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REPORT ON

**IMPLEMENTATION OF THE LANDFILL DIRECTIVE
IN THE 15 MEMBER STATES
OF THE EUROPEAN UNION**

Submitted to:

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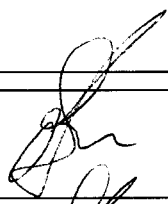
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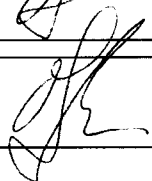
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EXECUTIVE SUMMARY

Introduction

This Report presents the results of a study into the implementation of Council Directive 1999/31/EC on the landfill of waste undertaken on behalf of the European Commission (EC).

The 'Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste' (the Landfill Directive) was published in the Official Journal of the European Communities on the 16th July 1999. Member States were required to bring into force the laws, regulations and administrative provisions necessary to comply with the Landfill Directive not later than two years after its entry into force i.e. the 16th July 2001.

The Landfill Directive sets requirements for the authorisation, design, operation, closure and after-care of landfills. The reduction of the biodegradable fraction of municipal waste going for landfill disposal is given specific targets in the Landfill Directive. Some wastes may no longer be accepted in landfills and only wastes that fulfil certain acceptance criteria may be disposed of in the appropriate class of landfill. In addition to the Landfill Directive, the Council Decision 2003/33/EC established the criteria and procedures for the acceptance of waste in landfills (commonly referred to as 'WAC').

Methodology

The study and questionnaire was structured on the six tasks required by the EC. It was stipulated in the Technical Annex to the tender documentation that; Task 1 on the 'changes in amounts and types of waste going to landfill', Task 2 on the 'presence of illegal/uncontrolled landfill', and Task 6 on 'measures taken to divert used tyres', were to be detailed on the basis of existing information. Therefore, where possible, information available in the public domain has been referenced throughout this Report. The Project Team undertook intensive searches of nationally and locally available information, but in some cases detailed data was not available.

It became evident that the implementation of this methodology provided major challenges. The Project Team endeavoured to obtain robust accurate information from the various representative of government and industry within the Member States. However, this was often not possible with the representatives in many cases unable to provide the data required. The Project Team has therefore been unable to provide as much detail as was initially envisaged for certain aspects of the tasks detailed in the tender documentation.

The main tools used for the completion of this study were a governmental questionnaire and an individual landfill site operator interview in each Member State. The questionnaire was used to elicit responses, in a structured format, from the appropriate government bodies. The interview of the landfill operators was at a single landfill in each Member State, selected by that government's representative. These are also referred to as 'case studies'.

The combination of the interview with a government representative and the interview with the landfill operator ensured that the full range of data required to fulfil the objectives of this study could be obtained. Where data was not available from these representatives local NGOs and bodies representing the waste management industry were approached, in addition to the literature review.

Task 1

Task 1 of the Technical Annex to the tender documentation requires this study to describe how the amounts and types of waste going to landfill have changed since the application of the Landfill Directive on the basis of existing information.

The data shows that the quantity of municipal solid waste arisings continues to increase across Europe. However, with the exception of Greece, the amount of municipal solid waste being disposed of to landfill by the Member States is in most cases decreasing or, at worst, levelling off. This reduction in the quantity of municipal solid waste being disposed to landfill reflects the Landfill Directive's requirement for a reduction in the quantity of biodegradable waste being sent to landfill. It would appear that certain countries such as Germany, Belgium and the Netherlands, took action in the mid 1990s (or earlier) to reduce the amount of municipal waste being disposed to landfill enabling them to fulfil their requirements and divert biodegradable municipal waste from landfill. For other countries that are more heavily dependent on landfills for the disposal of their municipal solid waste such as Ireland, the UK and Portugal, the decrease in municipal solid waste being sent to landfill would appear to coincide with the implementation of the Landfill Directive.

Task 2

Task 2 of the Technical Annex to the tender documentation requires this study to assess the presence of illegal/uncontrolled landfills on the basis of existing information. It can be seen from the details provided in this report that the existing information is often sparse and incomplete despite an extensive literature review and discussions with government representatives and NGOs.

Ten Member States have reported zero illegal landfill sites. These countries pointed out that they have had other (non-EU) legislation requiring the permitting of landfills in place for many years. Consequently, in addition to effective enforcement activities, the government representatives of these Member States are confident that there are no illegal landfills.

Six Member States have reported a significant number of illegal landfills during the course of this study, and 2 reported 'no data'. Six Member States have relevant data because they have passed specific legislation that identifies the problem of illegal landfills.

The difference between the majority of the Member States who report that they have zero illegal landfills and the four Member States that report having in excess of 950 illegal landfills, gives rise to the conclusion that the methods by which illegal landfills are being measured between these countries are not comparable. It appears likely that some of those Member States reporting illegal landfills are counting incidents of fly-tipping, historic landfills, or permitted landfills that are having regulatory action progressed against them. Conversely, it is possible that those Member States reporting zero illegal landfills do not have the internal reporting mechanisms regarding illegal landfills or are defining all illegal landfills as fly-tipping incidents. For example the UK reported having no illegal landfill sites but a governmental report recognised that there are illegal landfills in Northern Ireland.

The reasons for the existence of illegal landfills would appear to be country specific, except for the obvious economic reason, which is the avoidance of the gate fees at regulated landfills. Those Member States that provided the most useful information with regard to numbers of illegal landfills also gave valuable back-up information regarding the probable causes.

Task 3

Task 3 of the Technical Annex to the tender documentation requires this study to 'indicate how many new landfills have been built or are planned since the application of the Landfill Directive.

In most Member States the number of permitted or legal landfills appears to have declined since the implementation of the Landfill Directive. It has been concluded in this Report that this decline has been due, at least in part, to the implementation of Landfill Directive itself. This is due to the closure of non-compliant landfills and the increased difficulties and costs associated with the siting, design, construction and operation of a modern landfill. This should be qualified by recognising that most Member States have implemented their own national strategies which call for increased waste minimisation, reduction, recycling and treatment of residues.

Nevertheless, it is the Landfill Directive which contains statutory targets for the reduction of biodegradable waste going to landfill and many would argue that it is these targets that ensure that a concentrated effort is made to reduce the volumes of waste landfilled. Indeed, some Member States are introducing systems which will incur severe penalties on municipalities who fail to meet the Landfill Directive targets.

The changes in landfilling activities are likely to continue as elements of the Landfill Directive continue to be implemented. In some countries, the implementation of the Landfill Directive will not be completed until 2007, and therefore any changes to the number of landfills as a direct consequence of the Landfill Directive, is likely to continue for some time.

Task 4

Task 4 of the Technical Annex to the tender documentation requires this study to ‘assess examples of existing landfills in Member States that already fully comply with the Landfill Directive, identify possible problems and give information on the impact of these landfills on the environment assessing in particular the benefits due to the Landfill Directive in comparison to previous landfilling practises.

Whilst it is acknowledged that the case studies probably represent some of the better landfills in each country, there is good evidence that there have been important developments in the standard of engineering of landfills across Europe over the past few years. The Landfill Directive has brought some consistency to the principles of engineering design and has encouraged many operators to develop high-standard compliant landfills, perhaps becoming one of the first to do so whilst knowing that the Landfill Directive will ensure that ultimately competitors will need to follow.

Task 5

Task 5 of the Technical Annex to the tender documentation requires this study to ‘describe how the procedures for the acceptance of waste in landfills are implemented and identify possible problems with the implementation’.

Annex II of the Landfill Directive describes the general principles for acceptance of waste at the various classes of landfills upon which the future waste classification should be based. It also states that until the Waste Acceptance Criteria (WAC) are fully completed, only Level 3 (on-site verification) testing is mandatory and Level 1 (basic characterisation) and Level 2 (compliance testing) should be applied to the extent possible.

The implementation of the waste acceptance procedures would appear to be slow and sporadic Europe, and appears to be still on-going in most countries. This may be due to the difficulties in local definitions and characterisation of wastes, and particularly in moving from the original country system, commonly understood amongst operators, to another less well understood system. In addition, it is widely recognised that it can be difficult and costly for site operators to comply with the new Landfill Directive WAC.

The study also looked at the implementation of Section 3 of the Directive 2003/33/EC which details the requirements for sampling and test methods.

Section 3 of the Annex to Directive 2003/33/EC contains the requirement that if the formal EN revision of the CEN standard, which provides waste operators with guidance on establishing criteria and procedures for the acceptance of waste at landfills, is not available then the draft version should be used.

On this basis, most Member States should have been able to work to this draft since that time. The evidence suggests that most had not done so by the time of the study in early 2005.

Task 6

Task 6 of the Technical Annex to the tender documentation requires this study to describe the measures taken to divert used tyres from landfills based on existing information.

From the information obtained, most countries appear to be increasing the recovering of energy or recycling waste tyres. Over the past few years, due to the publicity surrounding the Landfill Directive ban on landfilling used tyres, there has been a noticeable decline in the practice of landfilling whole tyres. Principally, the measures taken appear to ensure that the ban is clearly transposed into national legislation and to ensure that the licensing and enforcement of landfill operators and tyre processors is carried out effectively.

Tyre manufacturers and the recycling and energy recovery industries generally appear to be acting responsibly and there are also economic factors that now weigh heavily toward the recycling or processing rather than dumping in landfills. As is so often the case in the waste management industry, economic drivers will usually have the most effect and this seems to be the case for tyre re-processing. If the alternative is to pay for landfill disposal, rather than to obtain some credit or rebate due to the potential value of the tyre, clearly most operators will go for the latter.

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1.0 INTRODUCTION

1.1 Background

This Report presents the results of a study, undertaken on behalf of the European Commission (EC), into the implementation of the Directive 1999/31/EC in fifteen Member States.

The 'Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste' (the Landfill Directive) was published in the Official Journal of the European Communities on the 16th July 1999. Member States were required to bring into force the laws, regulations and administrative provisions necessary to comply with the Landfill Directive (Appendix 1) not later than two years after its entry into force i.e. the 16th July 2001.

The overall objective of the Landfill Directive is:

"by way of stringent operational and technical requirements on the waste and landfills, to provide for measures, procedures and guidance to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, and on the global environment, including the greenhouse effect, as well as any resulting risk to human health, from landfilling of waste, during the whole life-cycle of the landfill" (Art 1.1)

The Landfill Directive sets requirements for the authorisation, design, operation, closure and aftercare of landfills. The amount of biodegradable waste must be reduced and specific reduction targets are set for the landfilling of biodegradable municipal waste. Some wastes may no longer be accepted in landfills and only wastes that fulfil certain acceptance criteria may be disposed of in the appropriate class of landfill. In addition to the Landfill Directive, Council Decision 2003/33/EC established the criteria and procedures for the acceptance of waste in landfills (commonly referred to as 'WAC').

The study was undertaken by a Consortium of consultants led by Golder (Europe) EEIG. Golder carried out the studies in Denmark, Finland, France, Germany, Ireland, Italy, Portugal, Spain, Sweden and the UK. The other members of the Consortium, and the relevant countries where these members assisted the study, are listed below:

- iC Consulenter (Austria);
- Tebodin (Belgium, Luxembourg, the Netherlands); and
- EPEM (Greece).

1.2 Aims and Objectives

The EC wishes to analyse the current status of the implementation of the Landfill Directive within the first 15 Member States. The aims and objectives of this Project and this Report are summarised as follows:

- to provide an overview of the development of the situation regarding landfills in the first relevant Member States (EU 15) since 16 July 2001 (date of transposition of the Landfill Directive);
- to provide an assessment of the changes incurred towards compliance with the Landfill Directive and identify possible problems;
- to provide information for the evaluation of the effectiveness of the Landfill Directive in achieving its objective (in short, the recovery and disposal of waste without endangering human health and the environment, and the targeted reduction of the landfilling of biodegradable waste);
- to assess the quantity and types of illegal landfills;
- to assess how Member States apply the Waste Acceptance Criteria; and
- to gain an understanding of the implementation of the ban on the landfilling of used tyres.

1.3 Layout of the Report

This Report is laid out in eight chapters with a brief summary detailed below including how these chapters relate to the Tasks detailed in the Technical Annex to the project tender documentation:

- Chapter 1** provides a background to the study and this Report.
- Chapter 2** describes the methodology used to gather information from the Member States for this study and some of the important issues regarding data collection.
- Chapter 3** provides the overview of the development of the landfill situation, including the changes that have incurred towards compliance, by discussing the Landfill Directive and the context in which it is implemented in the Member States: history of waste regulations, landfill numbers, timeframes, waste data, problems and other general issues. (Tasks 1 and 3 of the Technical Annex to the tender documentation).
- Chapter 4** assesses the presence of illegal and uncontrolled landfills in the Member States. (Task 2 of the Technical Annex to the tender documentation).

- Chapter 5** presents a summary on the landfill sites used as case studies in each of the Member States. It also discusses specific issues related to the implementation of the Landfill Directive at a local level. (Task 4 of the Technical Annex to the tender documentation).
- Chapter 6** provides an overview of the implementation of the Waste Acceptance Criteria in each Member State based on the case studies. (Task 5 of the Technical Annex to the tender documentation)
- Chapter 7** discusses the diversion of tyres from landfills and the specific issues this raises. (Task 6 of the Technical Annex to the tender documentation).

It should be noted that for the production of this Report the national laws and legislative framework within the Member States have not been investigated in detail. This study has relied on information provided to the Project Team by the appropriate representatives of; national and local government, non-governmental organisations (NGOs) and the waste management industry. Subsidiary information was also obtain through the literature review.

The comments inserted into the Report from the government representatives and site operators have in most cases been inserted without any alteration. However, in some instances it has been necessary to clarify the responses provided for ease of understanding.

2.0 METHODOLOGY

2.1 Development of Methodology

This Section discusses the detailed methodology undertaken by the Project Team to elicit the information required to meet the objectives of the study and complete the specific tasks detailed in the Technical Annex of the tender documentation.

This Report has attempted to deliver a high quality study based on a robust approach and strong methodology for the assessment of the implementation of the Landfill Directive in the first fifteen Member States of the European Union. The methodology was implemented identically across all the Member States in order to maximise the consistency of approach, enable a detailed comparison between the different Member States, and ensure a high quality of analysis.

The study and questionnaire was structured on the six tasks required by the EC. It was stipulated in the Technical Annex to the tender documentation that; Task 1 on the 'changes in amounts and types of waste going to landfill', Task 2 on the 'presence of illegal/uncontrolled landfill', and Task 6 on 'measures taken to divert used tyres' were to be detailed on the basis of existing information. Therefore, where possible, information available in the public domain has been referenced throughout this Report. The Project Team undertook intensive searches of nationally and locally available information, but in some cases detailed data is not available.

It became evident that the implementation of this methodology provided major challenges. The Project Team endeavoured to obtain robust accurate information from the various representative of government and industry within the Member States. However, this was often not possible with the representatives in many cases unable to provide the data required. The Project Team has therefore been unable to provide as much detail as was initially envisaged for certain aspects of the Tasks detailed in the tender documentation. This is discussed in more detail below.

2.2 Questionnaire

One of the main tools used for the completion of the aims and objectives of this study (Section 1.2) was a questionnaire. This was used to elicit responses, in a structured format, from the appropriate government bodies and the organisations operating landfills that have been used as case studies.

The questionnaire was reviewed by the European Commission on the 21 February 2005 prior to it being sent to the government representatives.

Contact was made by the Project Team with known contacts in the national government of each Member State. These contacts then assisted in identifying the appropriate representative(s) to whom the questionnaire was to be sent and to who all the subsequent requests for information were to be sent. The list of government representatives is contained within Appendix 2. The

questionnaire was sent to each of the appropriate government representatives, in advance, to enable them to prepare the information prior to the auditor undertaking an interview with them.

The questionnaire was broken into the following sections on order to elicit background information and addressed the objectives of the study.

Questionnaire	Contents
1.0	Administrative Information;
2.0	General Background Information;
3.0	Landfill Directive Background;
4.0	Situation Before and After Landfill Directive Transposition;
5.0	Presence of Illegal/Uncontrolled Landfills;
6.0	Examples of New Compliant Landfills;
7.0	Administrative Information (Case Study);
8.0	Examples of Existing Compliant Landfills;
9.0	Waste Acceptance Criteria Implementation; and
10.0	Diversion of Used Tyres from Landfills.

Sections 1.0 to 6.0 and 10.0 of the questionnaire were used to support a direct interview between the auditor and the government representative from each Member State. This often included representatives from more than one government department and on occasions included representatives from the regulatory arm of the government.

Sections 7.0 to 9.0 of the questionnaire were used to support a site visit to a landfill. The landfill was put forward by the relevant government organisation as being representative of a landfill that was fully compliant with the Landfill Directive. In certain cases the compliance was limited to the most recent phase of the landfill, as opposed to the entire landfill. A representative from the company or organisation operating the landfill was then interviewed by a member of the Project Team on-site.

The combination of the interview with a government representative and the interview with the landfill operator ensured that the full range of data required to fulfil the objectives of this study could be obtained. Where data was not available from these representatives local NGOs and bodies representing the waste management industry were approached, in addition to the literature review.

A large amount of information was obtained using this methodology; however, there are gaps in the information provided. The reasons for these data gaps are discussed below.

The information from; the questionnaires, NGOs, waste industry bodies, and available literature was collated and analysed for the production of this Report. Tables based on the data obtained have been compiled to analyse a number of different parameters from which conclusions can be drawn regarding the implementation of the Landfill Directive in the 15 Member States to date.

2.3 Data Gaps

An assessment, both qualitative and quantitative, of the data obtained has been provided in Chapters 3 to 9 of this Report. This assessment is based on the data provided in the questionnaire and, where possible and necessary, has been supplemented by data from NGOs, waste industry bodies and literature. However, there are areas where the lack of data has meant that a full assessment of certain aspects of the implementation of the Landfill Directive could not be undertaken. The areas where the most significant data gaps have occurred are discussed below in Sections 2.3.1 to 2.3.4.

Although the data gaps have restricted the scope of this study to a certain degree, their presence has provided additional evidence of the difficulties Member States have had in collating this data. The evidence of difficulties in providing information, in many cases due to the genuine lack of specific data being collated by each Member State, may prove valuable to the EC in its future operations, especially in light of Regulation (EC) No 2150/2002 on waste statistics.

It should be noted that the information obtained from the government representatives and site operators have been lost to some degree through the requirement to translate the questionnaire into the local language and the answers back into English. Each language contains concepts that do not translate well and thus through two stages of translation it was inevitable that some information would be lost.

