incentivised separate collection for certain wastes

All the case studies had, alongside landfill bans and restrictions, implemented some sort of mandatory separate collection for certain wastes, and all have used pay-as-you-throw (PAYT) systems, in some guise and to some extent, to increase household recycling rates.

- Austria's 1993 packaging waste ordinance requires the separate collection and reuse/recovery of all metal, plastics, glass and paper packaging. In the same year, an ordinance on 'the separation of materials generated during construction' required that groups of construction materials be separated if they exceed certain threshold levels. The separate collection of biodegradable waste from households and commercial sources has been mandatory since 1995, and since 2001 a compost ordinance has regulated the type and origin of input materials for compost.
- Flanders has a mandatory system of separate collection of materials that could either be recycled or incinerated, as well as for hazardous waste. Household and commercial/industrial wastes that require separate collection include wood, metal, glass, paper and cardboard, as well as textile and vegetal waste.
- With no landfill tax, the German system relies on a combination of regulatory and voluntary measures: producer responsibility ordinances for household packaging, whereby kerbside collection and sorting of recyclables is financed by packaging producers and retailers; biowaste, where many local authorities have introduced separate bins for food and garden waste (although this is not mandatory); and wood, to encourage environmentally-sound recovery. Since 2003, Germany also has an ordinance on the management of municipal wastes of commercial origin, which requires paper, cardboard, glass, plastic, metals and organic wastes (wastes from kitchens, canteens, markets, parks and gardens) to be kept separate and consigned to suitable recovery operations.
- Cities and towns in Massachusetts have the authority to establish mandatory recycling initiatives at a local level, and approximately 35 per cent of all communities are covered by a PAYT programme which is intrinsically linked to the compliance system for the landfill bans (see section II, 6).
- In the Netherlands, municipalities have been obliged to provide separate collection of household organic waste since 1994, and many municipalities implement either mandatory or incentivised separation of recyclables.
- Sweden has had legislation requiring households to sort waste into separate streams to facilitate collection under its extended producer responsibility legislation since 1994, and both households and businesses must sort combustible waste. However, the Swedish system is still largely reliant on bring centres and so enforcement is limited.

5. Results

Interviewees in all the countries studied believed that the landfill bans or restrictions had, to varying extents, succeeded in achieving their objectives. There are two main caveats to this statement. Firstly, as highlighted previously, while countries shared the general objective of reducing reliance on landfill, there were differing emphases on what should replace landfill; and secondly, many interviewees stressed the difficulties of attributing success to landfill bans or restrictions specifically, due to the wide range of supporting instruments employed and the interactions between them.

Table 5 compares the treatment of municipal waste (or its nearest equivalent) by taking the year before the introduction of the landfill ban/restriction⁵ and comparing it with the most recent year for which we have figures.

Table 5: Summary of results across countries, showing percentage share of treatment technologies before and after the introduction of landfill ban/restriction initiatives

Share of treatment	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	35	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			28	37
Biological treatment	15	17	20	23	15	17	9	9	40 R	51 R	10	12
Other	15 MBT	18 MBT	1 RU	1 RU 2 MBT		8 TR 5 OTR						

Notes: R = recovery, 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.

⁵ (Or the year before the implementation of the first ban/set of bans if there are more than one)

Impact on recycling, composting and incineration

All of our case study countries had relatively high recycling and composting rates before or shortly after bans and restrictions were introduced, which makes it difficult to make a strong statement about effects on alternate treatment.

- Austria first introduced restrictions in 1997, and set a deadline of 2004 for total compliance. By 1999, 50 per cent of municipal waste was already separately collected for recycling and composting.
- In 1997, the year before Flanders introduced bans on the landfilling and incineration of separately collected waste materials, 51 per cent of household waste was already separately collected.
- Germany was already recovering 40 per cent of municipal waste in 1997 and incinerating 20 per cent of municipal waste in 1997, four years after the first introduction of the landfill ban, and almost ten years before the deadline for total compliance.
- Massachusetts' total recycling and composting rate was 30 per cent in 1992, when the landfilling and incineration bans on glass and metal containers and garden waste came into force.
- The Netherlands was already recovering 40 per cent in 1995, the first year the landfill ban came into force, through reuse, recycling, composting or energy from waste from activities other than incineration.
- Sweden was recycling 28 per cent and composting ten per cent of household waste in 2000, two years before the first ban was introduced and despite an incineration rate of 38 per cent.

However, in all cases the combined effect of landfill (and in Flanders' and Massachusetts' cases, incineration) bans and restrictions, as well as the package of supporting measures including fiscal instruments, resulted in increases both in recycling and composting rates, and, in most cases, incineration rates.

Austria

In the space of five years, Austria reduced direct landfill of municipal waste from 29 per cent (1999) down to under eight per cent (a decrease of 70 per cent in tonnage). This dramatic drop in landfilling saw a resulting shift into thermal treatment. Less than four per cent of municipal waste went to landfill in 2006, and it is expected that this figure will be zero in 2009. Recycling and composting rates in Austria did not seem to be affected by the ban, targeted as it was at residual waste.