2.3.1 Situation Before and After the Landfill Directive Implementation

Data gaps from the Member States often existed due to the split of responsibilities within the different departments and levels of government regarding the regulation of waste. This has often lead to a fragmented approach in the management of data regarding waste management. Information collected at a local or regional level was not always collated at a national level to provide an overall country-wide viewpoint, and therefore in some instances this data could not be provided.

For some Member States the data was not available because there was no perceived value associated with the collection of this data by the particular Member State, and that to date the EC has only required certain areas of this data to be reported. It is known that some reporting is being undertaken in certain Member States primarily because of the EC's repeated requests for this information,.

The assessment of data has also been difficult due to the fact that the answers provided in response to the same questions have been collected in different ways, different definitions have been used and data has been provided for different years. This has meant that although an assessment has been undertaken in this Report, often the data has been aggregated to represent the lowest common denominator and in some cases is not directly comparable.

The waste management industry rarely collates data from its individual members as unless it has a direct tangible benefit to the members it is often felt that this time and money is better spent lobbying central government and the EC. Thus unless a particular report had been commissioned, often to support the waste management industries argument on a particular case they were unable to provide additional information.

The Project Team discovered that NGOs are invariably organised on a local basis. Even having approached Greenpeace, Friends of the Earth and WWF it would appear that there is often a lack of central coordination. The NGOs were therefore often unable to assist except in providing anecdotal information regarding local issues or where a particular study had been commissioned to support one of their campaigns.

This Report should therefore be read with the above in mind and, where more information is required, the original and unedited answers to the questionnaires can be reviewed directly from the full copies presented in Appendix 3.

2.3.1.1 Comparative analysis of waste going to landfill

This section of the study shows some data gaps primarily because of differences or misunderstandings associated with the definition of the various waste streams, the infrastructure and reporting mechanisms present within the Member States, and the conflict of responsibilities between government departments. This has meant that where data has been provided it is not always possible for it to be directly comparable. This is discussed further in Section 3.10 .

2.3.2 Presence of Illegal/Uncontrolled Landfills

The main difficulty in assessing this data is the confusion created by the differences between Member States in the definition of illegal landfills, fly-tipping and contaminated land. Many Member States perceive waste that has been tipped in an uncontrolled manner to be fly-tipping and the person responsible for this is prosecuted.

In many Member States landfills are only allowed to operate if a license or permit has been applied for (and therefore these landfills do not operate illegally). Historic landfill sites that no longer accept waste may have operated before there was a requirement for them to be permitted and so they are now often classed as contaminated land. Illegal/uncontrolled landfills are discussed further in Chapter 4.

2.3.3 Waste Acceptance Criteria

It is true to say that it is very early in the implementation process to review progress on this particular requirement of the Landfill Directive. The Waste Acceptance Criteria (WAC) were fully defined within “Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC” (2003/33/EC). However, the requirement is for Member States to apply the criteria within Section 2 (compliance testing) of the Annex to this Directive by the 16 July 2005, i.e. after the main questionnaire and field parts of this study were undertaken.

This study therefore concentrated, initially; on the implementation of Section 1 of this Annex (procedure for the acceptance of waste at landfills) constituting basic characterisation, compliance testing and on-site verification as first put forward in Annex II of the Landfill Directive. Directive 2003/33/EC requires this to take effect from 16 July 2004.

The main difficulty in providing meaningful information concerning the implementation of the Waste Acceptance Criteria (WAC), put forward by the organisations operating the case study landfill sites, was that the CEN standard (“Characterisation of Waste - Sampling of waste materials: Framework for the preparation and application of a Sampling Plan”) is currently being developed and only a draft version has been published to date.

This was seen as an important aspect of the implementation of ‘procedures for the acceptance of waste in landfills’ (Task 5 of the Technical Annex) due to the connectivity between the WAC and the Waste Acceptance Procedures (WAP), during daily operation of a landfill.

In some Member States, there has also been a lack of guidance provided at national level, making it difficult for landfill operators to ascertain their legal obligations with respect to WAC.

These difficulties, and an analysis of the information obtained are discussed in more detail in Chapter 6. It is also noted in Chapter 6 that Section 3 of Directive 2003/33/EC states that ‘As long as a CEN standard is not available as formal EN, Member States will use either national standards or procedures or the draft CEN standard, when it has reached the prEN stage’.

2.3.4 Diversion of Used Tyres from Landfill

Member States found it difficult to provide data on the quantities of used tyres generated and the fate of those tyres as it does not appear to be part of any current reporting requirement. Similarly the waste industry was unable to provide data on a single waste stream. Data that was available through the literature review was often prior to the implementation of the Landfill Directive and therefore not pertinent to this study.

Chapter 7.0 discusses in detail that information that was available.

3.0 SITUATION BEFORE AND AFTER THE LANDFILL DIRECTIVE IMPLEMENTATION

3.1 The Legislative Framework before the Landfill Directive

The Waste Framework Directive (*Directive 75/422/EEC on waste*) entered into force in 1977 and established a framework for the management of waste across the European Community. It continues to provide the foundation for subsequent directives on waste.

The main provisions of the Waste Framework Directive are:

- the definition of waste;
- the waste hierarchy;
- the proximity principle and self sufficiency of Member States regarding disposal of waste;
- the production of waste management plans;
- permits for undertaking disposal and recovery operations and inspections by competent authorities;
- the polluter pays principle; and
- reporting requirements.

The Waste Framework has subsequently been amended and there have been additional directives relating to specific waste streams.

The regulation of waste management will continue to present difficulties due to the heterogeneity of the source, composition and disposal/treatment options of waste. In trying to define many of the issues related to the landfilling of waste the Landfill Directive has revealed the level of complexity associated with this one disposal route. The following chapters of this Report will highlight some of the issues associated with the interpretation and implementation of the Landfill Directive at a national level and consequently the difficulties in implementing the appropriate national legislation.

3.2 Number and Type of Landfills

In order to undertake an assessment of the number and type of landfills permitted since the implementation of the Landfill Directive (as required by Task 3 of the Technical Annex to the tender documentation), it is first necessary to establish whether there is a consistent definition of what constitutes a “landfill”.

A landfill is defined within the Landfill Directive as being:

"a waste disposal site for the deposit of waste onto or into land (i.e. underground), including:

- *Internal waste disposal sites (i.e. landfill where a producer of the waste is carrying out its own waste disposal at a place of production, and*
- *A permanent site (i.e. more than one year) which is used for temporary storage of waste" (Article. 2(g))*

The questionnaire was used to ascertain whether this definition was contained within national legislation or whether the 15 Member States used different definitions (see Appendix 4).

Furthermore, in order to determine the number of permitted landfill sites in each Member State the definition of excluded sites under national law, in each country, must also be defined. In addition which Member States apply which derogations, with the result of excluding landfills from the full requirement of the Landfill Directive, should also be ascertained (see Appendix 4).

3.2.1 Number and types of landfills permitted since the Implementation of the Landfill Directive

The Member States were asked to detail the number of landfills before and after the implementation of the Landfill Directive to ascertain how the implementation of the Landfill Directive has affected this. Table 1 below details the information obtained.

In order for the data in Table 1 to be more readily understood Graph 1 was produced to show the change in the number of landfills from before the implementation of the Landfill Directive compared to that after the implementation of the Landfill Directive. This was done for each country by landfill type and the change in numbers shown as a percentage.

Table 1: Number and type of landfills in Member States

Country	Year	Hazardous	Non-Hazardous	Inert
Austria	1998	0	61	400*a
	2001	0	53	752
Belgium-Flemish	2001	6	11	11
	2004	4	7	5
Belgium-Walloon	2002	10*b	13	16
	2004	10*b	10	16
Denmark	1998	1	120	37
	2004	1	120	37
Finland	1998	7	351	8
	2003	15	162	71
France	1992	14	1200	No data
	2005	13	20	No data
Germany	2000	22	1,838	No data
	2002	23	1,775	No data
Greece	2000	0	14	0
	2005	0	39	0
Ireland	2001	0	48	2
	2005	0	30	2
Italy	2001	10	765	626
	2002	8	642	591
Luxembourg	2001	0	2	10
	2004	0	2	10
Netherlands	1999	38*c		
	2004	30*c		
Portugal	2002	1	57	1
	2005	0	45	No data
Spain	No data	No data	No data	No data
	No data	No data	No data	No data
Sweden	1998	500*c		
	2002	44	225*d	47
UK	2001	200	2300*e	
	2004	12	938*e	

*a - Inert landfills before the implementation of the Landfill Directive does not include landfills for excavated soil.

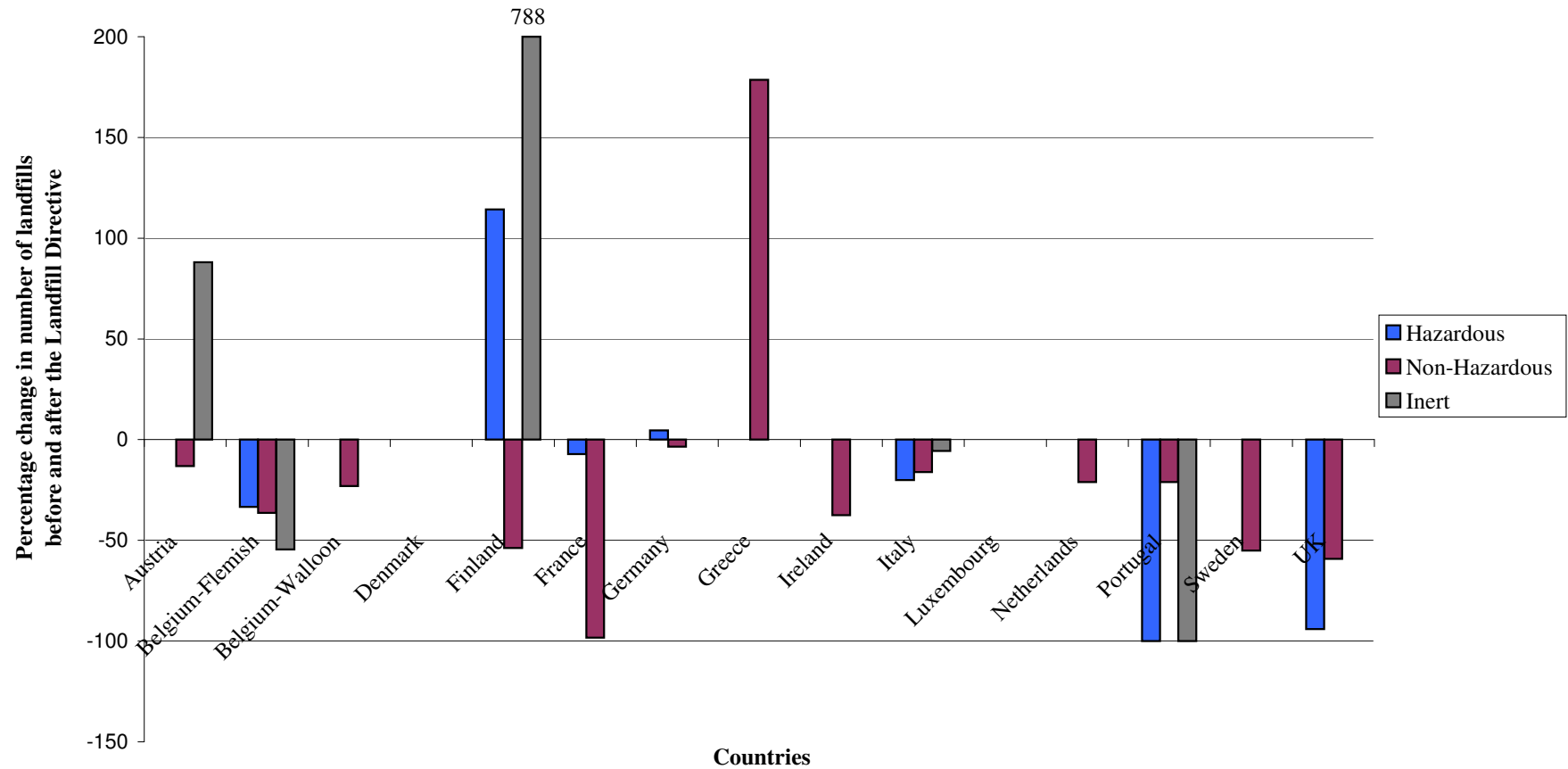
*b - Hazardous landfills includes industrial landfills (no data was available on whether industrial landfills are hazardous)

*c - Before the implementation of the Landfill Directive the different types of landfills have not been differentiated and all of the landfills have therefore been classes as non-hazardous.

*d - Non hazardous landfills after the implementation of the Landfill Directive include 39 of an undifferentiated type of landfill.

*e - Non Hazardous landfills include inert landfills.

Graph 1: Comparison of the number of landfill sites before and after the implementation of the Landfill Directive



Notes:

Austria: inert landfills before the implementation of the Landfill Directive does not include landfills for excavated soil.
 Belgium-Walloon: hazardous landfills includes industrial landfills (no data was available on whether industrial landfills are hazardous).
 The Netherlands and Sweden: before the implementation of the Landfill Directive the different types of landfills have not been differentiated and all of the landfills have therefore been classed as non-hazardous.
 Sweden: non-hazardous landfills after the implementation of the Landfill Directive include 39 of an undifferentiated type of landfill.
 UK: non-hazardous landfills include inert landfills

Source: Data from question 4.6 of the questionnaire (no data has been provided for Spain).

It would appear from Graph 1 that one of the general effects of the implementation of the Landfill Directive in the majority of the Member States is that it has reduced the overall number of permitted landfill sites which are in operation. In contrast, in Austria, Finland and Greece the number of landfills appears to have increased; although, the only country that has experienced an increase in the number of hazardous landfills (i.e. those that are likely to have the largest inherent risk to the environment) is Finland.

It is not possible from the information obtained from the Member States to determine the reasons behind this apparent increase in the number of landfills. It is possible that the increase is only on paper due to more accurate recording of the number of landfills present.

The increase in the number of inert landfills in Austria would appear to be skewed by the fact that no data was provided on landfills for excavated soil prior to the implementation of the Landfill Directive.

Whilst it is true that all Member States have introduced increased waste reduction legislation and/or strategies, and theoretically these activities alone could reduce the need for landfills (although in parallel municipal waste arisings are increasing as discussed below), other evidence suggests some direct effects of the Landfill Directive implementation programme. For example, the study shows that no new landfill sites have been permitted since the introduction of the Landfill Directive in Belgium-Flemish, Belgium-Walloon, Denmark and Luxembourg. Organisations representing the waste industry were contacted in each country in addition to the government representatives and where information was available this has been detailed below.

Germany stated that there had been no new municipal landfills permitted but could not provide data on industrial landfills. According to the Federal Statistic Agency in Germany, data on the number and types of landfills since 16 July 2001 is not collated at a national level. Furthermore, the Federal Statistic Agency explained that this information would have to be obtained from the different 'Laender' directly, and would not be possible in the timescale of this study.

The only countries that had permitted new landfills since the introduction of the Landfill Directive, are Finland, Greece, Ireland, Portugal, the Netherlands and the UK.

A review of the on-line register for Ireland shows that 58 licenses have been issued since 16 July 2001. These apply to 51 'landfills sites' (7 sites having 2 licenses). The figures provided on the on-line register for Ireland are different to the figures provided in Table 1 from the EPA/Gov for the following possible reasons:

- 3 licenses have been issued since the May 2005 when the original meeting was held with the EPA;
- the EPA/Gov reported that there were 30 non-hazardous and 2 inert landfills;

- only the numbers of active landfills in the state which are accepting waste were provided; and
- many of the 58 landfill licenses issued cover the closure and restoration period.

According to the EPA, Ireland is reducing its reliance on landfills from 84 landfills in 1999 to 32 landfills in 2005. There are no hazardous landfill sites in Ireland.

According to the Waste Institute in Portugal, there are 34 MSW landfills and 11 industrial waste (non hazardous) landfills. Of the 11 industrial waste landfills only 5 are in operation since 1 is in the process of being constructed and 5 are currently being analysed by the Waste Institute. All hazardous waste generated in Portugal is exported to other EU countries according to the Waste Institute.

The UK has permitted new landfills since the introduction of the Landfill Directive; however, they were unable to provide details on the numbers of those permitted or planned.

France, Italy, Spain and Sweden were also unable to provide the relevant information on the number of landfills permitted or planned.

The general trend since the introduction of the Landfill Directive is therefore a reduction in the number of landfill sites.

The changes depicted above are likely to persist as elements of the Landfill Directive continue to be implemented. In some countries the implementation of the Landfill Directive will not be completed until 2007, and therefore any changes to the number of landfills is likely to continue and possibly extend beyond this date.