Figure 3a

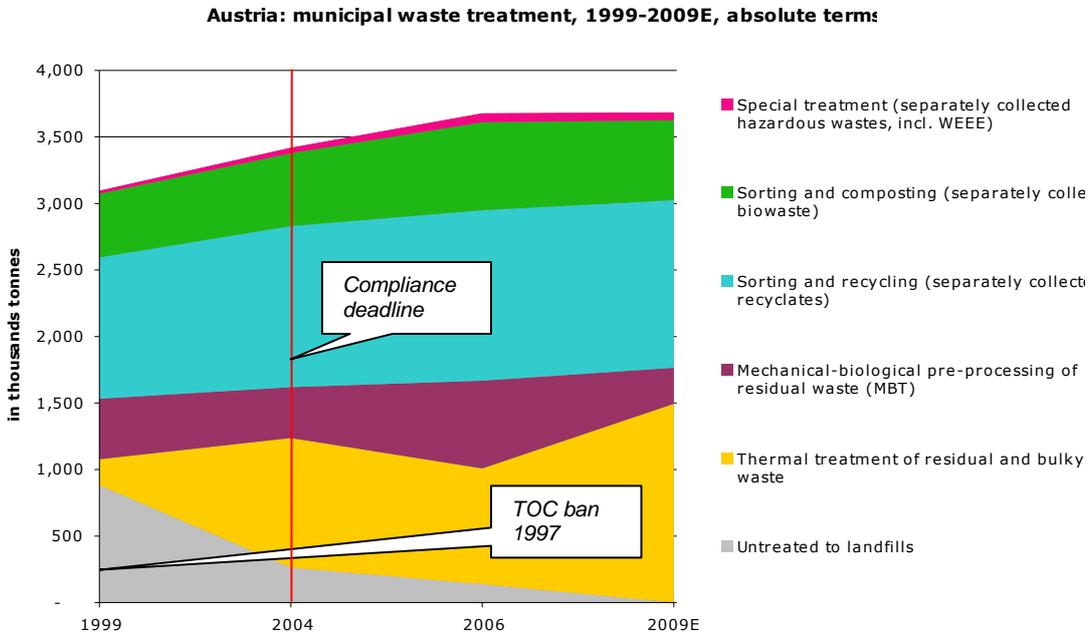
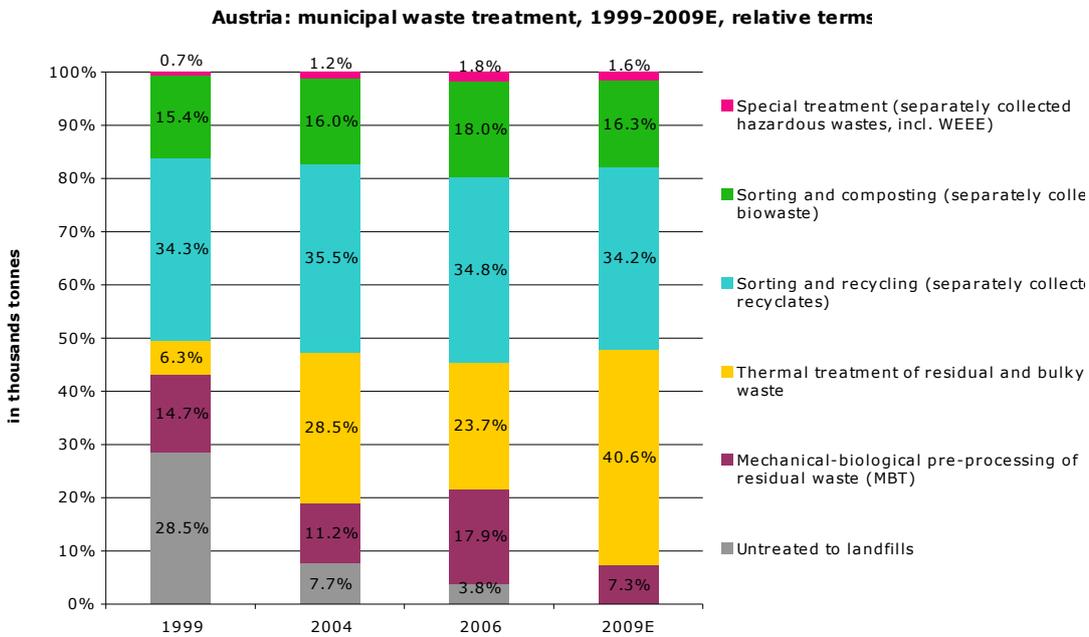


Figure 3b



Flanders

Landfilling of household waste in Flanders had already more than halved between 1991 and 1998 prior to the introduction of the landfill and incineration restrictions, probably in response to the introduction of mandatory separate collection during the mid 90s.

The incineration bans have been successful in reducing Flanders' dependency on incineration compared to 15 years ago. From 36 per cent in 1991, the share of incineration is now just 25 per cent and has been stable since 2002. The significant drop in incineration rates to 22 per cent in 1998 (from 25 per cent the previous year), followed by an increase again in 2000 (to 24 per cent) can be interpreted as the combined effect of the incineration and landfill bans: from 1998, separately collected waste materials could no longer be incinerated (nor sent to landfills) so were pushed towards reuse, recycling, and composting; while in 2000, combustible residual wastes cannot be sent to landfill any more so were pushed towards incineration instead.

Figure 4a

Flanders: municipal waste treatment, 1991-20

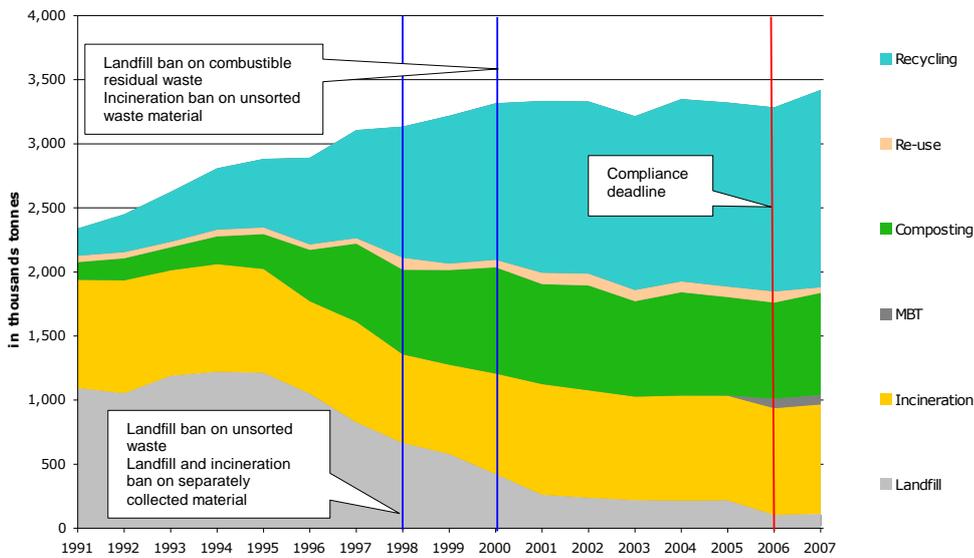
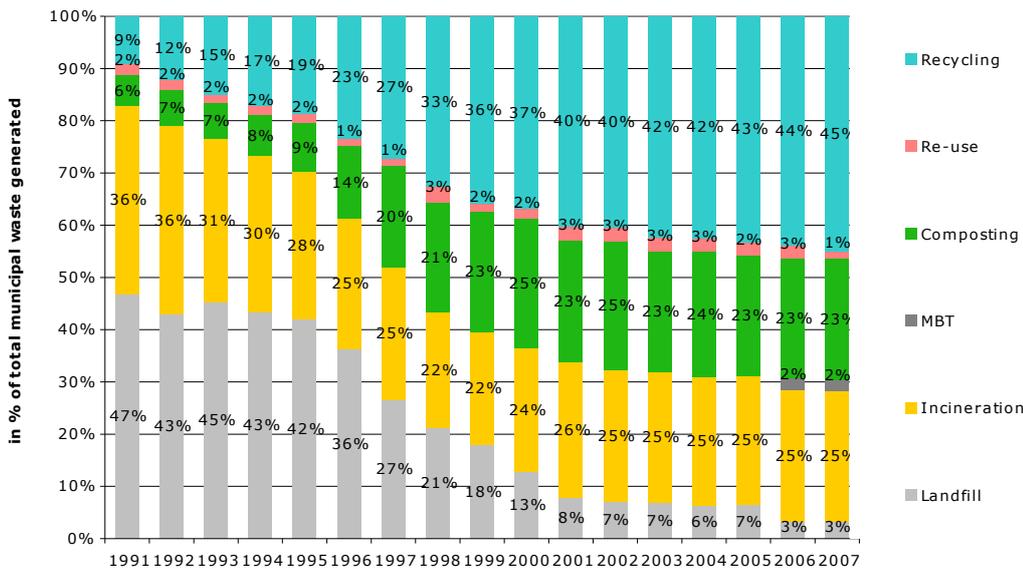