Based upon the Project Team's experiences of the permitting process in the Member States, it is considered that the apparent decrease in the number of landfills is likely to be due to a combination of the following reasons:

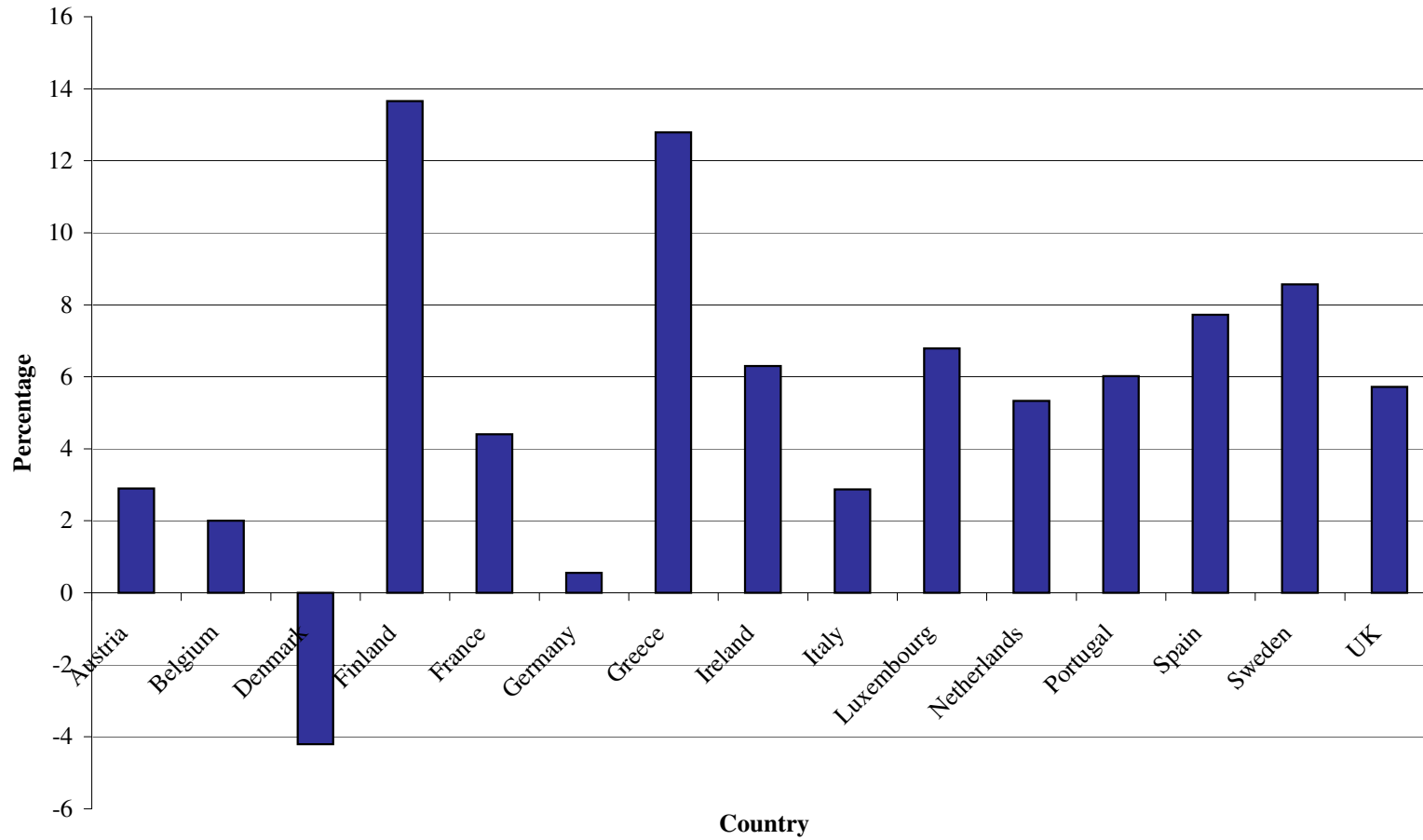
- the ceasing of operations, and subsequent closing down, of landfill sites that were open before the implementation of the Landfill Directive but did not immediately comply with the new requirements and either (i) the permitting authority would not issue a licence to continue operations or (ii) the operator decided that the problems and costs of compliance would be prohibitive;
- increased difficulties in the initial siting and obtaining permits for landfills, due to the more stringent technical requirements of the Landfill Directive, thereby limiting the number of potentially suitable sites available;

- increased cost of constructing and operating landfill sites, making it less likely that new landfills will be commercially viable; hence, a natural slowing down in the process of bringing on new sites to replace old;
- as landfill construction and operating costs increase, so landfill disposal prices will rise inevitably, sometimes in addition to a national tax on landfill (also aimed at limiting the practice of landfilling), resulting in waste producers seeking methods of waste minimisation and alternative forms of treatment and disposal;
- increased liabilities associated with the operation of landfills through long term monitoring etc. leading to operating companies being less willing to create new landfills, especially hazardous landfills; and
- increased public awareness of landfills, especially hazardous landfills, making it more difficult to obtain the necessary permissions to create and operate a new landfill site.

Graph 2 below shows the percentage increase in municipal waste arisings which is indicative of the increase in the total amount of waste produced by the Member States. It is believed that this upward trend in waste arisings has been extended beyond 2000. Clearly, if this continues for a with the parallel environment of a decreasing number of landfills, the resulting situation will be fewer landfills which, unless there is a significant diversion from landfill, will be filled a faster rate. This leads inevitably to increased prices for direct landfill disposal which, in addition to some national landfill taxes, will encourage the introduction and use of alternative treatment systems. It is known that in some Member States this is already happening although many projects are currently at the embryonic or planning stage.

One of the objectives of the Waste Framework Directive and the Landfill Directive is to encourage the treatment of waste which is further up the waste hierarchy than landfill disposal. From the information provided, and the above analysis, it can be concluded that this appears to be happening.

Graph 2: Percentage increase in municipal waste arising from 1998 to 2000



Source: Data from Eurostat - http://epp.eurostat.cec.eu.int/portal/page?_pageid=1996,45323734&_dad=portal&_schema=PORTAL&screen=welcomeref&open=/HH1/H12&language=en&product=Yearlies_new_environment_energy&root=Yearlies_new_environment_energy&scrollto=0 (municipal waste generated)

3.3 Register of Sites

There is a requirement under the Landfill Directive that permit details are made available.

"Following a successful application for a permit, this information shall be made available to the competent national and Community statistical authorities when requested for statistical purposes" (Article 7)

The questionnaire tried to ascertain if this information was available. The table below details how the Member States maintain lists of landfill sites.

Table 2: Register of licensed/permited sites

Country	Register of site
Austria	<p>“There is a register, which is provided by The Federal Environment Agency – Austria (Umweltbundesamt) an agency of the Austrian Federal Ministry of Agriculture and Forestry, Environment and Water Management.</p> <p>http://www.umweltbundesamt.at/umwelt/abfall/abfall_datenbanken/anlagendb/abfrage03/ (Online-Request for waste management plants).</p> <p>According to the Abfallwirtschaftsgesetz 2002 (Austrian Waste Management Act 2002) every waste treatment plant has to be registered until 31 July 2005 at a federal register (edm.umweltbundesamt.at).”</p>
Belgium-Flemish	<p>”Lists containing approved landfill sites can be found on www.ovam.be under ‘ondernemingen’ – ‘overbrengers en verwerkers’. There are three lists:</p> <ul style="list-style-type: none"> • category 1 landfill sites, company waste; • category 2 landfill sites, domestic waste; and • category 3 landfill sites, inert waste”.
Belgium-Walloon	<p>“Centres d’Enfouissement Techniques autorises en exploitation, liste arrêtée le 20 Avril 2005”.</p>
Denmark	<p>“There is no register available on a national level in Denmark. Regional authorities do however have registers”.</p>
Finland	<p>It is written in “Environmental Protection Act 86/2000;Chapter 3; Section 27 that Regional Environment Centres and the Finnish Environment Institute maintain an environmental protection database”.</p>
France	<p>“All the hazardous waste landfills are registered</p> <p>An inventory of non-hazardous wastes landfills (both < 20000 t/a and > 20000 t/a) is available on the Ministry’s web site:</p> <p>http://www.ecologie.gouv.fr/Déchets/décharge/</p>

Country	Register of site
	<p>There is no national inventory for the inert landfills except for in-house C&D inert waste (The information was collected using another investigation on financial guarantees undertaken by the Government). There are some regional registers of inert waste landfills.</p> <p>The Government has a non-public inventory called GEDIC, referencing all permitted sites (hazardous, non-hazardous and industrial inert)".</p>
Germany	<p>"There exist registers in each Federal State but no national register. A central public access to federal landfill registers is available under:</p> <p>http://www.deponie-stief.de/deponie/statistik/index.htm".</p>
Greece	<p>"The statistical data about the number of landfills per region can be found in the following site: http://www2.minenv.gr/press/doc/0505252.doc."</p> <p>"More detailed data can be found in Solid Waste Management Department of the Ministry for the Environment, Physical Planning and Public Works".</p>
Ireland	<p>"A register of waste licenses is held by the EPA and is available on-line at http://www.epa.ie/Licensing/WasteLicensing/SearchforaWasteLicence/"</p> <p>A register of IPC licences is held by the EPA and is available on-line at http://www.epa.ie/Licensing/WasteLicensing/SearchforaWasteLicence/</p>
Italy	<p>"In the <i>Rapporto Rifiuti 2004</i>, APAT the licensed/permitted landfills are reported.</p> <p>Weblink:</p> <p>http://www.apat.gov.it/site/it-IT/APAT/Pubblicazioni/Pubblicazioni/rapporto_rifiuti_2004.html"</p> <p>There is no centralised information on in-house landfills i.e. those associated with production sites.</p>
Luxembourg	<p>The list of landfills is found at the following site:</p> <p>http://www.environment.public.lu/dechets/inspections_envir/impact_eaux/programme/index.html</p>
Netherlands	<p>"Yes, Overzicht Stortplaatsen (overview Landfill spots), 23 -01- 2005,</p> <p>http://www.senternovem.nl/mmfiles/Stortrap_tcm24-108224.pdf (in Dutch)"</p> <p>"There is no register of landfills associated with production sites online available at the Dutch waste administration centre SenterNovem."</p>
Portugal	<p>"Exploration Licences (there is a internal register of all the exploration licenses and GAIB)</p> <p>Environmental Licences :</p> <p>http://www.iambiente.pt/portal/page?_pageid=33,32142&_dad=gov_portal_ia&_schema=GOV_PORTAL_IA&id_doc=6186. "</p>

Country	Register of site
	<p>“Waste Institute does not have any register on this kind of landfill.” (landfills associated with production sites)</p>
Spain	<p>“There does not exist a centralised register in Spain for licensed sites. The registers are set up by the competent authorities in the regional governments.</p> <p>Some of these registers are accessible through the web pages of the regional authorities. Links to the web pages of the environmental authorities in the regional governments can be found in the internet site of the Ministry of Environment (www.mma.es, click the “Enlaces” icon).”</p> <p>“The way how this requirement on registering landfills at production sites are implementation is defined by the regional authorities.”</p>
Sweden	<p>“According to the Swedish EPA there is no central register for landfill sites because there have been no need for it. However local authorities (local and regional supervisory authority) and the authority granting permits have registers in each county.”</p> <p>“Below Is an example of a web-link to register for one county (Västra Götalandsregionen):</p> <p>http://www.o.lst.se/NR/rdonlyres/CCA044E1-E6D0-46A1-BB64-BFA8641F6959/6962/Deponier041213.pdf”</p>
UK	<p>“Two registers are in place in the UK:</p> <ul style="list-style-type: none"> • PAZ. Permitting of all potentially polluting activities – These include all the activities subject to the PPC permitting regime. • REDUCE: all the sites licensed under the Waste Management Licence <p>The two databases will be merged under the PAZ database. These databases are maintained regionally by the licensing officers. The regional information is then collected centrally but it is not an automatic systems</p> <p>Registration. List of licensed waste management facilities available to licensing officers – not fully automated update.</p> <p>Eventually everything will go under PAZ.”</p>

It can be seen that all of the Member States have some form of register for landfills although this may be at a local level rather than centrally available. Where these registers contained information in a manner such that it is possible to determine whether any new landfill sites have been permitted since the implementation of the Landfill Directive this is detailed Section 3.2. It was not possible to integrate some of the registers as access is not available to the public.

The Netherlands and Portugal do not keep a register of “in-house” or “on-site” landfills (i.e. for single, private use only) mostly associated with manufacturing or production facilities, although these sites are formally permitted. The majority of other Member States do not distinguish between these landfills and other landfills.

3.4 Timetable of Implementation

The Landfill Directive included bans on certain wastes that were felt would adversely affect the environment or human health if disposed of in a landfill. The Landfill Directive states:

"Member States shall take measures in order that the following wastes are not accepted in a landfill:

(a) liquid waste;

(b) waste which, in the conditions of landfill, is explosive, corrosive, oxidising, highly flammable or flammable, as defined in Annex III to Directive 91/689/EEC;

(c) hospital and other clinical wastes arising from medical or veterinary establishments, which are infectious as defined (property H9 in Annex III) by Directive 91/689/EEC and waste falling within category 14 (Annex I.A) of that Directive.

(d) whole used tyres from two years from the date laid down in Article 18(1), excluding tyres used as engineering material, and shredded used tyres five years from the date laid down in Article 18(1) (excluding in both instances bicycle tyres and tyres with an outside diameter above 1 400 mm);

(e) any other type of waste which does not fulfill the acceptance criteria determined in accordance with Annex II." (Art. 5.3)

Graph 3 below shows the period over which certain practices are allowed and consequently the dates when the Member States introduced the bans on certain substances going to landfill, such as; liquid waste, hospital waste, whole tyres and shredded tyres. In addition it details the date when the co-disposal of hazardous and non-hazardous waste ceased and the ban on certain hazardous wastes were implemented.

This information has been detailed in this report although not part of the Tasks detailed in the tender documentation as it is felt that this complements the information in this report providing a more complete picture regarding the implementation of the Landfill Directive in the Member States.

There are no prescribed dates stipulated within the Landfill Directive for the banning of the above substances, except for tyres, leading to a lack of consistency between Member States.

It can be seen from the graph that the Netherlands, Austria and France had already implemented most of the bans through national legislation before the Landfill Directive was published in 1999, and therefore they should be the more advanced countries in control of waste going to landfill.

Other Member States; such as Belgium-Flemish, Finland, Luxembourg, and Portugal introduced the majority of the bans in 1999 at the same time that the Landfill Directive was published. Therefore, these countries have had longer to rectify any difficulties in the implementation of the Landfill Directive compared to the final set of countries who have implemented the bans at the

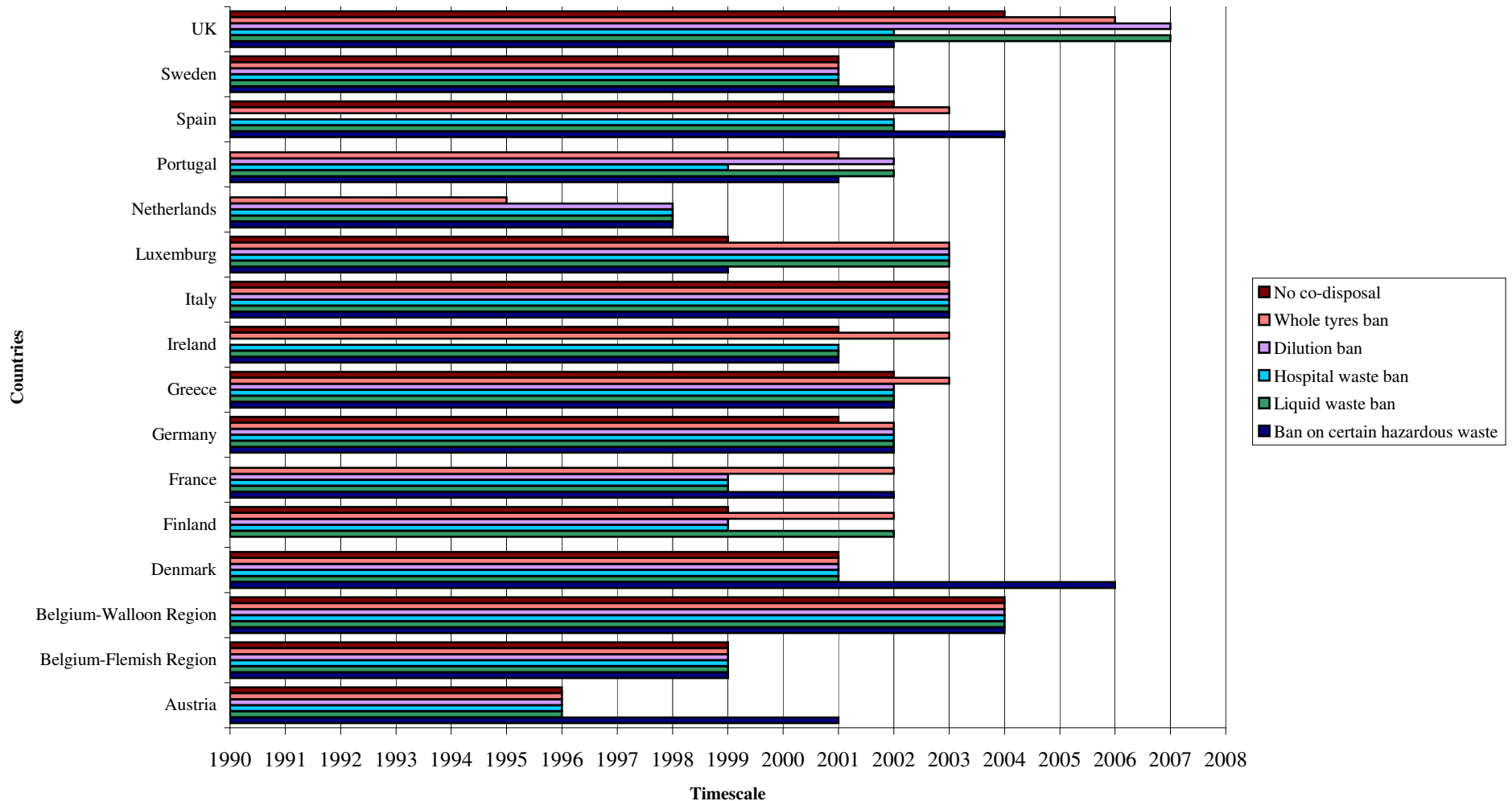
same time or after the date (2001) the Landfill Directive required it to be transposed into national legislation.

It should be noted that in France the ban on liquid and hospital waste going to deposit in landfills and the dilution of wastes at landfill took place before 1999. Furthermore, in Spain the ban on certain hazardous wastes going to deposit in landfill took place between 2002 and 2004. In the UK, the ban on liquid waste was and will be implemented at hazardous and non-hazardous landfill sites in 2002 and 2007 respectively. In addition, in the UK the dilution ban, the ban on whole tyres and the ban on shredded tyres were implemented jointly at hazardous landfills in 2003 and non-hazardous landfills in 2005.

Article 5(2) of the Landfill Directive allows Member States that landfilled more than 80% of their municipal waste in 1995 or the latest year before 1995 to postpone the attainment of targets for the reduction of biodegradable waste going to landfill by a maximum of four years. The UK has informed the EC that it will make use of this possibility. The timetable for the implementation of the Landfill Directive within the UK is amongst the longest in the EU15.

The delayed situation in the UK makes it difficult to assess the impact of the Landfill Directive, at this time, as it has not been fully implemented. Therefore, the full impact of the distribution of landfills and operational practices due to the implementation of the bans is still to be observed.

Graph 3: Timetable for the implementation of banned practices



Note:

France: the ban on liquid and hospital waste from landfills and the dilution of wastes at landfill took place before 1999.

Spain: the ban on certain hazardous wastes from landfill took place 2002/2004.

The UK: the ban on liquid waste was and will be implemented at hazardous and non hazardous landfill sites in 2002 and 2007 respectively.

the dilution ban, the ban on whole tyres and the ban on shredded tyres were implemented at hazardous and non hazardous landfill sites in 2003 and 2005 respectively.