Figure 4b

Flanders: municipal waste treatment, 1991-200



Germany

The German landfill ban contributed to a dramatic decline in municipal waste landfilled. In 2001, the year of the Waste Storage Ordinance, 27 per cent of municipal waste was landfilled. By 2006, the year after the compliance deadline, this had fallen to one per cent. Recycling, composting and thermal recovery have all seen increases as a result, while incineration rates have increased slightly.

Figure 5a

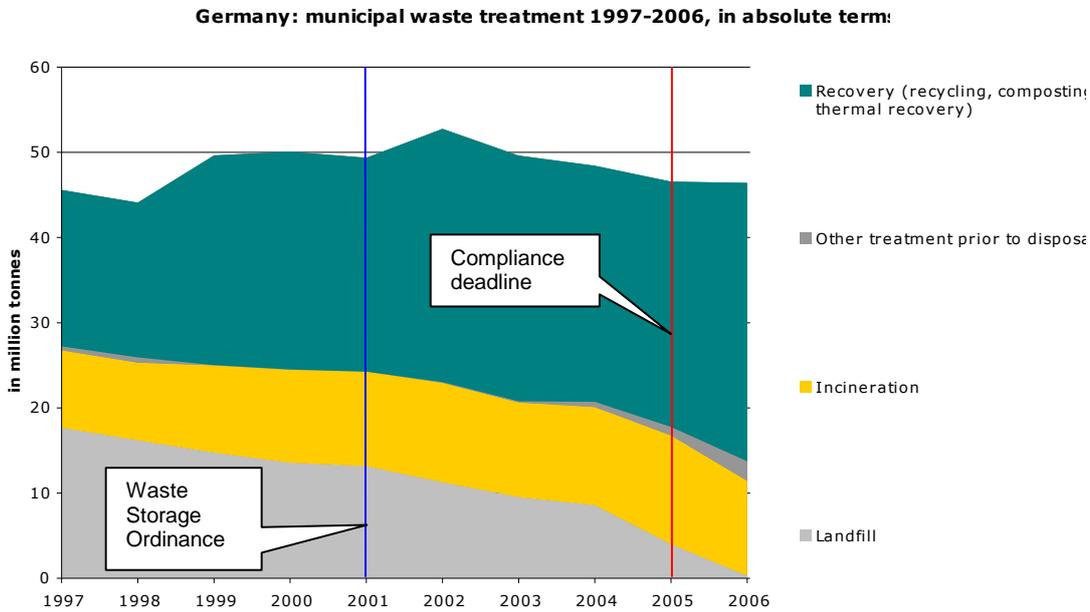
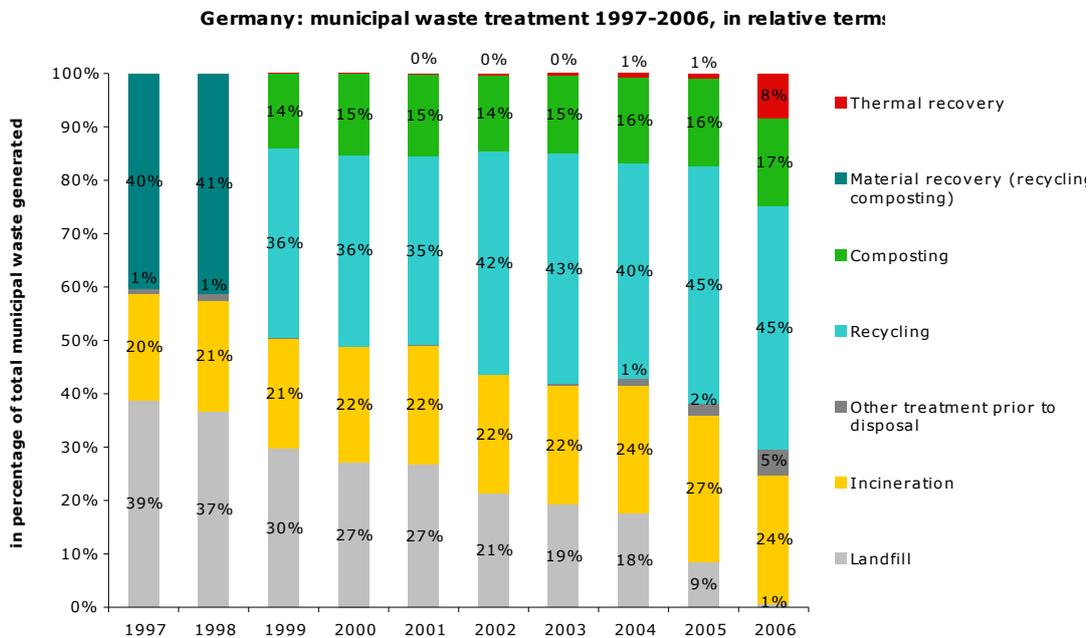


Figure 5b



Massachusetts

Massachusetts now recycles and composts over 40 per cent of its municipal waste and 66 per cent of its construction and demolition waste, an overall recycling rate of 47 per cent in 2008. It is on track to meet its recycling target for total waste of 56 per cent by 2010, but ten per cent net of total waste is currently exported to neighbouring states (net export is not broken down into waste types and so is not included in the municipal waste graphs below). Relative and absolute incineration of municipal waste has fallen since the incineration bans were introduced.