Source: Data from Question 3.2 of the questionnaire.

3.5 Costs of Landfilling

The Landfill Directive states:

"Member States shall take measures to ensure that all of the costs involved in the setting up and operation of a landfill site... and the estimated costs of the closure and after-care of the site for a period of at least 30 years shall be covered by the price to be charged by the operator for the disposal of any type of waste in that site" (Art. 10)

The following table shows the range of costs for each country associated with hazardous, non-hazardous and inert wastes.

Table 3: Estimated cost range for disposal of waste (excluding any landfill tax if relevant)

Country	Latest date	Cost range for hazardous waste (€/tonne)	% change	Cost range for non-hazardous waste (largely municipal solid waste) (€/tonne)	% change	Cost range for inert waste (€/tonne)	% change
Austria	1999	No data	unknown	50 - 150	unknown	No data	unknown
Belgium-Flemish	2003	102	2 (after 2 years)	116	5 (after 2 years)	28	58 (after 2 years)
Belgium-Walloon	2003	58	unknown	No data	unknown	10	unknown
Denmark	2004	900	592 (after 17 years)	110	57 to 340 (after 17 years)	60	362 (after 17 years)
Finland	2003	42 - 189	unknown	30 - 121	unknown	No data	unknown
France	No date	60 - 150	unknown	No data	unknown	5 - 10	unknown
Germany	2005	No data	unknown	123 (average from 12 sites)	unknown	No data	unknown

Country	Latest date	Cost range for hazardous waste (€/tonne)	% change	Cost range for non-hazardous waste (largely municipal solid waste) (€/tonne)	% change	Cost range for inert waste (€/tonne)	% change
Greece	2005	No data	unknown	8 - 35	75 (after 6 years)	No data	unknown
Ireland	2005	No data	unknown	120 - 240	+52 (after 4 years)	No data	unknown
Italy	2003	No data	unknown	90 - 110	unknown	No data	unknown
Luxembourg	2003 and 1970 for inert	75	unknown	50	unknown	4	unknown
Netherlands	2002	128	38 (after 4 years)	58	- 8 (after 4 years)	No data	unknown
Portugal	2004	No data	unknown	26	unknown	No data	unknown
Spain	2004	No data	unknown	12	unknown	No data	unknown
Sweden	2004	100-160	unknown	70 - 90	unknown	40 - 60	unknown
UK	2003	65 - 185	unknown	21	unknown	4	unknown

The costs detailed above are approximations as actual costs are often dependent upon the exact type of waste to be disposed of, the location of the facility in respect of local competition and internal business processes of the operating organisation.

In the UK, one theory is that the cost of landfilling has been artificially depressed since the implementation of the Landfill Directive, as certain landfills try to fill their void space before a permit is required (due to the large number of landfills involved, permits are being phased in gradually). Nevertheless, currently gate prices have increased in the UK over the past few years to reflect the higher costs of construction and operation required for the Landfill Directive.

According to Royal Institute of Charter Surveyors, RICS, after July 2004 gate prices for hazardous waste were expected to quadruple in the UK. RICS (www.rics.org) quotes disposal prices for copper-contaminated soils at £9 per tonne before July 2004 and the 'Economics Survey April 2004' (www.echarris.com) quotes disposal process of special/hazardous waste at about £13 per tonne. Not only have disposal prices for hazardous waste quadrupled, but haulage costs have risen from an average of £16 per tonne to about £32 per tonne (Economics Survey April 2004) and further additional costs of pre-treatment of material prior to disposal could cost £3 per tonne.

It is often difficult to obtain representative costs as government representatives may not be aware of the operational details at landfills. Also, organisations operating landfills are reticent about revealing their disposal charges since they regard this as commercially sensitive information.

In the Netherlands, between 1985 and 1995 the gate fees at landfills increased as a result of more stringent environmental emission-thresholds. From 1995 to 2005, prices have increased as a consequence of higher taxes on the landfilling of waste, together with a prevention policy of waste going to landfills (RIVM milieucompendium, <http://www.rivm.nl/milieuennatuurcompendium/nl/i-nl-0428-04.html>, 2005).

There are significant gaps in the information provided. However, it can be seen that for Ireland and Italy, who rely on landfilling as their primary disposal route, the gate price for landfilling is comparable with that in the other Member States, whereas for Greece and the UK, who also rely on landfills as their primary disposal route, the gate prices are some of the lowest. This would tend to suggest that the reliance on landfills in Greece and the UK is partially related to the low cost of disposal.

In Italy and Ireland, the gate price for landfilling is likely to be related to other drivers, such as the difficulty in obtaining planning permission for other treatment/disposal facilities. In Ireland landfill gate prices for non-hazardous MSW have increased by 447% and 52% from 1996 to 2001 and 2001 to 2005 respectively.

In Greece according to articles posted on the following website: http://www.kathimerini.gr/4dcgi/w_articles_kathcommon_82641_09/07/2005_1284281, municipalities that landfill their waste at a certain landfill site have to pay 6% of their annual budget to the host local authority. 1.5% of the annual budget is used for the expenses of operating the landfill site and 4.5% of the annual budget would appear to be profit for the host local authority.

In Portugal the gate price for the disposal of waste to landfill before and after 2002 did not vary and remained at 26€/tonne. The transposition of the Landfill Directive into Portuguese law in 2002, appears to have had no effect on the price of disposal of waste to landfill.

3.6 Comparative analysis of waste going to landfill

This study sought to identify any changes, as a result of the implementation of the Landfill Directive, in the types and quantities of waste being disposed of to landfill in the Member States. It can be seen from Graph 3, in Chapter 3, that different Member States have different timescales for the implementation of the Landfill Directive with some still in the process of implementing it. This has made an analysis of any changes difficult to assess.

Incineration in the context of the questionnaire is the thermal treatment of wastes, without recovery of the combustion heat generated. Recovery in the context of this discussion means incineration with energy recovery and should be distinguished from 'incineration mass burn'.

It was difficult to obtain comparable data from the Member States. Some of the reasons that caused this lack of data are given below:

- Each Member State has its own definition of what constitutes a certain waste stream. Furthermore, it should be noted that although many of the countries collate data on waste treatment/disposal methods, it is often collected in a different formats and categorised differently. For example, municipal waste may be limited to waste collected from households or may include all waste collected by local government including commercial premises;
- The infrastructure within the Member State may not be developed in a way that facilitates the collection of this information. Thus, local government may not be able to distinguish between waste collected from households and that collected from commercial premises because frequently it is carried out in the same collection operation;
- The reporting mechanisms for information to be collated at a central level may not be present within the Member State;
- It often takes time for the data to be processed, collated and reported; thus, the data available is usually two years out of date.
- Conflict of responsibilities between government departments and government levels often make it difficult to obtain any data that has not been officially approved and released to the public.

The information obtained from the questionnaire highlighted that the treatment routes vary widely between Member States. Table 4 below shows the breakdown between recycling recovery and bio-treatment of wastes in the Member States. Graph 4, which presents the information from Table 4 in a different form, has aggregated these three categories to form a common denominator and allow a better comparison between Member States

It can be seen from the graph below that although all Member States undertake a certain amount of landfilling, the reliance on landfilling as a disposal route differs considerably. The figures provided are for the total amount of waste produced except for France, Portugal, Luxembourg and Spain that have only reported municipal solid waste.

Table 4: Treatment/disposal routes for waste

	Austria		Belgium-Flemish		Belgium-Walloon		Denmark		Finland		France		Germany		Greece	
	1999		2002		2002		2003		2003		2004		2002		2004	
Treatment	Quantity (Tonnes per year)	Percentage	Quantity (Tonnes per year) (All values are totals provided by Belgium, sub totals are available)	Percentage	Quantity (Tonnes per year) (All values are totals provided by Belgium, sub totals are available)	Percentage	Quantity (Tonnes per year)	Percentage	Quantity (Tonnes per year)	Percentage	Quantity (Tonnes per year)*f	Percentage	Quantity (Tonnes per year)	Percentage	Quantity (Tonnes per year)	Percentage
Recycling	36,000,000	74	7,525,900	52	ND		8,493,000	66	4,739,000	23	3,308,000	8	247,827,000	65	382,000	8
Recovery	2,400,000	5	2,551,900	18	ND		*a		1,143,200	6					0	0
Biotreatment	1,300,000	3	818,600	6	ND		*a		*e		4,173,000	10	7,600,000	2	0	0
Incineration	530,000	1	1,616,500	11	ND		3,287,000	26	4,462,700	22	12,583,307	29	17,951,000	5	0	0
Landfill	7,250,000	15	1,894,300	13	3,570,989		981,000	8	10,140,400	50	23,681,647	54	108,325,000	28	4,328,250	92
TOTAL	48,600,000	100	14,407,200	100	ND		12,761,000	100	20,485,300	100	43,745,954	100	381,703,000	100	4,710,250	100

Ireland		Italy		Luxembourg		Netherlands		Portugal		Spain		Sweden		UK	
2003		2002/3		2004		2003		2003		2003		2002		2000/1	
Quantity (Tonnes/ year)	Percentage	Quantity (Tonnes/year) (the totals include the addition of MSW and Special Waste)	Percentage (calculated as a percentage of the total waste)	Quantity (Tonnes/year)	Percentage	Quantity (Tonnes per year)	Percentage	Quantity (Tonnes per year)	Percentage	Quantity (Tonnes per year)*g	Percentage	Quantity (Tonnes per year)	Percentage	Quantity (Tonnes per year)	Percentage
514,437	20	5,926,000	5	4,194	2	49,940,000	81	236,477	5	6,034,603	29	4,372,108	6	86,000,000	39
	*d	46,563,278	41	2,022	1	*a		*d		1,806,873	9	1,500	0	27,000,000	12
212,429	8	17,531,934	15	ND		*a		296,234	6	*b		1,183,698	2	*b	
0	0	5,788,776	5	133,891	67	8,220,000	13	1,002,011	21	1,338,835	7	8,079,215	11	4,000,000	2
1,832,521	72	37,996,328	33	59,459	30	2,750,000	5	3,150,475	67	11,427,951	56	56,641,487	81	105,000,000	47
2,559,387	100	113,806,316	100	199,566	100	60,910,000	100	4,685,197	100	20,608,262	100	70,291,893	100	222,000,000	100

*a Recovery and biotreatment are considered to be recycling activities

*b Biotreatment is included in recycling

*c Includes municiple and household waste

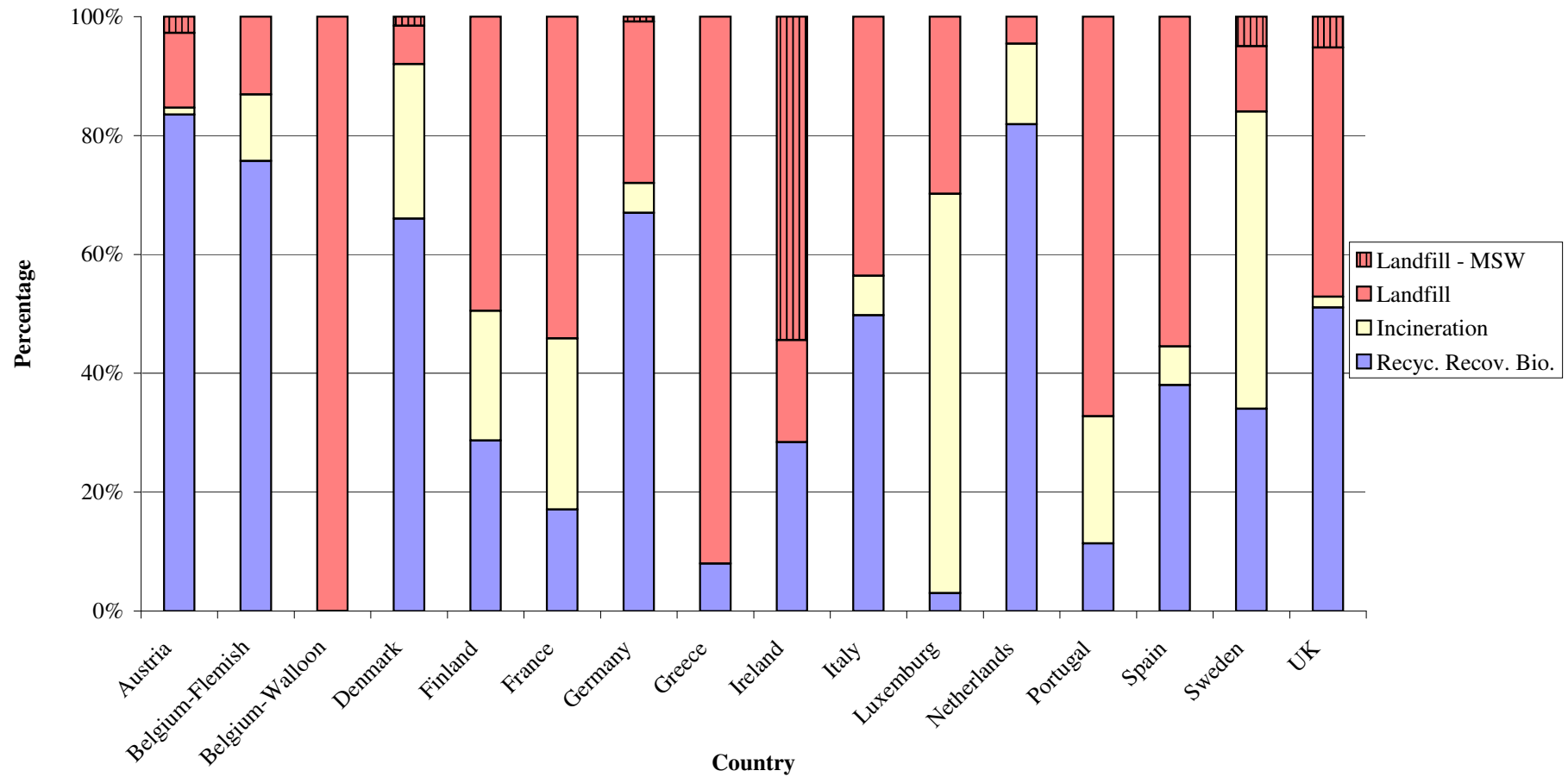
*d Recycling and recovery included together

*e Both the recovery and biotreatment are considered jointly as other disposal methods which together total 1,143,200t

*f Data for France is MSW only

*g Some of the waste attributed to recycling is separation with certain fractions going to landfill

Graph 4: Comparison of treatment/disposal methods for waste after the introduction of the Landfill Directive



Note: Belgium Walloon Region only provided data on landfilling thus this represents 100% of the disposal routes used
 Data for France, Portugal, Luxembourg and Spain are MSW only
 95% of waste landfilling in Sweden is mining waste.
 Source: Data from question 2.1 of the questionnaire.

There are six countries that landfill more than 50 % of their total waste (hazardous and non-hazardous). These are, France, Spain, Portugal, Ireland, Sweden and Greece. It is estimated that about 67% of all waste landfilled in Portugal is MSW. According to the Luxembourg plan "Data on Waste Recycling and Waste Disposal by Incineration and Landfilling" 25% of organic waste and 45% of packaging waste has to be recycled in 2005 (<http://www.gouvernement.lu/dossiers/environnement/plandechets/index.html>).

It should be noted that the high percentage of landfilling in Sweden is largely attributed to mining waste which may not be included in the data provided by other Member States. 56,641,487 tonnes of waste generated in Sweden in 2002 was landfilled, 54 million tonnes of which was mining waste, according to Swedish statistics. Furthermore, a press release by the Swedish EPA in April 2004 (www.naturvardsverket.se), data for 2002, showed that 2,641,487 tonnes of waste (excluding mining waste) was landfilled, 825,243 tonnes of which was MSW (i.e. 31%).

Contacts made by the Project Team with the relevant authorities in Belgium, Greece, Finland and Italy were unable to provide further information on the quantities of MSW waste sent to landfill in comparison to the total amount of waste landfilled

Greece were unable to provide data on the amount of MSW sent to landfill, since waste that is landfilled is not checked and recorded according to discussions with waste operators. According to an article posted on the web in July 2005 (http://www.kathimerini.gr/4dcgi/w_articles_kathcommon_82641_09/07/2005_1284281) there is little confidence in the plans for new regulated landfill sites in Greece. As an example, the author of this article, explains how the biological treatment of the only regulated landfill site in Athens is not operational.

The countries that have the least reliance on landfill disposal are Austria, Belgium-Flemish, Denmark and the Netherlands. It is possible that the implementation of the Landfill Directive is affected by this with countries that are less reliant on landfilling already having implemented legislation to reduce the amount of landfilling required.

This comparison of treatment/disposal methods was undertaken for the total amount of waste produced and it is possible that the high recycling rate of industrial wastes is obscuring the reliance of certain countries on landfilling e.g. it is known that the UK is heavily dependant on landfills which is why they requested the derogation on biodegradable municipal waste (Article 5(2)).

The following countries provided information on the amounts of MSW landfilled: Austria, Denmark, Germany, the Netherlands, Ireland and the UK. Of the 7,250,000 tonnes of waste landfilled in Austria in 1999, 1,330,000 tonnes of this waste MSW. According to 'Affald sstatistik 2003', 184,000 tonnes of MSW was landfilled in Denmark. In Germany in 2002, 11,266,000 tonnes of the waste sent to landfill was MSW. This amounts to 3% of the total 28% of waste

landfill in Germany in 2002. In the Netherlands, in 2003, 519,000 tonnes of MSW was landfilled. According to the Irish 'National Waste Database 2003 Report', in terms of the total waste generated in 2003, 61% of the waste was sent to landfill in Ireland (76% of this was MSW), 10% of the waste was exported and 29% of the waste was recycled or recovered. (National Waste Database Interim Report 2003, December 2004).