Figure 6a

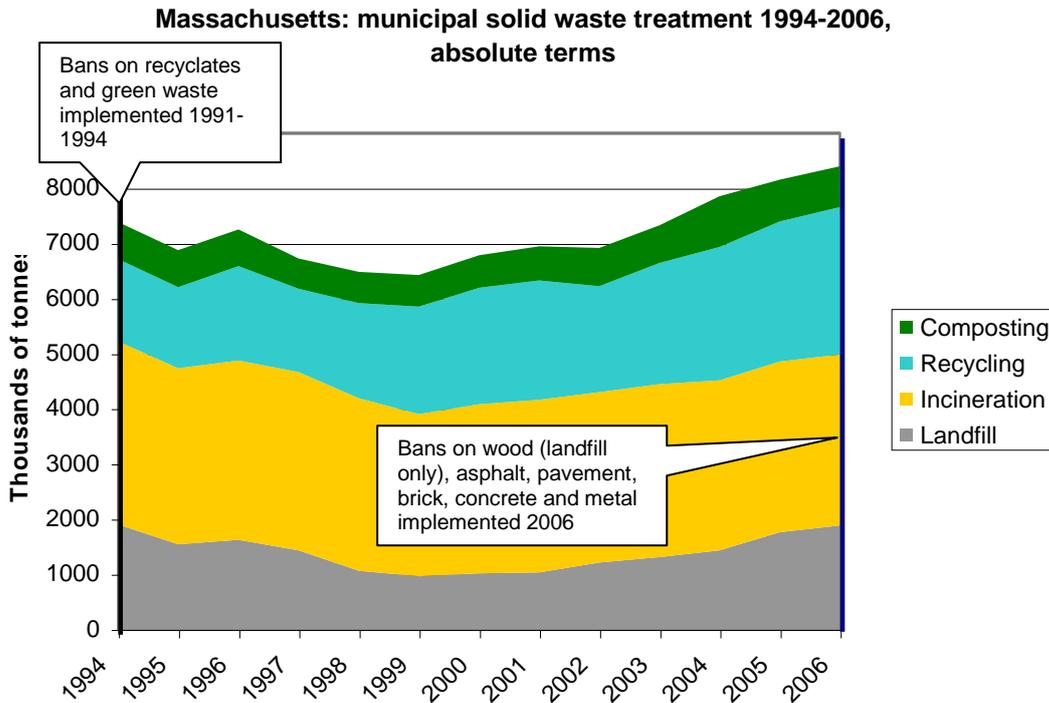
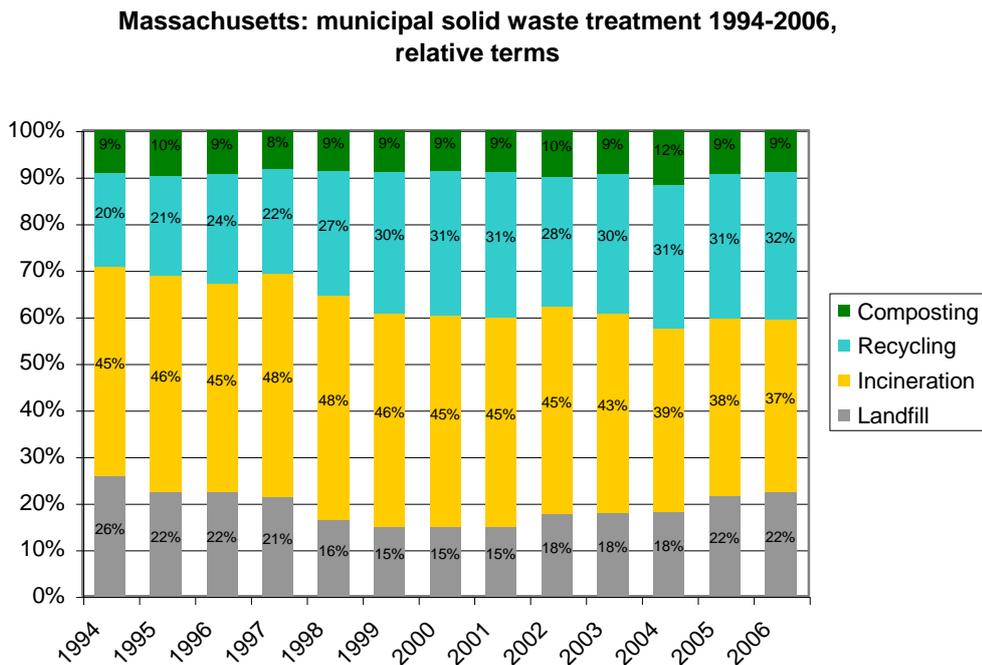


Figure 6b



NB: more waste was imported into Massachusetts in 1994 than was exported so this was not included in the table above. Net export figure for 2006 includes both municipal and non-municipal waste and is not broken down into separate categories. We have made the assumption that the majority of exported waste is non-municipal.

The Netherlands

Landfilling of household waste in the Netherlands peaked in 1991, one year before the landfill ban was announced. Since then it declined to three per cent in 2004, although the last few years have seen a slight increase. Both incineration and 'recovery', defined in the Netherlands as reuse, recycling, biological treatment and some other forms of thermal recovery, have benefited from this decline in landfill. In 2006 the Netherlands recovered 82 per cent of its total waste arisings, one per cent short of its 2012 target to increase the level of waste recovery to 83 per cent. 81 per cent of commercial and industrial waste was recovered and 13 per cent incinerated; and 98 per cent of construction and demolition waste was recovered.