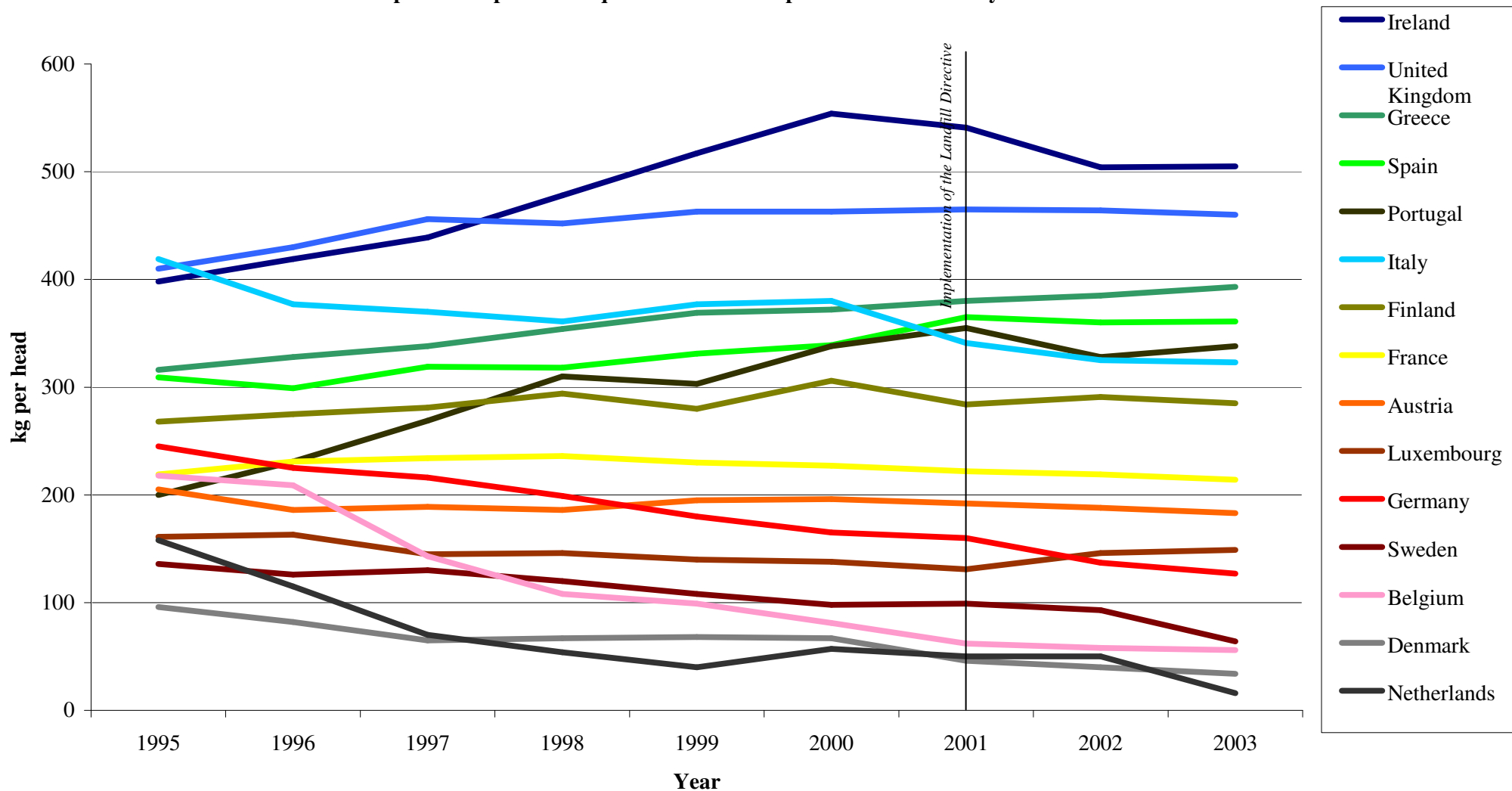
Graph 5 below compares the quantities of municipal waste in the form of kg per head going to landfill for each of the Member States over time. It also highlights the changes that have occurred in the landfilling of municipal waste since the implementation of the Landfill Directive.

It can be seen that certain countries such as Germany, Belgium and the Netherlands took action in the mid 1990s to reduce the amount of municipal waste being disposed of to landfill. For a large number of other countries such as Ireland, the UK and Portugal the trend has steadily increased. However, for these three countries a decrease or levelling of the amount of waste disposed to landfill has coincided with the implementation of the Landfill Directive.

It can be seen that the amount of municipal waste being disposed of to landfill is still increasing significantly for only one country, namely Greece.

In Greece there appears to be a great increase in the amount of waste per person, this is disproportionate to other EU countries. From 1995 to 2003 there was a 40 % increase in the amount of waste produced per person (306 kg of waste per person in 1995 and 428 kg of waste per person in 2003). Greece is second only to Portugal in terms of the waste produced for every euro spent. According to the above mentioned article posted in the web in July 2005, the author describes how Greece has failed in terms of its recycling efforts because programmes for this have been sporadic and not properly funded; however, this appears to be changing over the past few years. In Athens, a treatment plant at the Ano Liosia landfill site was built at a cost of about €75 million but remains inactive to date.

Graph 5: Comparison of quantities of municipal waste landfilled by Member States



Source: Data from Eurostat - http://epp.eurostat.cec.eu.int/portal/page?_pageid=1996.45323734&_dad=portal&_schema=PORTAL&screen=welcome&open=/H/H1/H12&language=en&product=Yearlies_new_environment_energy&root=Yearlies_new_environment_energy&scrollto=0 (municipal waste landfilled).

Table 5 highlights the difference in the top six countries with regards to landfilling being a primary disposal route for all wastes (Graph 4) and those that landfill the most municipal waste (Graph 5).

Table 5: Comparison of rank for countries with landfilling as the primary disposal route and countries that dispose of the greatest quantity of municipal waste through landfilling

Rank of Country	Countries that use landfilling as the primary disposal method for all waste	Countries that dispose of the greatest quantity of municipal waste through landfilling
1	Greece	Ireland
2	Sweden	UK
3	Ireland	Greece
4	Portugal	Spain
5	Spain	Portugal
6	France	Italy

It can be seen that although landfilling appears to be a primary disposal route for Sweden it is ranked fourth lowest in terms of the amount of municipal waste it disposes to landfill, since 95% of the waste landfilled is mining waste. Whilst the UK is ranked second highest in terms of the amount of municipal waste disposed of to landfill. This is likely to affect the ease and speed with which the Landfill Directive is implemented. This is indeed the case in the UK, where the large number of landfills has resulted in the issuing of new permits covering the requirements of the Landfill Directive needing to be phased in over a period of 3 years.

According to an article (http://europa.eu.int/comm/energy_transport/atlas/htmlu/mswint.html), MSW typically consists of the household waste fraction and light commercial, industrial wastes which is often used as a feedstock for mass burn incineration. Although energy is an important and valuable by-product, the technology exists primarily as a waste disposal means. The technology is widely deployed, particularly in the Northern European countries which have a mature waste management infrastructure in place and where, typically, availability and accessibility preclude the landfill option. In the Southern countries where the waste infrastructure is less developed and low cost landfill is still available the technology is less deployed.

According to the article above there are over 250 MSW combustion facilities currently operating in the EU. Waste throughputs vary from less than 10,000 tonnes per year to over 600,000 tonnes per year, with 100,000 tonnes per year to 200,000 tonnes per year being typical. Direct conversion

to power generation is the dominant technology and conversion rates of 500 kWh per tonne of waste are now common. New facilities continue to emerge, for example a combustor serving 65,000 households near Antwerpen, Belgium has been completed recently.

There is wide variation in the percentage of municipal solid waste arisings treated by MSW combustion in the EU:

- 36% in Germany;
- 11% in Austria;
- 7% in the UK;
- 35% in Netherlands;
- 48% in Denmark;and
- 42% in France.

3.7 Conclusions

Task 3 of the Technical Annex to the tender documentation requires this study to 'indicate how many new landfills have been built or are planned since the application of the Directive. This has been detailed in Sections 3.2 and 3.3 above. The implications due to the implementation of the Landfill Directive are discussed below.

In most Member States the number of permitted or legal landfills appears to have declined since the implementation of the Landfill Directive. It has been concluded in this Report that this decline has been due at least in part to the implementation of Landfill Directive itself. This should be qualified by recognising that most Member States have implemented their own national strategies which call for increased waste minimisation, reduction, recycling and treatment of residues.

Nevertheless, it is the Landfill Directive which contains statutory targets for the reduction of biodegradable waste going to landfill and many would argue that it is these targets that ensure that concentrated effort is made to reduce the volumes of waste landfilled. Indeed, some Member States are introducing systems which will incur severe penalties on municipalities who fail to meet the Landfill Directive targets.

In Austria, Finland and Greece the number of certain types of landfills appears to have increased since the implementation of the Landfill Directive. In Austria, the number of inert landfills has increased by 352, although it was pointed out that records of inert landfills prior to the implementation of the Landfill Directive did not include excavated soils; hence, the increase is likely to be due to the change in reporting method. In Finland, the increase refers to the number of hazardous landfills, which have risen by 8.

Whilst it is true that all Member States have introduced national legislation or strategies for increased waste reduction and recycling, and theoretically these activities alone could reduce the need for landfill (although, in parallel, the study showed that municipal waste arisings are continuing to increase), other evidence suggests perhaps some direct effects of the Landfill Directive implementation programme. For example, the study shows that no new landfill sites have been permitted since the introduction of the Landfill Directive in Austria, Belgium-Flemish, Belgium-Walloon, Denmark and Luxembourg. Similarly, Germany stated that there had been no new municipal landfills permitted although they could not provide data on industrial landfills.

The Member States that had permitted new landfills since the introduction of the Landfill Directive, and where further landfill sites are currently being permitted, are Finland, Greece, Ireland, Portugal, Netherlands and the UK (although unable to provide data). France, Italy, Spain and Sweden were also unable to provide the relevant information on the number of landfills permitted or planned.

The general trend, since the introduction of the Landfill Directive is a reduction in the number of landfill sites. The report discusses many of the main reasons for this, most of which are linked directly to the implementation of the Landfill Directive, such as the closing down of non-compliant landfills and the increased difficulties and costs associated with the siting, design, construction and operation of a modern landfill.

The changes in landfilling activities are likely to continue as elements of the Landfill Directive continue to be implemented. In some countries, the implementation of the Landfill Directive will not be completed until 2007, and therefore any changes to the number of landfills as a direct consequence of the Landfill Directive, is likely to continue for some time.

Task 1 of the Technical Annex to the tender documentation requires this study to describe how the amounts and types of waste going to landfill have changed since the application of the Landfill Directive on the basis of existing information. This information has been detailed throughout Chapter 3 with the implications of the implementation of the Landfill Directive on the amounts and types of waste discussed below.

The data shows that the quantity of municipal solid waste arisings continues to increase across Europe. However, with the exception of Greece, the amount of municipal solid waste being disposed of to landfill by the Member States is in most cases decreasing or, at worst, levelling off. Thus, there must be an associated increase in alternative methods of treatment of municipal solid waste. This reduction in the quantity of municipal solid waste being disposed to landfill reflects the Landfill Directive's requirement for a reduction in the quantity of biodegradable waste being sent to landfill. Again, this is arguably another positive aspect of the Landfill Directive being implemented.

It would appear that certain countries such as Germany, Belgium and the Netherlands, took action in the mid 1990s (or earlier) to reduce the amount of municipal waste being disposed to landfill.

Due to this action, consisting mainly of the construction of incinerators and municipal waste treatment plants), these countries are already able to fulfil their requirements and divert biodegradable municipal waste from landfill. The Netherlands was also one of the first countries to introduce the bans on certain types of waste before the implementation of the Landfill Directive.

For other countries that are more heavily dependent on landfills for the disposal of their municipal solid waste such as Ireland, the UK and Portugal, the decrease in municipal solid waste being sent to landfill would appear to coincide with the implementation of the Landfill Directive.

4.0 PRESENCE OF ILLEGAL AND UNCONTROLLED LANDFILLS

4.1 Introduction

The Landfill Directive states that:

*"Member States shall apply this Directive to any landfill as defined in Article 2(g)"
(Art 3.1)*

The definition of a landfill in Article 2(g) is:

"a waste disposal site for the deposit of waste onto or into land including:

- Internal waste disposal sites...; and*
- a permanent site (i.e. more than one year) which is used for temporary storage of waste" (Article. 2(g))*

An illegal landfill is therefore a waste disposal site that has existed for more than a year where the Landfill Directive has not been applied. With the time period for existing landfills to comply with the Landfill Directive extending to 2009 (Article 14) an "illegal landfill" could be defined today as an existing landfill (as defined above) for which a conditioning plan has not been submitted. As discussed in Chapter 3 above and Appendix 4, these are not legal definitions within the Landfill Directive or any national legislation.

New landfills are required to apply for a Permit prior to the acceptance of any waste (Article 7). Where waste has been deposited onto or into land for the first time after the 16th July 2001 (the date for the transposition of the Landfill Directive (Article 18)) without first being permitted and is present for more than one year, it will be an illegal landfill.

Within the context of this study an illegal/uncontrolled landfill is to 'include municipal and commercial landfills created and operated without a permit under waste legislation as well as other significant unpermitted and uncontrolled landfilling activities'.

Table 6 below summarises the responses in the questionnaires regarding the number and type of illegal landfills in each Member State. In addition where available from the literature review and discussions with NGOs subsidiary information is provided.

4.2 No. of Illegal Landfills

Table 6: Number of illegal landfills in the Member States

Country	No of Illegal Landfills	Main types of waste
Austria	0	Not relevant since there are no illegal landfills in Austria.
<p>“There are no illegal landfills in Austria. Old landfills and industrial sites are being systematically detected and redeveloped according to the Altlastensanierungsgesetz (Act on the Remediation of Contaminated Sites).”</p>		
Belgium-Flemish	0	Not applicable since there are no illegal landfills.
<p>“According to the OVAM in Flanders there are no illegal landfills in exploitation. For old closed illegal landfills soil legislation applies. The local authorities are now responsible for illegal landfills.”</p>		
Belgium-Walloon	963	Mainly municipal solid waste and inert waste consisting of construction material.
<p>“According the Act of 24 June 1993 one person is assigned to record and register illegal landfills.”</p> <p>“Division de la Police de’Environnement from the Direction Générales des Ressources Naturelles et de l’Environnement (DGRNE) is responsible for illegal landfills.”</p> <p>“There is a decree in project, which creates a databank based on several databases, existing or to constitute: register of the granted licenses of environment, inventory of the sites of economic activities to rehabilitate or likely to be regarded as such, inventory of old landfills and other waste dumps, an inventory of closed sites and certain establishments which are likely to pollute the soil or being able to pollute for some reason.”</p>		
Denmark	0	Not applicable
<p>“There is no specific system for identifying illegal landfills. There has been rigid regulations regarding landfilling since the early 1970s. The local authorities are responsible for monitoring.”</p>		
Finland	0	Not applicable
<p>“There is no register of illegal landfills, because in Finland illegal landfills don’t exist. Random fly-tipping does exist.”</p> <p>If an illegal landfill were to be found, it would be an environmental crime and illegal actions noticed and interrupted (by authorities and police) as defined in the Waste Act and Environmental Protection Act.</p>		
France	1042	<p>> 30% household waste (municipal solid waste)</p> <p><30% is bulky items of waste</p> <p>30% is undetermined.</p>
<p>“The procedure for identifying illegal landfills is defined in Circular 23 February 2004.</p> <p>The document defines the difference between illegal landfill and illegal deposit of waste. Illegal</p>		

Country	No of Illegal Landfills	Main types of waste
<p>deposit of waste is defined by small quantity of waste deposited by individual members of the public. Illegal landfill is defined by sites that receive regular loads of waste to a site in activity usually managed by the municipalities.”</p>		
Germany	0	Not applicable
<p>“In Germany there are no known illegal landfills. This hasn’t been an issue for the old Federal States since the late 1970s. Landfills without permits in the new Federal States after the reunion in 1990 were closed or permitted within a short time.”</p>		
Greece	1453	Mostly municipal and inert (construction and demolition waste), ashes and a small amount of hazardous and infectious waste.
<p>“There is no definition in Greek legislation for illegal landfill. What is meant with the term illegal landfill in Greece is a landfill that does not have one or more of the following: Geological barrier (composite liner etc), leachate treatment, biogas management, environmental monitoring and gate control of the incoming vehicles.</p> <p>There is a register of the illegal landfills in place (http://www2.minenv.gr/press/doc/0505252.doc). The authority responsible for the registration of illegal landfills is the Ministry for the Environment, Physical Planning and Public Works. The authorities responsible for the existence and the restoration of illegal landfills are the municipalities, controlled by the regional authorities.</p> <p>With Joint Ministerial Decision 175535/04 a Task Force for the registration of illegal landfills has been created and the results of their work is the current national registration of illegal landfills.”</p>		
Ireland	>9	Consists of commercial, industrial, construction/ demolition, municipal waste (<5%), consist of clinical waste (<1%) Tyres and WEEE are also believed to be illegally flytipped.
<p>According to the National Waste Database Report 2003, December 2004, the quantity of waste illegally landfilled in Ireland is not reported.</p> <p>“There is currently no register of illegal landfills however a register is being compiled at present. Under Section 22, 7 (h) of the Waste Management Act 1996, local authorities are instructed to include in their waste management plans information on or otherwise have regard to the identification of sites at which waste disposal or recovery activities have been carried on. It is intended that this requirement will be used as a register of illegal sites.”</p>		
Italy	1763	No data provided.
<p>“Illegal waste disposal activities are investigated both by environmental control authorities in general and by criminal departments with different levels and degree of responsibility.</p> <p>In 2002, the ‘Corpo Forestale dello Stato’ has produced a Report on the Illegal Landfill; this report was not based on established procedures.” “Environmental Ministry has asked to Regions and Districts, which are the authorities responsible for illegal landfills, to report regarding the illegal landfill situation and has fixed as deadline 10/06/05.”</p> <p>The Ministry opposed the findings of the report, with the support of the regional governments, on the grounds that the CFS report included fly tipping and litter abuses, and therefore is preparing a counter</p>		

Country	No of Illegal Landfills	Main types of waste
<p>report (not available at the time of writing) on the actual situation of “proper” illegal landfills.</p> <p>In 2002 the “Corpo Forestale dello Stato” (the Police Force specialized in the environmental protection) produced the third report on illegal landfills (http://www.corpoforestale.it/eventi/discariche/relazionediscariche.htm and http://www.corpoforestale.it/eventi/discariche/indaginediscariche.ppt). According to this report Italy has received a final written warning because of numerous illegal or uncontrolled landfills on its territory. At least 4,866 such landfills were identified as existing or as being in operation in Italy in 2002. 3,836 of these have apparently not undergone any action to prevent environmental damage to soil, water and air. 705 are believed to contain hazardous waste. However, it must be noted that the number of illegal landfills have decreased from 5,978 to 4,866 from 1986 to 2002, according to this report.</p>		
Luxembourg	0	Flytipping wastes include: tyres, household waste and oil barrels.
<p>The “L'administration de l'Environnement “ performs several controls with a list of the results found on http://www.environment.public.lu/dechets/inspections_envir/index.html.</p>		
Netherlands	0	Not applicable
<p>“Every deposit of waste outside a permitted landfill site is considered to be illegal. Therefore there is no difference between illegal landfills and waste on streets or anywhere it doesn’t belong. According to article 10.2 of the “Environmental Management Act” it is prohibited to dispose waste outside a landfill or waste incinerator (permitted waste treatment facility). There is a possibility to take enforcement measures against polluters.</p> <p>There is no register of illegal landfills. They do not exist in The Netherlands.”</p>		
Portugal	2 (these are now closed)	Construction and demolition waste is the main waste flytipped.
<p>“In Portugal there is no register on illegal landfills because there are none. All the existing one’s were closed and at this moment (June 2005) there are only two places (Setúbal and Azores Island) with illegal landfills that are already closed (sometime ago) and they are proceeding with all the works related with the capping and aftercare.”</p>		
Spain	No data provided.	No data provided.
<p>There is no register of illegal landfills. However, the waste management plan of 2000 highlights the situation that 4000 illegal landfills have been closed and rehabilitated.</p>		
Sweden	No data provided.	Construction/demolish waste and inert/contaminated or inert soils.
<p>“In 1996 the Swedish EPA published a report (NV rapport 4597) dealing with illegal landfills. The conclusion was that “illegal landfills” occur in the whole country, on isolated places reachable by car (ravines, pits, closed and open landfill sites). Between 1 and 10 new illegal landfills are identified in each municipality each year. The numbers of existing landfills are however more. Note! A lot of what the report call “illegal landfill” is probably better described as ‘fly-tipping’. “According to the Swe</p>		

Country	No of Illegal Landfills	Main types of waste
EPA contact there is no project/work going on by the central authorities regarding this issue.		
UK	0	Flytipping wastes include: tyres, commercial, domestic waste and fridges.
A register of fly-tipping incidents is now maintained by the Environment Agency and local authorities. There is no definition of illegal landfills in national legislation and therefore all waste deposited outside of a permitted site is considered flytipping.		

It can be seen from the responses in the questionnaires that the definition of what an illegal landfill is differs widely between Member States, thus it is difficult to compare the figures provided above.

Within some countries there is no definition of illegal landfill as a landfill is often defined as an engineered facility which can only be constructed after a permit has been received from the competent authorities.(Section 3.2.1). Thus, for these Member States all landfills are permitted and therefore legal. This is likely to be one of the reasons why some of the Member States have reported to having zero illegal landfill sites.

Waste that is unlawfully deposited outside of permitted facilities is usually defined as fly-tipping. The Landfill Directive defines a landfill as a place where waste has been deposited for more than one year (Section 4.1 of this Report). However in most countries there are no records regarding the length of time fly-tipped waste has existed at a particular location and thus no way to determine whether this is now an illegal landfill rather than an incident of fly-tipping. Thus, the response from Sweden says that what they refer to as illegal landfills may be better defined as fly-tipping.

Some of the Member States, for example Greece, may be reporting permitted landfills that are having enforcement action brought against them for not complying with national legislation as illegal landfills. For other Member States, these are legal landfills that are being prosecuted for a minor infringement and therefore not reported as illegal landfills.

Finally there is the issue of historic landfill sites that are now closed. These sites may not have operated legally or may have been constructed and/or operated outside the specifications of a modern landfill. However, as they are now closed, and any question of legality or compliance may be of a historic nature, they are usually classed as contaminated land in most Member States rather than illegal landfills.

The issues discussed above are likely to be some of the reasons why eight of the Member States report that they have zero illegal landfill sites, while four of the Member States report that they have over 950 illegal landfill sites each, with the highest one reporting 1763 illegal landfills. A normal distribution would be expected for this data and this large gap between the majority of

Member States and others would suggest that the data is not representative. This is a major area where legal definitions within national legislation and interpretation are of great significance.

The conclusion that the data presented above is not representative of what is actually occurring is reinforced by the additional information obtained by the Project Team as detailed below.

According to the Finish Authority there is no illegal landfilling in Finland. Local authorities and local newspapers have reported single, random illegal landfills; however, this is not a common problem in Finland and statistics are not available. Random fly-tipping of cars and scrap metal etc has occurred in forested areas; however, waste management is very well organised in Finland and producer responsibility has contributed to the decrease in fly-tipping (*personal communication*).

According to government organisations and NGOs no illegal landfill activity is reported within Germany (www.deponie-stief.de, www.bund.net, www.gruene-partei.de, www.bka.de, and <http://bde.org>).

According to a presentation given by the president of The Ecological Society for Recycling in Greece in February 2004, the quantity of waste illegally landfilled in Greece is not defined although it is stated that 80 to 90% of waste will end up in 33 regulated landfills in the near future. It does not state what will occur to the remaining 10 to 20% of waste generated (<http://www.europarl.eu.int/comparl/envi/pdf/implementation/is20050203.pdf>).

Spain was unable to provide any data regarding the number of illegal landfills however it is known that the EC is bringing action against Spain with regards its illegal landfills (http://www.consumer.es/web/es/medio_ambiente/2002/10/02/52522.php).

The EC has referred Spain to the Court of Justice because of an illegal landfill site at Olvera, Cadiz, where there is no waste treatment system, and where water filters through caves to the Salado stream. This poses a threat to the quality of underground waters. There are also problems with permit and inspection requirements, which are set out in the Waste Framework Directive. The EC considers that the landfill should be closed and that a decontamination plan should be implemented. The EC has also sent Spain a final written warning in connection with an illegal landfill located in the municipalities of Corcubión and Cée in La Coruña in Galicia. According to the Spanish authorities, the landfill is due to be closed and replaced by a new facility. However, confirmation of closure and of the establishment of aftercare arrangements has not been sent to the EC, according to an EU study (http://www.consumer.es/web/es/medio_ambiente/2002/10/02/52522.php).

This study also states that there are currently seven cases brought to the EU Court of Justice with regards to illegal dumping in Spain (these are Málaga, Formentera, Ávila, León, Ibiza, Alicante y la Bañeza, León). Others are still in the first stages of being brought to court, namely: Corcubión

(La Coruña), Punto de Avalos (La Gomera, Canarias) y Olvera (Cádiz). In 2000 five sites were identified as illegal landfills in Granada (<http://www.granada.org/inet/wambiente.nsf/0/8b54394b8b4476ec1256e21003e50eb?OpenDocument>). This website includes a table with all the illegal landfills in Granada in September 2000. The table gives details on the location, types of dumped waste and land areas of five illegal landfills in Granada. No further details about waste illegally landfilled in Spain was gained from government and non government sites reviewed (<http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/04/52&format=HTML&aged=0&language=EN&guiLanguage=en>)

A recent report (The Nature and Extent of Unauthorised Waste Activity in Ireland, EPA, 2005) details 25 unauthorised landfills in Ireland.

In the UK the Organised Criminal Task Force in the UK reporting (www.octf.gov.uk/index.cfm/section/article/page/dumping) that the Environment and Heritage Service in Northern Ireland has detected approximately 40 illegal landfill sites in Northern Ireland. In support of this the complaint from Greenpeace to the European Commission (*O.J. L194/39*) regarding the failure of the UK government to comply with Community law (dated 4 May 2004) details specific examples of illegal landfills. This information would appear to be contradictory to the information provided by the UK government representative.

4.2.1 Types and nature of waste illegally landfilled

No information regarding the nature of waste illegally landfilled within Finland was gained from the Authority and NGO sources (Finnish Authority and NGOs).

Historic illegal landfills in Germany, since 2001, include 54 sites in Berlin. 37 of these illegal landfills were larger than 100 tonnes (www.taz.de/pt/2001/01/29/a0158.nf/text). 13 of these cases were denounced. In Wartenberger Straße, next to the tramline, surrounded by concrete buildings and the colony "Feierabend", lay around 80,000 tonnes of construction waste, plastics and hazardous waste wood (www.taz.de/pt/2001/02/24/a0207.nf/text.ges,1). This landfill is now being closed and the operator has been prosecuted.

No details of the waste illegally landfilled within Spain was available from the government representative, NGOs or the literature review. Web sites reviewed include:

- <http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/04/52&format=HTML&aged=0&language=EN&guiLanguage=en>,
- <http://www.granada.org/inet/wambiente.nsf/0/8b54394b8b4476dec1256e21003e50eb?OpenDocument>,
- http://www.consumer.es/web/es/medio_ambiente/2002/10/02/52522.php,
- <http://ania.eurosur.org/tns.php3?finicio=20050831000000&ffin=20050907235959>.

It has been reported that the Austria, Belgium-Flemish, Denmark, Germany, Luxembourg, Netherlands and the UK have no illegal landfill waste. However, waste fly tipped includes tyres, household waste, oil barrels, fridges and commercial wastes.

From the information above and anecdotal data it would appear that the waste type most commonly associated with illegal landfills is construction and demolition waste. Although this is not the most costly of wastes to dispose of the quantities produced mean that the gross cost can be significant. In addition this type of waste is often produced in very large quantities over a short period of time and there is pressure at these sites for the waste to be disposed of as quickly as possible so that the development can be finished as quickly as possible.

4.2.1.1 Quantities of waste deposited in illegal/uncontrolled landfills

It can be seen that the information available on illegal landfills is extremely sparse as Member States either believe they have no illegal landfills or have such a significant number of illegal landfills that they are having difficulties in addressing this issue. This has meant that despite extended discussions with government representatives and NGOs it has not been possible to obtain any data on the quantities of waste deposited in illegal/uncontrolled landfills.

Any data that is available is usually an estimate as due to the illegal nature of these facilities accurate records are not kept. The most detailed report available for any of the Member States appears to be *The Nature and Extent of Unauthorised Waste Activity in Ireland*, EPA, 2005. This details approximate quantities of waste deposited (Table 2 within the EPA report – Summary Details of Unauthorised Landfills Reported) with the largest site being approximately 360,000 tonnes of C&D waste and commercial and industrial waste.

The Project Team initially thought to compare the quantity of waste accepted by authorised facilities compared to the total waste arisings to determine the quantity of waste illegally disposed of. However, due to the difficulty in obtaining accurate and robust data on waste arisings and the quantities of waste accepted at permitted facilities this was not possible. The data available on waste often have such large margins of error associated with them that it is not possible to use them for such detailed analysis.

4.2.2 **Characteristics of locations of illegal landfills**

The one recorded instance of an illegal landfill within Finland is at Ylikiiminki, Oulu. It is thought that the sparsely populated north of Finland, which is suffering a reduction in licensed landfills, will be more susceptible to illegal landfill activities (*Personal communication Finnish Authority*).

Figure 1 – Location of Unauthorised Waste Facilities and Landfill Sites in *The Nature and Extent of Unauthorised Waste Activity in Ireland*, EPA, 2005 details the locations of illegal landfills in Ireland.

All areas of Italy are affected to a varying degree. Italy has also received a final written warning concerning pollution caused by an illegal landfill in Lodi (Lombardy) (<http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/04/52&format=HTML&aged=0&language=EN&guiLanguage=en>).

Extensive research has been carried out in the Veneto region of North-eastern Italy on illegal dumping, this is discussed in the following article: 'The Use of Remote Sensing to Map Illegal Dumps in the Veneto Plain'. The article explains how the Veneto region of Italy has seen great industrial development taking place over the last few decades. It is recognised that every year thousands of tons of industrial and urban waste are produced and possibly placed in illegal dumps. Italian law provided environmental regulations on illegal dumping only recently, as a result, illegal dumps that were created 30-40 years ago may be hidden or forgotten about today. This led to a monitoring program that was started in August 2003 in the Veneto region, to identify these illegal dumps.

The programme specifically uses remote sensing to identify these dumps and provide information on their spatial distribution. The technique has identified hidden underground dumps by checking for evidence of vegetation stress or unusually high soil temperature due to organic fermentation with biogas production. The project looked at identifying waste in three categories: 1) organic materials mainly from urban rubbish; 2) dangerous and toxic materials mainly from industries; 3) special but non dangerous materials mainly from construction activities. The study calibrated the technique through data based on the Venice lagoon watershed in which 20 illegal dumps are already known to the authorities. The results showed that in the watershed area, 20 illegal dumps and 26 authorized dumps were identified by remote sensing proving that the technique works. The study focused entirely on the Venice lagoon watershed (1491 square kilometres) and results for the whole of the Veneto plain (more than 10000 square kilometres) will be available by the end of 2006.

According to the 2002 report on illegal landfills, which included fly tipping and litter abuse in Italy by the "Corpo Forestale dello Stato", (<http://www.corpoforestale.it/eventi/discariche/relazionediscariche.htm> and <http://www.corpoforestale.it/eventi/discariche/indaginediscariche.ppt>), 12% of illegal landfill are located in protected areas and more than 70% of illegal landfills are located in areas subject to land constraints. Furthermore, most illegal dumping is found in forested areas (28%), 24% in streams, 15% in cities, 9% on province roads, 8% on other roads, 4% on state roads and 12% in other areas.

Areas of Spain affected by illegal landfill activity include La Palma, Malaga, Formentera, Avila, Leon, Ibiza, Alicante y la Baneza, Granada, Cadiz and Galicia. (<http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/04/52&format=HTML&aged=0&language=EN&guiLanguage=en>, <http://www.granada.org/inet/wambiente.nsf/0/8b54394b8b4476dec1256e21003e50eb?OpenDocument>,

http://www.consumer.es/web/es/medio_ambiente/2002/10/02/52522.php,
<http://ania.eurosur.org/tns.php3?finicio=20050831000000&ffin=20050907235959>).

4.2.3 Potential Environmental Impacts of Illegal and Uncontrolled Landfills

From the information obtained regarding illegal landfills it would appear that C&D waste is the primary waste disposed of in an uncontrolled manner (*The Nature and Extent of Unauthorised Waste Activity in Ireland*, EPA, 2005, page ix). However this is likely to give rise to less severe environmental impacts due to the high inert content of this waste. Household, commercial and industrial waste would appear to be less likely to be disposed of in an uncontrolled manner however this will have more significant environmental impacts.

The environmental impacts from an illegal/uncontrolled landfill are the same as those from landfills that are not subject to the engineering and management controls detailed in the Landfill Directive. The main impacts will be:

- contamination of groundwater and surface water, possibly with List I and List II substances;
- emission of bulk and trace gases (including methane and VOCs depending on the waste deposited) in an uncontrolled manner; and
- creation of nuisance which will affect the surrounding area through the production of litter, odour, vermin and degradation of the visual amenity.

4.3 Factors contributing to Illegal and Uncontrolled Landfills

It can be seen from the discussion above that a large number of Member States report that they do not have any illegal landfills. It would therefore appear that there is little information to be obtained from assessing their response as to factors contributing to the presence of illegal landfills.

The table below shows the responses from those Member States that have stated that they have illegal landfills, or where inadequate data was provided, such as Spain and Sweden.

Table 7: Responses by Member States on factors contributing to illegal landfills

Country	Shortage of authorised landfills	Lack of controlled operators	Fragmented/inadequate administrative responsibility	Incentives for operating illegal landfills
Belgium-Walloon	No	No	Yes "8 Associations Intercommunale in Walloon region having their own responsibilities for waste collection. In addition there are regions in Belgium with three governments."	"The tax system is differentiated: tax is not applicable on household waste, whereas tax is applicable at all other type of waste. Lack of administrative control makes it possible for waste collectors to dispose the non-household waste" illegally.
France	Yes This is dependant on regional variability.	No	No However, there is inadequate admin capacity. "There are not enough inspectors of authorised activities. 400 new inspectors are expected in the next 4 years. About 1300 inspectors are covering the entire territory for all the authorised activities (not only landfills)."	"The reason to resort to illegal landfill is mainly due to the lack of local facilities for the disposal of certain types of waste streams (bulky items and green waste). This includes a lack of transfer stations, and civic amenity sites in some municipalities."
Greece	Yes Especially in remote areas.	Yes	Yes "There is fragmented administrative responsibilities in the country. This has to do most of all with the geography of the country. There are too many small cities and villages dispersed all over the country and consequently the administration follows their allocation. Also the planning and the permitting systems are separated. The Regional authorities approve the planning, the prefecture	"The administrative structure of the country, until 1997 was a big barrier to more rational approaches in waste management The direct cost of illegal dumping is quite low NIMBY (Not In My Back Yard) syndrome which stops or terminate new landfill development."

Country	Shortage of authorised landfills	Lack of controlled operators	Fragmented/inadequate administrative responsibility	Incentives for operating illegal landfills
			<p>gives the permission and the municipality implements it.”</p> <p>There is also no staff to be involved with waste management and landfill issues</p>	
Ireland	No	No	No	<p>“A large proportion of older landfill sites closed down between 1996 to 2001 while little new landfill capacity was added. Waste generation rates grew significantly at the same time. The scarcity of landfill capacity and recycling and recovery facilities led to a rise in landfill gate fees. There was therefore a financial incentive for illegal operations. In addition, a lack of convictions showed the law enforcement not to be a deterrent.”</p>
Italy	No	No	<p>Yes</p> <p>“There is certainly a fragmented administrative responsibility due to geographically fragmentation and also planning and permitting processes are separated: the Regions give permit; instead the Provinces are responsible for control.”</p>	<p>“There are two general motivations: the potential and fragmented lack of control and the criminal waste organizations, the price disposal offered by the criminal waste organization is much more low respect to the disposal price of legal landfill, especially in case of special waste.</p> <p>Furthermore the resort to illegal landfill is due to local factors: specific difficulties in disposing a special kind of waste in a particular geographic area.”</p>

Country	Shortage of authorised landfills	Lack of controlled operators	Fragmented/inadequate administrative responsibility	Incentives for operating illegal landfills
Portugal	No comment given	No comment given	No comment given	No comment given
Spain	No comment given	No comment given	<p>Yes</p> <p>“Regional authorities have the main responsibilities in planning and permitting of landfills.” The “local authorities also have powers on planning and in some cases on permitting and operation of landfills for municipal waste.” This is likely to continue until 2007 when landfills come under the existing IPPC legislation.</p> <p>There is also anecdotal evidence of a shortage of staff.</p>	“The main reasons for illegal landfilling; are avoidance of cost, lack of landfills close to point of generation, lack of environmental awareness, difficulties in prosecuting.”
Sweden	<p>Yes</p> <p>There are few hazardous waste landfills and they are to far away to transport waste to.</p>	No	<p>Yes</p> <p>“There are no major problems in communication between authorities on central/permitting/national level and on local level.” Sweden generally has a “good observance of the laws and a relatively extensive supervision activity.”</p>	<p>“According to the Swe EPA representative the main reasons are:</p> <ol style="list-style-type: none"> 1. High gate fees 2. Complicated regulations 3. Ignorance, sometimes in combination with practical problems in sorting mixed waste.”