Figure 7a

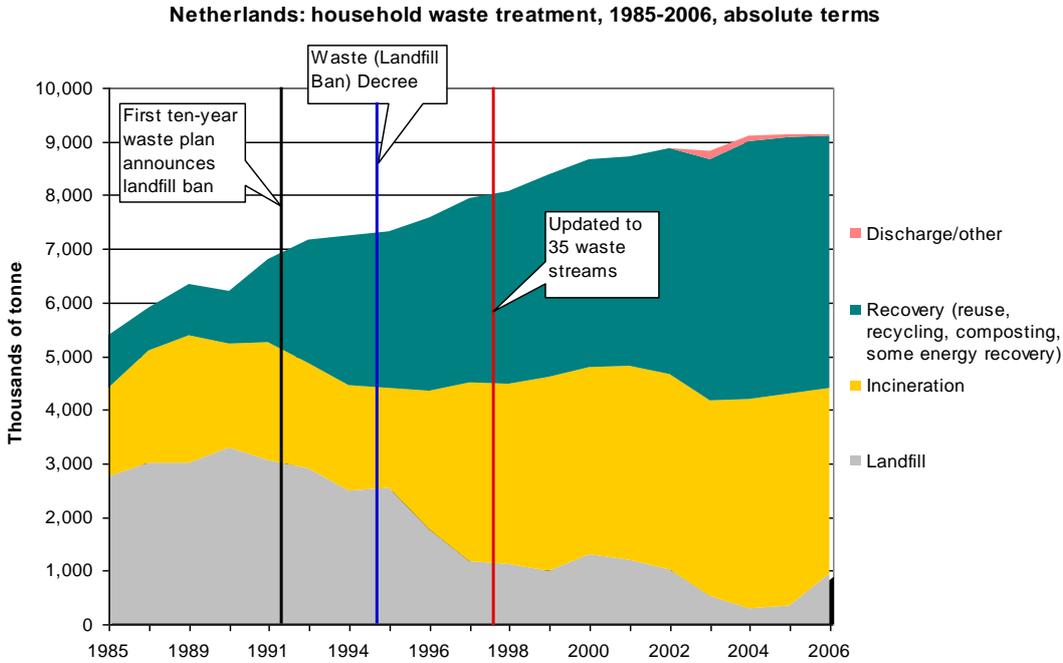
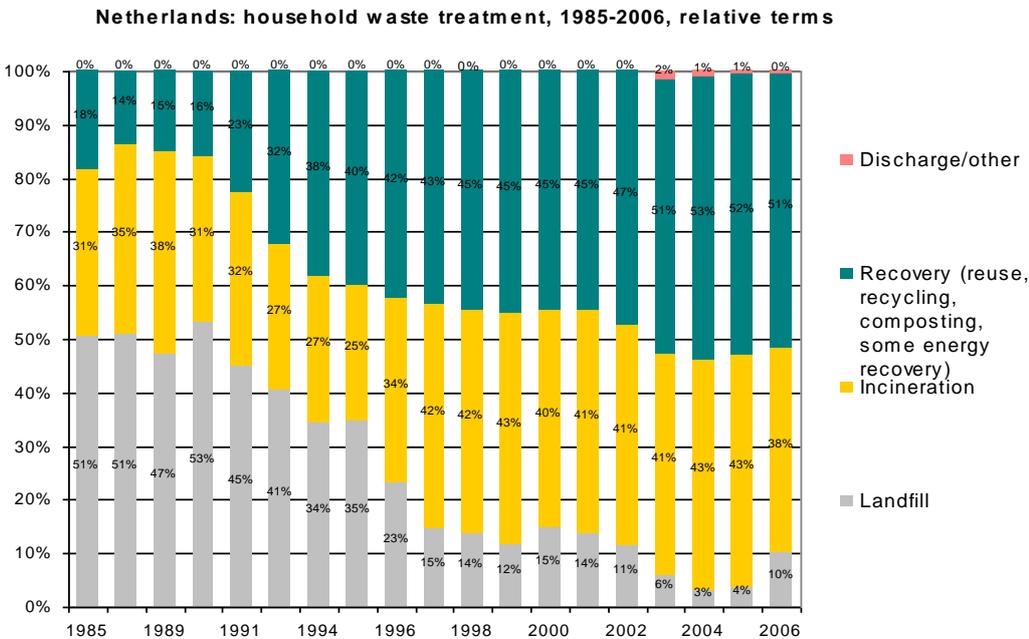


Figure 7b



Sweden

Landfill as a percentage of final disposal for household (municipal in UK terms) waste in Sweden had already started to decline before the announcement of the ban on landfilling combustible waste in 2000. In 2007, two years after the ban on landfilling organic was implemented, Sweden landfilled only four per cent of its household waste. Material recovery, biological treatment and incineration have all increased as a result of the significant decline in landfilling, and Sweden will meet its 2010 target of recycling and composting 50 per cent of all household waste.

Figure 8a

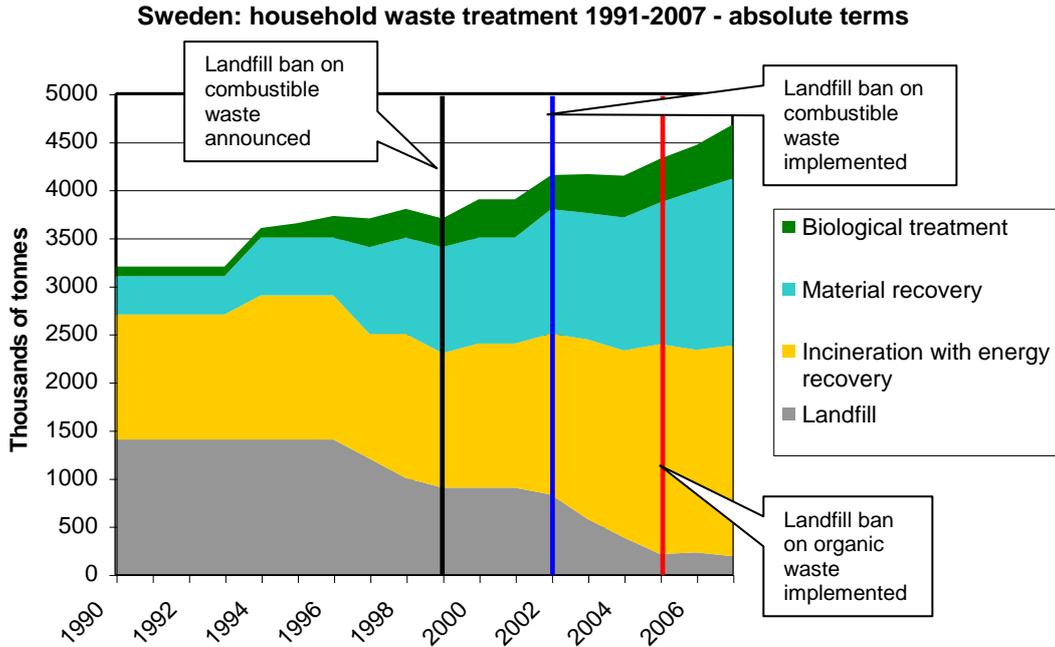
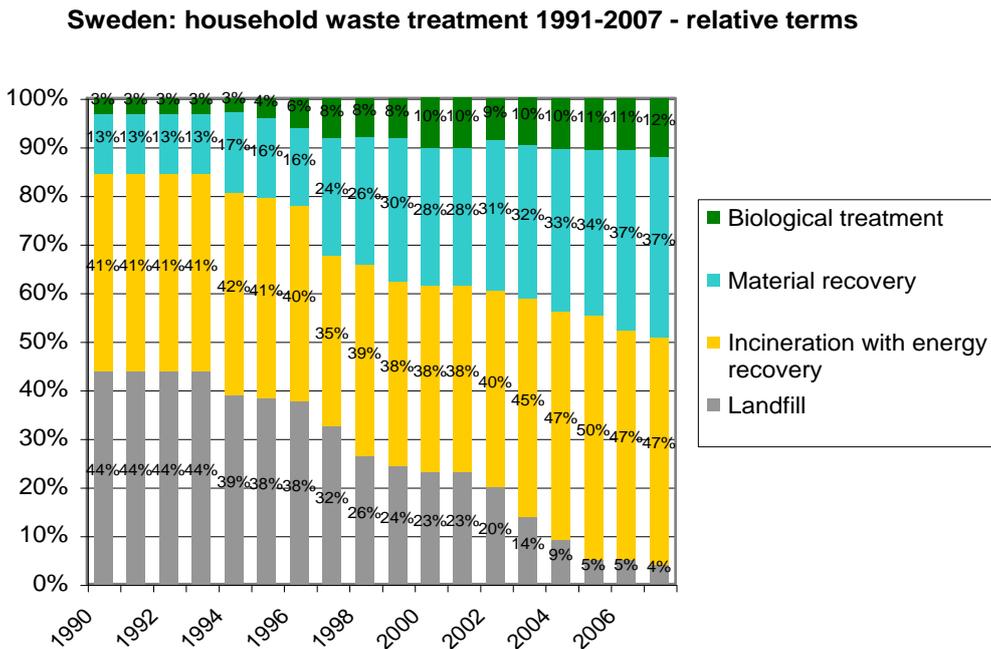


Figure 8b



The role of MBT

Although it is difficult to generalise, mechanical biological treatment (MBT) did not seem to be viewed as a desirable treatment option and as a result was not mainstream. Concerns were raised over costs (in the Netherlands MBT is seen as having a lower capital cost but a having higher variable cost), the stability of markets for the end 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. 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.

Unforeseen results

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. The latter had to apply for exemptions to allow them to continue landfilling untreated waste because it was not practical to truck it around the country. Massachusetts, by contrast, has had to rely on a steady net export of waste to neighbouring states: nearly 900,000 tonnes of Massachusetts' construction and demolition debris was landfilled outside the state in 2007, 45 per cent of the total generated.

The timetables of neighbouring European countries' landfill restrictions had unforeseen impacts on the implementation of other's 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.

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.

6. Practicalities

Lead times

In general, a long lead-time was seen as a key factor in the successful implementation of a landfill ban or restriction. Commentators in a number of our case study countries stressed the importance of a long lead-time combined with political certainty that the ban or restriction would be enforced after that date. In some cases a lead time was too long: one German stakeholder felt that the twelve years between the Technical Instructions on Municipal Waste (TASi) in 1993 and the 2005 deadline for final implementation of the regulations was perhaps excessive, and that the eight years originally proposed by the federal states or *Länder* would have been sufficient. However, another argued that the twelve-year period was necessary to bring the required infrastructure on stream, and that more legal certainty and supporting pressures and measures were needed (referring to the German decision not to tax landfill).

Other countries used lead times that were considerably shorter. In the case of Massachusetts, lead times of between two and four years were used depending on the material stream and the extent to which alternate treatment existed. Stakeholders commented that this system worked well as long as there was clarity both about the final deadline for compliance and about the exemption system that applied in the run-up to this deadline.

Exemptions

The major type of exemption used was in the 'transition periods' between the introduction of the bans or restrictions and the deadline for total compliance. During these periods, the landfill operator, the waste disposal company (if different to the landfill operator) or the municipality must make a representation to the competent authority on the basis that alternative capacity has not yet been developed. In general, exemptions are granted where genuinely needed, but in most cases the trajectory away from a reliance on landfill is reinforced by steadily increasing landfill taxes.

Compliance and enforcement

While compliance and enforcement were seen as important and a number of case studies reported problems with resourcing the necessary enforcement activities, it was interesting to find that this was not an area that was independently raised by stakeholders as particularly problematic. The main commonality was that while in theory responsibility for complying with landfill bans and restrictions rests with all parties involved in the generation, transfer and disposal of waste, in practice compliance rests largely on landfill operators: it is at the landfill site that loads are either accepted or rejected, and it is generally the landfill operators' records which are inspected for evidence of compliance.

That said, the nature of the compliance and enforcement systems tended to relate closely to the nature of each country's bans or restrictions. By far the most complex compliance and enforcement system is that of Massachusetts. This is unsurprising, because the state bans the landfilling or incineration of specific materials and products (for example glass and metal containers). The complexity lies primarily in the distinction between 'ongoing waste stream monitoring', which in practice requires disposal facility operators to visually inspect incoming loads, and 'comprehensive load inspections', where facilities must conduct detailed inspections of the types, amounts and sources of material entering the facility in a limited sample of waste loads each month. Ongoing waste stream monitoring is not expected to pick up hazardous waste such as batteries, tyres, white goods and cathode ray tubes but the guidance accepts that detecting banned materials such as plastic, glass or metal containers is difficult unless these materials are present in large quantities.

Further complexity is added by the two main exemptions to the bans. Firstly, facilities that do not accept waste in containers with a capacity great than five cubic yards do not have to conduct 'comprehensive' inspections. Secondly, loads originating from communities that have a recycling programme meeting certain criteria (for example, at least a fortnightly kerbside collection of recycling and garden waste) do not have to be inspected for 'hard to enforce' material streams such as glass, metal and plastic containers, paper, leaves and garden waste. Criteria for approved recycling programmes are updated every year to challenge communities to expand their recycling programmes. As a combined result of the system of monitoring and exemptions, it is clear that there is little to stop an aluminium can from going to landfill unless it actively enters the recycling system.

By contrast, the Netherlands' system for ensuring compliance with its landfill bans is very simple and Dutch commentators suggest this generally makes the approach easy to enforce and difficult to cheat (apart from problems with construction and demolition waste – see below). While the Dutch legislation sets out 34 waste streams that are banned from landfill (these categories range from the very broad – 'residual household waste', 'residual waste for trade services and government', 'waste from public spaces' – to the very specific – textiles, organic waste, plastic waste), the compliance system works purely on the density of the load. Waste with a density below 1100kg per cubic metre is automatically assumed to be biodegradable or combustible waste and is banned from landfill, unless a permit is presented that demonstrates an exemption based on lack of alternate

capacity, in which case it pays a high rate of landfill tax of nearly 90 euros/tonne. Waste with a density above this level (sludges, inert residues from recycling operations, contaminated soils) is eligible for landfilling and attracts a lower tax of approximately 15 euros/tonne. The system works well apart from for construction and demolition waste, which is banned from landfill but is very dense, resulting in some landfilling of this banned material stream.

Our other four examples have similar systems in which the final responsibility for complying with the ban or restriction is on landfill operators as the end of a chain of waste 'actors', whereby municipalities, businesses and waste haulage companies must be able to account for the volume and type of waste, and demonstrate that it was consigned to an appropriate waste management facility or company.