It can be seen that the major contributing factors tend to be country specific except for the main reason which is usually the avoidance of higher gate fees at authorised landfills. One of the fears with regards to the implementation of the Landfill Directive is that this would cause higher landfilling prices and consequently higher levels of fly-tipping.

There is anecdotal evidence that illegal waste disposal is the second highest earning activity for organised crime. It may be that this refers to illegal landfills where regular deposits are made, compared with ad-hoc dumping of one load due to immediate lack of facilities or cost.

4.3.1 Deterrence of Illegal and Uncontrolled Landfills

The table below shows the responses from those Member States that have stated that they have illegal landfills, or where inadequate data was provided, such as Spain and Sweden.

Table 8: Responses by Member States on deterrents of illegal landfills

Country	Practical measures to stop illegal landfilling	Incentives and measures to reduce illegal landfills	Shortcomings in deterrent measures
Belgium-Walloon	A fence is usually put around the area to prevent the activity continuing.	<p>“An act on soil rehabilitation is put into action. Tax reform, improved infrastructure for waste management and better enforcement” has reduced illegal landfilling. The key success factor to deter illegal landfilling is education and public campaign schemes on waste management and prevention of illegal landfills . There may be a requirement to increase the number of environmental enforcement officers since the availability of them in Wallon is less than in Flanders.</p> <p>‘The maximum penalty is €250,000 through the tax evasion scheme.’</p>	<p>Reform of the tax system is on going.</p> <p>“The pressure for regulations, like soil rehabilitation, is insufficient.”</p>
France	<p>“There are immediate measures that can be taken to stop the illegal activities but it is usually followed by a warning procedure to stimulate the operator to regularise the problem.</p> <p>Immediate measures are the installation of a fence to avoid any further deposit of waste.</p>	<p>“The incentives and measures in place that contribute to the reduction of the landfill are:</p> <ul style="list-style-type: none"> •Development of alternative waste deposit facilities (civic amenity sites, recycling centres, transfer stations, kerbside collection of certain types of waste such as bulky items. •Rehabilitation of closed illegal landfills to avoid further deposit of waste 	<p>“There are various deterrent measures that exist in France. An example is the removal of the blue flag label for seaside resorts. Other deterrent are the enforcement of various administrative or penal sanctions.”</p>

Country	Practical measures to stop illegal landfilling	Incentives and measures to reduce illegal landfills	Shortcomings in deterrent measures
	The practical actions taken to reduce the illegal deposit of waste is to inform about alternative mode of disposal of the waste such as the use of civic amenity sites and recycling centres.”	<ul style="list-style-type: none"> •- Installation of inert waste landfills for the safe and controlled disposal of inert C&D waste.” ‘The maximum penalty is €75,000 and up to a year in prison’	
Greece	“Fencing and police patrols.”	Financing for the construction of new licensed landfills Recycling Construction of landfills for special waste (inert, hazardous etc.) Environmental education of the citizens	“There is no obvious problem with the regulation. There is no adequate mechanism of control and prosecution of the violators. There is a hope that the situation will be better with the operational help of the Environmental Auditors.”
Ireland	“The Enforcement Network (comprising of representatives from the EPA’s Office of Environmental Enforcement, the police and local authorities) is developing a best practice guidance on what to do when an illegal deposit is identified. Training on this issue is underway as detailed under Point 5.9.”	“An amendment to the Waste Management Act 1996 has been made (October 2004) - under Section 11 a of the Act the landowner is assumed to be responsible for illegal waste activities unless proven otherwise. Increased public awareness of waste management through initiatives such as the Race Against Waste campaign (www.raceagainstwaste.com) · Increased waste collection and transfer permits control. Increased staffing of Enforcement Networks. Local authority Community Wardens are investigating incidents of fly-tipping (most	“There is no system of administrative sanctions as the Irish constitution states that the courts must determine the appropriate sanction. Court procedures must follow, leading to a long lead in period, during which the illegal operations continue to operate and profit. None of the illegal landfill operators have gone to prison except one incidence of the six month sentence.”

Country	Practical measures to stop illegal landfilling	Incentives and measures to reduce illegal landfills	Shortcomings in deterrent measures
		<p>local authorities have 2 Wardens)</p> <p>It is anticipated that these actions will reduce the incidence of illegal landfills.”</p> <p>Penalties available under the EPA and WMA Acts are a summary conviction, a fine not exceeding €3,000 or imprisonment for any term exceeding ten years or both fine and imprisonment, or on conviction on indictment, a fine not exceeding €15,000,000 or imprisonment for a term not exceeding ten years or both fine and imprisonment.</p>	
Italy	<p>“Prevent the access to the site, together with other measures that are specific and related to the type of waste and to the characteristics of the surrounding, than start legal actions.”</p>	<p>“Improving the control system and the level of law enforcement.”</p> <p>For non-hazardous waste the maximum penalty is €25,822 and up to two years in prison. For hazardous waste this is €51,645 and up to three years in prison.</p>	<p>“The existing legislative system, D.Lgs. n. 22 of 5/02/97 and D.Lgs n. 36 of 13/01/2003 contain enough deterrent measures both at administrative and penal level.”</p>
Portugal	<p>“There as been a lot of education on the local municipals and promoted by the management systems responsible for the collection of the produced waste.”</p>	<p>“The measures in place are almost related with cleaning to prevent fires on the woods and forests. These actions occur normally before summer but with population only near these places. Usually these actions are done by the population and without a reward, and not by a legal authority.</p> <p>Although every year these kind of action is done. This means that there is always waste around illegally</p>	<p>No information provided.</p>

Country	Practical measures to stop illegal landfilling	Incentives and measures to reduce illegal landfills	Shortcomings in deterrent measures
		disposal.” The maximum penalty is €3,500,000 for individuals and €45,000,000 for companies.	
Spain	“Physical barriers, fencing etc. Surveillance and prosecution of infractors. Infringement procedures/criminal cases.”	“Awareness raising activities with stakeholders. Prosecution of infractors. Infringement procedures.” The maximum penalty is €1,200,000.	No information has been provided.
Sweden	“Depending how grave the illegal deposit are different measures will be taken, predominantly by using the legal framework. If the environmental impact is low you may have adaption period to correct the non-compliance. If the environmental impact is high the activity will be forbidden.”	“A waste handling system is available all over Sweden for all types of waste (Haz, recyclable, municipal etc.) Waste handling systems have been established in tight collaboration with different producers to maximise the re-use and recycling (also a legal obligation for some waste products, tyres, papers, glass, electronic products etc.) National educational measures and production of manuals, brochures, etc.” The maximum penalty is €110,000.	“According the Swedish EPA representative the fines is low and it is difficult to prove that a crime has been committed. The maximum penalty is 2 years in prison according to the law, 29 kap, 1§ Miljöbalken (Swedish Environmental Code) and 6 years according to the “criminal” law.”

It can be seen from the information provided above that a large amount of work is being undertaken on practical measures to stop illegal landfilling and that there are a number of incentives and measures to reduce the illegal landfilling activities.

Several of the Member States report that the immediate measures include ‘fencing’ the illegal landfill. This suggests that they are generally referring to fly-tipping, either where the land-

owner is not known or identified, or where it is clearly not the fault of the landowner, or where it is simply on the side of roads or highways. Where the landowner is easily identifiable, more direct legal action can be taken against this party.

It would appear that one of the main shortcomings is in the enforcement action related to this activity. Either the fines are too low, as in Sweden, or there is a failure in prosecuting the offenders as in Ireland. This latter approach simply encourages an increase in illegal landfilling or fly-tipping.

Greece has changed its National Waste Strategy in light of the Landfill Directive towards a rationalisation of sanitary landfills. It is hoped that this will also help to address the situation of illegal landfills.

As there is a general increase in pressure to divert waste away from landfills and a reduction in the number of landfills available (in tandem with increased costs) it is possible that the situation regarding illegal landfills may deteriorate unless these issues are addressed.

4.4 Conclusions

Task 2 of the Technical Annex to the tender documentation requires this study to assess the presence of illegal/uncontrolled landfills on the basis of existing information. It can be seen from the details provided above that the existing information is often sparse and incomplete despite an extensive literature review and discussions with government representatives and NGOs. The reasons for this lack of information and the conclusions from the information obtained are discussed below.

The definition of “landfill” in the Landfill Directive not always directly reflected in the definition contained within the legislation of each Member State. In some cases the definition of a landfill is given in relation to the issuing of a permit to construct and operate a landfill. This definition does not allow for the existence of a non-permitted (i.e. “illegal”) landfill.

The obtaining of data and evidence regarding illegal landfills has been the most difficult and frustrating part of the study. The crucial fact is that Member States do not share a common EC definition or directive which enforces them to record “illegal landfills”, and while this remains the case it will continue to be impossible to make proper comparisons with regard to similar activities. In addition, there was much confusion with regard to permitted landfills which are constructed or operated outside the terms of the permit. Whilst this might be generally classified as “non-compliant” in most Member States, it appears likely that some of the data and interpretation has led to these sites being recorded as “illegal”.

The EC appears to have known or feared for some time that there are a large number of “illegal landfills” in some parts of Europe. Parts of its original brief (Technical Annex) reveal what the EC was informally defining as an “illegal landfill” which could be one or more of the following:-

- Municipal and commercial (private) landfills created and operating without a permit under waste legislation;
- Other significant un-permitted and uncontrolled landfilling activities such as the infilling of wetlands, quarries and voids

The brief also stated clearly that the study was not intended to address problems of litter abuse and random fly-tipping. Even in the English language it is very difficult to obtain anecdotal rather than official data regarding these activities because most members of the public and NGOs find it difficult to differentiate between fly-tipping and illegal dumping. It seems that the EC’s informal definition above is with regard to a location where landfill disposal is being undertaken in a regular (daily/weekly) manner and is of sufficient size and presence in the neighbourhood that the local community would recognise it as a landfill (fences, gates, workers, machinery etc). The problem is that most of the general public would not know that such a local landfill was not properly permitted simply from its appearance and, if it is located in some parts of Europe where the landfill is controlled or operated by the municipality, then there are likely to be very few people who would consider it ‘illegal’, regardless of its permitting status. However, under EC legislation, the illegal landfill is basically one that is not permitted.

Against this background, ten Member States have reported zero illegal landfill sites; namely Austria, Belgium-Flemish, Denmark, Finland, Germany, Luxembourg, Netherlands and the UK. These countries pointed out that they have had other (non-EU) legislation in place for so many years (several quote the 1970’s) that required all landfills to be permitted. Consequently, in addition to effective enforcement activities which have been taken quickly if new illegal landfills are activated, the government representatives of these Member States are confident that there are no examples of illegal landfills.

Six Member States have reported a significant number of illegal landfills during the course of this study, and 2 reported ‘no data’, as follows:-

- Belgium-Walloon – 963;
- France – 1042;
- Greece – 1453;
- Ireland - >9;
- Italy – 1763;
- Portugal – 6, but these are now closed and remediation works being undertaken;

- Sweden – ‘no data – but considerable fly-tipping;
- Spain – ‘no data – no register/definition’.

The reason why these 6 Member States have relevant data is that they have made specific legislation that identifies the problem of illegal landfills and provides for specific parties to take action, often including the task of setting up a database. For example, Belgium-Walloon has had legislation since 1993 that assigned responsibility to one person to record and register illegal landfills. Today, the 963 examples are said to be mostly municipal solid waste and inert construction waste.

France established legislation to define and identify illegal landfills in 2004, following the implementation of the Landfill Directive. Interestingly, the legislation makes a clear distinction between “illegal deposit” (small quantity of waste by individual members of the public – or ‘fly-tipping’ as would be used in English) and “illegal landfill” (sites that receive regular loads of waste to a site in activity usually managed by the municipalities). This latter definition, to include municipalities, is a stark and transparent admission of the extent of the problem in France. The 1042 sites that were reported in this study were said to contain >30% municipal solid waste, <30% bulky waste and the remainder being undetermined. It is not clear from the study what the French government is doing with respect to these illegal landfills, but at least a good start has been made to identify and record the extent of the problem. Since earlier (10 years or so) reports had suggested that France might have as many as 25,000 illegal landfills (presumably with a wider definition), there appears to have been a significant improvement in the situation.

The situation in Greece that was found during this study provides further evidence of differences between Member States with regard to definitions. The government representatives for Greece explained that, whilst there is no formal definition of ‘illegal landfill’, what is meant by the term is a landfill that does not have the engineering requirements of the Landfill Directive such as the containment principles of geological/artificial liner, leachate treatment, gas management etc. Since 2004 a Task Force has compiled a national register of illegal landfills which is currently indicating 1,453, most of which are said to contain municipal solid waste and inert construction wastes with only a small amount of hazardous waste.

Greece is currently reviewing its National Waste Strategy to rationalise the number of landfills, aiming to ensure that there are a smaller number of compliant landfills and an associated reduction of illegal landfills. However, the gate fees for Greece are relatively low by comparison to the rest of the Member States and this is likely to increase the incentive to avoid the regulated waste disposal routes unless there is also an increase in enforcement.

In Ireland, a register of illegal landfills is in the process of being compiled, which currently records 9 landfills but expects there to be more especially in light of the EPA report *The Nature and Extent of Unauthorised Waste Activity in Ireland*, 2005 which details 25 unauthorised landfill

sites. These sites appear to be predominantly construction and demolition waste with only a small proportion (5%) deemed to be municipal waste.

In Italy, a report in 2002 appears to have suggested that there were 1,763 illegal landfills (although no details of wastes were provided). Following this report, the Environment Ministry has now instructed all Regions and Districts to report on all illegal landfills. The deadline for reporting was 10/06/06 any relevant official data has yet to be released.

Whilst Spain and Sweden reported no data, the comments from Sweden suggest that its problems are related mostly to small isolated dumps or fly-tipping.

The difference between the majority of the Member States who report that they have zero illegal landfills and those four Member States that report having in excess of 950 illegal landfills, gives rise to the conclusion that the methods by which illegal landfills are being measured between these countries are not comparable. It appears likely that some of those Member States reporting illegal landfills are counting incidents of fly-tipping, historic landfills, or permitted landfills that are having regulatory action progressed against them. Conversely, it is possible that those Member States reporting zero illegal landfills do not have the internal reporting mechanisms regarding illegal landfills or are defining all illegal landfills as fly-tipping incidents. For example the UK reported having no illegal landfill sites but a governmental report recognised that there are illegal landfills in Northern Ireland. Having said this, it does appear that France, Greece and Belgium-Walloon are prepared to recognise that they have had long-term problems with municipal authorities effectively operating illegal landfills in the past, and apparently continuing to do so after the implementation of the Landfill Directive.

The reasons for the existence of illegal landfills would appear to be country specific, except for the obvious economic reason, which is the avoidance of the gate fees at regulated landfills. Those Member States that provided the most useful information with regard to numbers of illegal landfills also gave valuable back-up information regarding the probably causes. France and Greece cited shortage of landfills in some parts of their countries and Greece suggested that there was a shortage of licensed operators. Four Member States, Belgium-Walloon, Greece, Spain and Sweden agreed that there was a fragmented or inadequate administrative responsibility. Finally, several countries agreed that cost of disposal was a major factor in the evolution of illegal dumping particularly Greece, Spain and Sweden.

It would appear that one of the main shortcomings of those Member States reporting illegal landfills is in the implementation of the enforcement action related to this activity. However, it can be seen from the information provided that a large amount of work is being undertaken on practical measures to stop illegal landfilling and the incentives and measures to reduce the illegal landfilling or fly-tipping activities. In this regard, it is concluded that the Landfill Directive is beginning to have a positive effect in encouraging those Member States with a recognised problem to take actions which will improve the situation.

5.0 EXAMPLE OF EXISTING 'COMPLIANT' LANDFILLS IN MEMBER STATES

5.1 Introduction

One landfill site was selected and visited in each of the 15 Member States as a representative case study. The selected sites were put forward by each Member State as examples of landfills compliant with the Landfill Directive. The Flemish and Walloon regions of Belgium have been dealt with separately throughout this Report. However, only one site visit was carried out in the Flemish region due to the lack of new landfills in the Walloon region.

The site visits were carried out to investigate how the Landfill Directive, especially Annex 1, is being interpreted and implemented at a local level to ensure the protection of the environment. A mixture of hazardous and non-hazardous landfills are presented.

This chapter of the Report repeats the key requirements of the Landfill Directive (Annex 1) in terms of the general requirements for all classes of landfill and then deals with each case study in detail. The name, address, operator and type of landfill site visited in each Member State are presented in the table below. Austria and Germany have requested that the sites visited remain confidential and therefore the names and addresses of the operator and sites are not detailed in this Report.

It was not always possible for the Member State to provide a landfill that was started after the implementation of the Landfill Directive (see Section 3.2.1 for a discussion on number of landfills permitted since the implementation of the Landfill Directive). Where this was not possible a the later phases/cells of a landfill were assessed in light of the implementation of the Landfill Directive.