- In Austria, the waste owner, landfill operator, head of the acceptance inspection department and an external landfill supervisor each have their own compliance obligations. The latter role is generally an auditor hired by the local authority or province, who performs regular supervision, examines documentation and reports non-compliance to the competent authorities.
- Flemish landfill sites and incineration facilities are inspected by the environmental control department. Local authorities can also inspect landfill sites, and local people also tend to have a high level of interest in ensuring that a landfill site is properly run and complies with Flanders' bans.
- In Germany, waste owners that regularly deliver large amounts (over 2000 tonnes) of waste must document the compliance of waste with specific criteria based on the results of waste analysis done at least once a month, and hand this documentation to the landfill operator. The responsibility then lies with the landfill operator to make a visual inspection of the waste and check the accompanying documentation. If in doubt about compliance, the landfill operator conducts a control analysis, notifies the competent authority and finds temporary storage for the waste.
- The Swedish system works in a similar way. Landfill operators are responsible for developing their own system for ensuring that they do not accept banned waste loads from their clients, and must submit yearly reports to their local or regional branch of the Environmental Protection Agency on wastes accepted and rejected. Waste that requires further sorting before it can be landfilled will be sorted on site and will attract a higher gate fee.

Threat/reality of fines

In general, the stakeholders that we interviewed did not have accessible details about the level of fines given to those who landfilled banned or restricted waste. However, the overall impression was that monetary fines of significant amounts were relatively rare.

Stakeholder engagement

Central to the success of the bans and restrictions studied was effective stakeholder engagement, particularly the waste industry themselves, who generally played a key role in discussions and negotiations about targets of the bans, exemptions, lead times and the development of alternative treatment infrastructure.

In general, no substantial efforts were made to communicate the rationale for the bans and restrictions to the general public above and beyond communication to households about waste services in their area, recycling and waste prevention.

III. Conclusions and considerations for UK policy

An in-depth consideration of how the experiences of other countries might apply to the UK was not within the remit of this study, however our research does highlight a number of considerations for policymakers going forward, both in terms of commissioning further work in this area and in developing a similar policy for the UK. These considerations are set out in brief below.

Clear signals that there will be a ban or restriction. It was clear that successful enforcement of the ban, as well as the development of appropriate alternative infrastructure, were both dependent on clear communication from government to the waste industry, local authorities and other sectors that would be directly and significantly affected. Engaging stakeholders fully and early was viewed as a factor in the success of several countries' bans.

Sufficient lead times. This will depend on the waste stream banned and the availability of alternative treatment infrastructure.

A simple compliance system. The Netherlands weight-based system seems to work well for most banned waste streams apart from construction and demolition waste, whereas Massachusetts' complex system does not seem to have had as significant an impact.

A clear view of the overall objectives of a ban or restriction. In a number of the countries studied, notably Austria, and to a lesser extent Sweden, incineration was the greatest beneficiary of landfill bans and restrictions. Flanders is an impressive example of a country that has used phased landfill and incineration bans to achieve nearly 70 per cent recycling, reuse and composting, while decreasing its dependence on incineration. Any diversion from landfill towards energy-from-waste should be the result of a clear policy, not a default result of a landfill ban or restriction. Government should explore the use of policy instruments to discourage the incineration of recyclable or compostable materials, to ensure that they are treated as high up the waste hierarchy as possible.

Supporting instruments. These fall into three main categories. 1) Economic instruments: Bans and restrictions should be used in conjunction with a landfill tax during the transition period to reinforce the signal sent by the other measure. 2) Upstream measures such as a mandatory separation of banned/restricted materials for businesses (for example by building on the existing pre-treatment regulations in the Landfill Directive) and pay-as-you-throw measures for households. Widespread collection of household food waste is also a pre-requisite for the high rates of biological recovery seen in a number of the case studies. 3) Quality standards for recycled products and other similar 'pull' factors to drive markets and ease the implementation of bans or restrictions.

Resources to enforce. Enough resources should be dedicated to police the compliance and enforcement system, particularly during the transition period to back up signals from government.

Public support. Public support for bans and restrictions, and other instruments, could be built by relating landfill bans/restrictions to possible future product standards for recyclability, compostability and recycled content.

Appendix

1. The role of landfill bans in UK waste policy: twelve key questions for interviewees

The questions below were sent to interviewees ahead of the telephone interviews to give them a chance to prepare their answers.

Introduction

It would be very helpful to have brief written responses to these headline questions before we conduct the interview, preferably typed into a version of this document. This would help us to target the interview questions more effectively.

Questions

- 1. Cultural aspects:** Are there any particular cultural aspects of (insert country) which would explain why the landfill bans were adopted and/or why their implementation was successful/unsuccessful?
- 2. Competent authorities for waste management:** Who is responsible for waste legislation and implementation, waste management planning, licensing, monitoring and enforcement? Who is legally responsible for waste collection, recovery and disposal?
- 3. Infrastructure ownership and financing:** Who owns the waste collection, recovery and disposal infrastructure in your country? Who is the principal agent for the delivery of waste management infrastructure? How is new infrastructure financed?
- 4. Landfill bans/restrictions:** In what legislation do they appear? What are the main provisions of the legislation? What are their objectives and scope (waste streams, recipients)?
- 5. Motivation/rationale:** Why were landfill restrictions chosen as opposed to other instruments to achieve the same objective?
- 6. Reception by key stakeholders:** What were the reactions of the main stakeholders when the landfill bans were announced?
- 7. Achievements so far:** How successful have the landfill bans been in achieving their objectives? What have been the main chosen alternative treatment/disposal routes? Have there been any unanticipated outcomes?
- 8. Implementation - key success factors and challenges:** What are the main reasons for the successes or failures of the landfill bans/restrictions? What were the main challenges and what were their solutions?
- 9. Economic impact:** What has been the economic impact of the landfill bans/restrictions?
- 10. Relationship with other policy instruments:** Do other instruments target the same waste streams as the landfill bans/restrictions? How do the landfill bans interact with other waste policies, and with other government policies?
- 11. The future:** What are the next steps?
- 12. Lessons:** What are the lessons from your experience? If you had one piece of advice for the UK what would it be?

2. Comparison of main waste categories of each case study country with main UK waste categories

(Cells highlighted in blue are waste streams subjected to a landfill restriction or ban in each of the case study countries)

UK main waste categories	Austria	Flanders	Germany	Massachusetts	Netherlands	Sweden
Municipal waste	Labelled as 'waste from households and similar establishments' ⁶ 3.4Mt (2004) Includes residual waste; ⁷ bulky waste; waste materials collected separately; biogenic and hazardous household waste collected separately	Labelled as 'household waste' 3.3Mt (1999) Includes household waste, bulky waste from household and municipalities (includes garden waste and waste from private C&D); other municipal waste (market waste, street sweeping, waste from offices). Excludes commercial wastes	Labelled as 'urban or municipal waste' 46.6Mt (2006) Includes waste from private households and similar institutions; ⁸ municipal waste of commercial origin; ⁹ bulky wastes, market wastes, road sweepings, garden and park wastes	Labelled as 'municipal waste' 9.1Mt (65% of total waste) (2006) Covers household waste and commercial waste; includes all commercial solid waste (waste generated by stores, offices, institutions, restaurants, warehouses, and non-manufacturing activities). Excludes street sweeping	Labelled as 'household waste' Includes all waste originating from private households, excluding waste water and end-of-life vehicles	Labelled as 'household waste' Similar to UK definition Includes bins and bags (including waste for which producers have responsibility, bulky waste including garden waste, and comparable waste from shops, offices, restaurants and industries
Commercial waste	Wastes from establishments similar to households is classified above	Labelled as 'other sectors': including transport, telecom, supermarkets, railways, cleaning, recreation, aviation, wholesale business, garages 3.3Mt	Labelled as 'production waste' 56.1Mt Waste from trade and industry and from agriculture and forestry	Included in 'municipal waste'	Labelled as waste from trade, services and government Includes waste from offices, shops and services and waste from street sweeping	Most commercial waste is 'household waste'

⁶ Administrative facilities of trade, industry or public administration, from kindergartens and schools, hospitals, small businesses, agriculture, markets, and other sites of waste generation, insofar as they are related to municipal waste collection; this will include green waste, market waste, kitchen and canteen waste and street sweepings.

⁷ Residual waste similar to household waste from agriculture, trade, industry and from public institutions and markets is also mainly collected by the municipal waste collection services.

⁸ Wastes which are produced in private households in the course of private living, as well as in other comparable places of production such as homes or assisted living facilities.

⁹ Includes both commercial and industrial wastes which are similar to household wastes on the grounds of their nature or composition (also called "domestic-type industrial waste") and wastes from private and public institutions, with the exception of wastes which are produced in private households and similar institutions.

Industrial waste	Labelled as 'separately collected waste materials from trade and industry' 2.3Mt Excludes 'secondary waste' (from waste incineration, etc)	Labelled as 'waste from manufacturing industries' 7.4Mt Excludes 'waste from energy production'		Labelled as 'non-municipal solid waste' 4.9Mt (35% of total waste) Covers industrial waste and sludge, C&D waste, sewage sludge, as well as waste from energy production and MSW incineration, street sweeping and contaminated soil	Labelled as 'industrial waste' Includes oil refineries	Two different categories: - 'Industrial waste' (sector specific such as metal, pulp & paper, food, beverage & tobacco, etc) - 'Non sector-specific waste' (company waste in the form of packaging, pallets, etc)
Construction and demolition waste	Excludes 'excavation materials' 6.6mt	Same as UK definition 6.8Mt	Same as UK definition 196mt	Labelled as 'non-municipal solid waste'.	Waste produced when buildings, engineering works or roads are constructed, renovated or demolished.	Same as UK definition
Sewage sludge	Labelled as 'municipal sewage sludge' 264,000t (dry matter)	Two categories: - Sewage and refuse disposal - Water purification and distribution Very small quantities	Part of 'waste that can be managed like municipal waste'	Included in 'non-municipal solid waste'	Two categories: - Sewage and waste water treatment sludge - Water treatment	Same as UK definition
Dredged material	Labelled as 'excavation materials' 22mt	No such category	No such category	No such category	Labelled as 'dredging waste and soils'	No such category
Agricultural waste	Included in other waste categories, depending on type of waste	Labelled as 'agriculture and forestry waste'	Included in 'production waste'	No such category	Two categories: - Agricultural waste - Manure surpluses	Same as UK definition
Mining and quarrying waste	No such category	Same as UK definition Very small quantities	Same as UK definition 41.9mt	No such category	No such category	Same as UK definition
Other waste categories not categorised in the UK	Selected secondary waste: 2mt Other waste (miscellaneous); 18mt	Waste from energy production 0.9Mt			Energy production Car wrecks and tyres, ship cleansing waste	Waste from power stations, gas works, and heating plants Scrap vehicles
Total waste quantities	54Mt (2004)	21.8Mt (1999)	340.4Mt (2006)	14Mt (2006)	120Mt (2004)	60Mt (2006)

3. UK waste definitions for reference

<p>Controlled wastes: wastes that require a waste management licence for treatment, transfer and disposal. This comprises municipal/household waste, industrial and commercial waste, and construction and demolition waste (including special wastes) and, since 2006, agricultural waste.</p> <p>The main exempted categories comprise mine, quarry and farm wastes. Other legislation and procedures control radioactive and explosive wastes.</p>	Municipal waste	<p>This includes household waste and any other wastes collected by a Waste Collection Authority, or its agents, such as municipal parks and gardens waste, beach cleansing waste, commercial or industrial waste and waste resulting from the clearance of fly-tipped materials.</p> <p>Household waste: includes waste from household collection rounds, waste from services such as street sweeping, bulky waste collection, hazardous household waste collection, litter collections, household clinical waste collection and separate garden waste collection, waste from civic amenity sites and wastes separately collected for recycling or composting through bring/drop off schemes, kerbside schemes and at civic amenity sites.</p>
	Industrial waste	Waste from any factory and from any premises occupied by an industry (excluding mines and quarries).
	Commercial waste	Waste arising from any premises which are used wholly or mainly for trade, business, sport recreation or entertainment, excluding municipal and industrial waste (includes end-of-life vehicles and ships).
	Construction and demolition waste	Includes excavated soil and miscellaneous materials as well as hard materials, such as brick, concrete and road planning.
	Sewage sludge	Sewage sludge undergoes treatment and then most is spread on land as fertiliser. Some densely populated areas incinerate the sludge or put it through an anaerobic digestion process to recover energy or reduce its volume.
	Dredged material	Dredging waste is that created to maintain waterways. It is usually disposed of in lagoons where excess water drains. Some sands and silts can be removed for reuse as construction materials.
	Agriculture	Excludes manure or straw. Manure and slurry when spread at the place of production, for the benefit of agriculture, will not be considered waste under the new controls.
<p>Non-controlled wastes</p>	Agriculture	Manure and straw (farm waste)
	Mining and quarrying	Mining and quarrying waste is two-thirds comprised of quarrying, china clay extraction and collieries. The other third is clay, coal wastes and chemical residues. Most is disposed of in landfill but some can be reused as aggregate in the Construction industry.

References to published material

9. This section should be used to record links (hypertext links where possible) or references to other published material generated by, or relating to this project.

The report in section 8 is a summary evidence review of six individual case studies: of Austria, the Flanders region of Belgium, Germany, Massachusetts, the Netherlands and Sweden. All six case studies have been sent to Defra in pdf format independently of this form.