Table 9: Case study landfills

Member State	Landfill Name & Address	Landfill Operator	Landfill Type
Austria	Confidential	Confidential	Non-hazardous
Belgium	Indaver NV, Poldervlietweg 5 Haven 550	Indaver NV	Separate hazardous and non-hazardous cells
Denmark	AV Miljø, Avedøreholme 97, 2650 Hvidovre, Denmark	AV Miljø	Separate hazardous and non-hazardous cells

Member State	Landfill Name & Address	Landfill Operator	Landfill Type
Finland	Ämmässuo, The Waste Treatment Centre in Espoo, Ämmässuontie 8, 02820 Espoo, Finland	Ämmässuo	Non-hazardous
France	Claye Souilly, RN3 CD404, 77410 Claye Souilly	Onyx	Non-hazardous
Germany	Confidential	Confidential	Non-hazardous
Greece	Patras Landfill, Kserolaka Achaïas	Municipality of Patra	Non-hazardous
Ireland	KTK Landfill, Brownstown and Carnalway, Kilcullen, Co. Kildare	KTK Landfill Ltd (subsidi. of Greenstar Ltd)	Non-hazardous
Italy	Casa Rota, Strada provinciale 7 Piantravigne Terranuova Bracciolini (Arezzo)	Centro Servizi Ambiente S.p.A.	Non-hazardous
Luxembourg	Landfill of Muertendall, L 6925 Buchholz-Muertendall	Syndicat Intercommunal (SIGRE)	Non-hazardous
Netherlands	Nauernache Polder, Nauerna 1, 1566PB, Assendelft	NV Afvalzorg	Separate hazardous and non-hazardous cells
Portugal	Aterro de Mato da Cruz (Mato da Cruz Landfill), Mato da Cruz, Calhandriz, Vila Franca de Xira	Valorsul	Non-hazardous
Spain	Vertedero de Las Dehesas, Cañada Real s/n Valdemingómez, Madrid	VERTRESA & RWE	Non-hazardous
Sweden	Sofielunds återvinningsanläggning, "Deponi 2000" (Stage 1), Landfill 2000, Holmträskvägen, Gladö industriområde, Huddinge (next to Stockholm)	Sofielunds återvinningsanläggning	Non-hazardous
United Kingdom	ICI No 3 (Teesport) Landfill, BV 1917 – Middlesbrough	Impetus Waste Management	Hazardous

5.2 Requirements under the Landfill Directive

5.2.1 Water control and leachate management

The general requirements for all classes of landfills, to ensure protection of the environment as detailed in Annex 1 of the Landfill Directive include the following:

Appropriate measures shall be taken, with respect to the characteristics of the landfill and the meteorological conditions, in order to:

- control water from precipitations entering into the landfill body,
 - prevent surface water and/or groundwater from entering into the landfilled waste,
 - collect contaminated water and leachate. If an assessment based on consideration of the location of the landfill and the waste to be accepted shows that the landfill poses no potential hazard to the environment, the competent authority may decide that this provision does not apply,
 - treat contaminated water and leachate collected from the landfill to the appropriate standard required for their discharge.

The above provisions may not apply to landfills for inert waste.” (Annex I, 2)

“a leachate collection and sealing system must be added ... so as to ensure that leachate accumulation at the base of the landfill is kept to a minimum” (Annex I, 3.3)

5.2.2 Protection of soil and water

“A landfill must be situated and designed so as to meet the necessary conditions for preventing pollution of th soil, groundwater or surface water and ensuring efficient collection of leachate as and when required according to Section 2.”

liner

“The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements with a combined effect in terms of protection of soil, groundwater and surface water at least equivalent to the one resulting from the following requirements:

- landfill for hazardous waste: $K \leq 1,0 \times 10^{-9} \text{ m/s}$; thickness $\geq 5 \text{ m}$,
- landfill for non-hazardous waste: $K \leq 1,0 \times 10^{-9} \text{ m/s}$; thickness $\geq 1 \text{ m}$,
- landfill for inert waste: $K \leq 1,0 \times 10^{-7} \text{ m/s}$; thickness $\geq 1 \text{ m}$

Where the geological barrier does not naturally meet the above conditions it can be completed artificially and reinforced by other means giving equivalent protection. An artificially established geological barrier should be no less than 0,5 metres thick.” (Annex I, 3.2)

cap

“If the competent authority after a consideration of the potential hazards to the environment finds that the prevention of leachate formation is necessary, a surface sealing may be prescribed” (Annex I, 3.3)

5.2.3 Gas Control

“Landfill gas shall be collected from all landfills receiving biodegradable waste and the landfill gas must be treated and used. If the gas collected cannot be used to produce energy, it must be flared” (Annex I, 4.2)

5.2.4 Nuisance and hazards

"Measures shall be taken to minimise nuisances and hazards arising from the landfill through:

- emissions of odours and dust,*
- wind-blown materials,*
- noise and traffic,*
- birds, vermin and insects,*
- formation and aerosols,*
- fires." (Annex I, 5)*

5.3 Austria

5.3.1 Basic Information

Name of the site	Confidential
Address of the site	Confidential
Date of creation	License according to the Waste Management Act of Burgenland of 1980 and the Water Right Law of Austria of 1980
Type of Landfill	Non-hazardous
Total capacity	4.095 M m ³
Remaining void space (at the time of the interview)	Void space: 2.569 M m ³ (2,569,000 m ³)
Site area	-

5.3.2 Site Engineering and Operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

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| <ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> • <i>Treat contaminated water and leachate</i> | <ul style="list-style-type: none"> • Water from undeveloped areas flows into surface water basins” and is used for dust suppression. Contaminated runoff is collected and discharged to foul sewer. • Eastern phase: there are “28 leachate collection shafts which are connected to one leachate collecting pipe” (“concrete, 200 mm diameter, 250 m – 350m in length”) that discharges to the relevant leachate catchment basin.

Northern phase: the leachate is collected in “8 leachate collection pipes” (“PE-HD, 200 mm diameter, 75 m – 135 m in length”) that discharges to the relevant leachate catchment basin.

The leachate is collected via the shafts and pipe detailed above. There is no drainage blanket as the leachate is able to be discharged under gravity • Leachate and contaminated water is discharged to foul sewer for treatment at the sewerage treatment works |
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Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- Water entering the landfill is controlled through the provision of a cap.
- Contaminated water and leachate is collected as detailed above.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- Eastern phase completed 1982 (i.e. prior to the Landfill Directive), “two clay layers 25 cm – 30 cm thick.”
- Northern phase completed 1995, “three clay layers at 25 cm thick, 2.5 mm HDPE, geotextile 1200g/m³, 50 cm drainage (16/32), fleece 50 cm protective layer.”

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- Eastern phase “0.2 m – 0.3 m mineral sealing” layer completed in 1995.

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- The gas from the site is collected and sent to a combined heat and power plant. When the plant is down the gas is flared. “Outside of the landfill area there is no gas monitoring.”

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- There are few issues regarding landfill nuisances as the site is 4 km from the nearest private houses. Uncontaminated surface runoff is used for dust suppression. There have been no complaints regarding noise, litter, odour or mud on the roads.

5.3.3 Assessment of Compliance with the Landfill Directive

The existing landfill lining system was constructed before the Landfill Directive came into force and therefore it is not possible to determine the effect of the Landfill Directive on the protection of soil and water by the lining. The thickness of the geological barriers beneath existing cells does not appear to be in line with the requirements of the Landfill Directive because the stated permeability is 1×10^{-9} m/s but the thickness is less than 1m. Annex 1 requires that the mineral liner provides protection of soil, groundwater and surface water equivalent to 1m of a material with a permeability of 1×10^{-9} m/s.

Water control and leachate management appears to be consistent with the requirements of the Landfill Directive. Leachate is discharged to the local sewage treatment plant. To date monitoring shows “no influence on groundwater; no problems with the surface water”.

The site appears to have gas control in line with the requirements of Annex 1 because the gas is being used to produce energy. Adequate measures (including appropriate site location) appear to have been taken to minimise nuisance and hazards.

5.4 Belgium

5.4.1 Basic information

Name of the site	Indaver NV
Address of the site	Poldervlietweg 5 Haven 550
Date of creation	October 1987
Type of Landfill	Separate hazardous & non-hazardous cells
Total capacity	2,000,000 m ³ (3,000,000 tonnes)
Remaining void space (at the time of the interview)	15.7 % (from exploitation deposit, 1,490,000 m ³)
Site area	10.76 ha

5.4.2 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

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| <ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> • <i>Treat contaminated water and leachate</i> | <ul style="list-style-type: none"> • The leachate comes from water which drains horizontally to the ring drainage system. Run-off is “derived from rain on the covering layer.” Water from non-landfill areas is not normally contaminated. • Leachate is collected through a ring drainage system. • The leachate is pre-treated through a physical/chemical reactor before being processed by the water treatment works. The contaminated run-off is sent to the water treatment works without pre-treatment. The uncontaminated water is stored prior to re-use. |
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Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- Water is prevented from entering the landfill body through the provision of a covering layer
- Leachate is collected through a ring drainage system. Contaminated run-off is also collected.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- Phase 1 side wall (2.5 m) – “Occlusion system: sand sealing (permeability 5×10^{-5} m/s) /HDPE foil (2.5 mm)/ laying bed/ control drainage/ geological barrier.”

Phase 2 border bunds – “Occlusion system: grind sealing as percolate drainage (grind diameter 16-32 mm)/ geo-textile/ clay mat/ HDPE-foil (2.5mm)/ electronic leakage detection system/ HDPE-foil (2.5mm)/ clay mat/ laying bed/ geological barrier.”

Cap

- *If the prevention of of leachate formation is necessary a surface sealing may be prescribed*
- The covering layer is a “homogeneous impermeable layer of solidification material/ impermeable clay mat/ electronic leakage detection system/ 2.5 mm HDPE-foil.” On the banks and top there is also a 1 m of soil mixture.

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- There is no gas collection as monitoring of gas in the past showed no gas production.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- Only one complaint regarding odour has been recorded to date.

5.4.3 Assessment of Compliance with the Landfill Directive

The waste deposit is predominantly a landraise. Some information has been provided regarding sidewall lining which is likely to the cap on the side of the landraise. There appears to be a basal artificial sealing liner, but information is insufficient to determine if there is an adequate basal mineral liner. The existing landraise lining system was constructed before the Landfill Directive came into force.

Landraise capping would appear to be adequate to meet the Annex 1 requirements. There is collection and treatment of leachate in line with Annex 1.

There is insufficient information to determine if the landraise complies with the Annex 1 requirements in respect of landfill gas management. The operator has considered no management of landfill gas is appropriate because there is “no registered gas evolution”. However, there has been one “grey” complaint about odour nuisance. Since only one complaint is recorded, measures to minimise nuisance and hazards from the landfill would therefore appear to be consistent with the requirements of the Landfill Directive.

The operational requirements of the Landfill Directive would appear to be preventing adverse effects from the landraise on the environment.

5.5 Denmark

5.5.1 Basic information

Name of the site	AV Miljø
Address of the site	Avedøreholme 97, 2650 Hvidovre, Denmark
Date of creation	1989
Type of Landfill	Separate hazardous & non-hazardous cells
Total capacity	2,000,000 m ³
Remaining void space (at the time of the interview)	729,076 m ³
Site area	40,000 m ²

5.5.2 Background

The position of different waste types being deposited at the landfill are continuously plotted on a site plan, although a GPS or GIS system is not used. Daily cover is applied to the asbestos waste and “shredder” waste is sprinkled with water in order to obtain optimal properties for compaction prior to covering.

5.5.3 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

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| <ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> • <i>Treat contaminated water and leachate</i> | <ul style="list-style-type: none"> • There is a drainage system with a drainage pipe every 12 metres in each cell. The drainage pipes are made of plastic and located in the clay till below the base of the cells. • There are two monitoring wells in each cell. There are a number of additional wells used to connect pipes where water can be sampled • All leachate water is discharged to the nearby located municipal waste water treatment plant. There is a waste water treatment plant on site for the removal of heavy metals prior to it being sent to the municipal plant. |
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Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- The cap does not “protect rainwater from entering the cells since the strategy is for rain water percolation to support the degradation of the waste.”
- Leachate is collected through the drainage system.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- “The base consists of 5-8 m of clay till together with hydraulic water pressure from the adjacent sea-level.” According to on-site monitoring the flow of water through the base into the cells is 0.011 m³/ m²/yr.”

Cap

- *If the prevention of of leachate formation is necessary a surface sealing may be prescribed*
- “The cap consists of gravel followed by argilliferous soil with a total thickness of 1.2 m.”

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- “No specific landfill gas abstraction wells exist since only minor amounts of bio-degradable waste” is deposited on site.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- No complaints have been received.

5.5.4 Assessment of Compliance with the Landfill Directive

The landfill accepts both non-hazardous and hazardous waste at different parts of the landfill separated by geological barriers and having separate leachate water handling systems.

The existing landfill lining system was constructed before the Landfill Directive came into force and therefore it is not possible to determine the effect of the Landfill Directive on the protection of soil and water by the lining.

The waste is underlain by at least 5 m of clay which extends to at least 10 m on the sidewalls. There is no record of permeability measurements on the clay and therefore it is not possible to

ascertain if the mineral layer offers protection of soil, groundwater and surface water equivalent to that prescribed by Annex 1 of the Landfill Directive. Mention is made of a “hydraulic membrane”, which probably constitutes the artificial sealing liner.

The waste is placed below sea level and water therefore enters the landfill. There is no comment as to whether there is management of leachate level to minimise groundwater entry to the waste and it is therefore not possible to ascertain if “appropriate measures” are being taken to “prevent surface water and/or groundwater from entering into the landfilled waste”.

The landfill is not in line with the Landfill Directive requirement to “control water from precipitations entering into the landfill body” because the strategy is to encourage rainwater to enter the cells to support the degradation of waste. The landfill has a leachate collection system although information is lacking to determine whether the drainage blanket thickness meets the Landfill Directive requirement of at least 0.5m. Leachate is treated to a standard fit for discharge in line with the requirements of the Landfill Directive and no impacts are reported on soil and groundwater.

Although “minor amounts of biodegradable waste” is landfilled, gas is not collected despite Annex 1 of the Landfill Directive requiring gas collection, treatment and use. Stressed vegetation is reported around the site and high levels of hydrogen sulphide reported in the leachate discharge. The landfill in not applying the full requirements of the Landfill Directive would appear to be resulting in an impact on the environment.

There are no reports of complaints, and wind blown litter is being managed in line with the Landfill Directive’s requirements.

5.6 Finland

5.6.1 Basic information

Name of the site	Ämmässuo, The Waste Treatment Centre in Espoo
Address of the site	Ämmässuontie 8, 02820 Espoo, Finland
Date of creation	1987
Type of Landfill	Non -hazardous
Total capacity	14.8 M m ³
Remaining void space (at the time of the interview)	3 M m ³
Site area	50 hectares (current landfill)

5.6.2 Background

The waste management department has been operating according to an ISO 14001 certified environmental management system since 1997. It has also had an ISO 9002 quality management system since 1999, which was expanded to include occupational safety matters in 2002.

The quality of waste and the waste that is load is monitored (e.g. weighing and visual screening) according to the permit conditions for the landfill and the authorities are informed about any offences.

5.6.3 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

- *Control water entering the landfill body*
- Surface water from restored areas is collected to in ditches around the landfill area. The quality of the surface waters is controlled constantly in 3 places to determine whether it is discharged to surface water or to the waste water treatment plant.
- *Collect contaminated water and leachate*
- Run-off is collected on site and if contaminated it is sent to the waste water treatment plant.

- *Treat contaminated water and leachate*

- All soiled waters from the waste treatment centre area are led to an equalizing basin before leading to a municipal waste water treatment plant.

Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*

- Water entering the landfill body is controlled through the construction of a cap.
- Contaminated water and leachate are collected and treated by the municipal waste water treatment plant.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*

- The liner for the latest cell is composed of “waterproof asphalt”.

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*

- Only cell one has been partially capped. This consists of a “gas drainage layer 500 mm, impermeable mineral layer 500 mm, artificial sealing liner, drainage layer 500 mm, top soil cover 1 m – 1.5 m.”

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*

- “There are 192 gas suction wells and 4 gas pumping stations within the landfill gas collection system.” “About 30% of the gas is flared and 70% is used in energy production.” The gas has been utilised since 2004” and in future will be used in the production of district heating.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*

- There have been complaints about noise, dust, litter and odour. A substantial programme of measures to identify the emission sources and reduce the odour emissions has been initiated.

5.6.4 Assessment of Compliance with the Landfill Directive

For those areas of the site that were constructed before the implementation of the Landfill Directive it is impossible to determine the effect of the Landfill Directive on the protection of soil and water by the liner.

For subsequent lining systems, waterproof asphalt is described within Cell 5; however, specific engineering specifications are not described, and therefore the performance of the lining system to protect soil and groundwater can not be assessed further.

Future cells are not described in depth, however are noted to be constructed to the correct specification for the specified waste types.

Capping specifications appear to be in line with the requirements of the Landfill Directive.

Water control and leachate management is interpreted to be in accordance with the Landfill Directive. Leachate is collected from the site and held within an “equalizing lagoon” prior to disposal at a waste water treatment plant. Despite active management of leachate, some impacts to groundwater and surface water are reported.

The site appears to have gas control because the gas is being used to produce energy which is in line with the requirements of Annex 1. Adequate measures including the progressive capping and utilisation of gas appear to minimise nuisance and hazards.

5.7 France

5.7.1 Basic information

Name of the site	Claye Souilly
Address of the site	RN3 CD404, 77410 Claye Souilly
Date of creation	Operated since before 1969, authorised in 1972 and 1986.
Type of Landfill	Non-Hazardous
Total capacity	40,000,000 m ³
Remaining void space (at the time of the interview)	5,700,000 m ³
Site area	153 ha

5.7.2 Background

The REP society operated the landfill since 1969. The landfill existed before; no piece of information was available about its creation. The landfill is authorised by French authorities in 1972. The society REP submitted a request for site use in 1985. The administration delivered a new authorisation in 1986 because of the extension of the landfill. A project to extend the landfill will be presented to the French authorities in 2008.

At present, there are 3 void cells. The current remaining empty space represents 5,7 millions tonnes of waste. There is another cell, but the site representative has the project to create a clinkers curing platform at this place to valorise a part of the storage in place. Two cells are currently used for storing material containing asbestos and for clinkers. A cell can be exploited for 2 years before its entire fulfilment.

5.7.3 Site engineering and operations

Landfill Directive Requirements	Site Specific Implementation
Water control and leachate management	
<ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> • <i>Treat contaminated water and leachate</i> 	<ul style="list-style-type: none"> • “Storm water drained (from the site) is treated in a separator and stored in a decantation basin. The major part is reused in the process mainly for avoiding dust dispersion and for roads cleaning.” “Water is collected below and above the waste.” “The drainage layer above the waste collects storm water.” • “Each cell is equipped with one well that collects leachate.” “PEHD, diameter 1000 mm.” The “distance between two horizontal pipelines collecting leachate is about 25 m.” “A cell can contain between 6 to 8 horizontal pipelines.” • “Before treatment leachate is stored in a sump of 800 m3 capacity. This basin is equipped with an aerator.” The leachate then passes to a plant for treatment by “vacuum evaporator and reverse osmosis.”
Protection of soil and water	
<ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> 	<ul style="list-style-type: none"> • Water controlled from entering the waste through the construction of a cap with a drainage layer. • Leachate is collected before being treated in the on-site treatment plant.
<u>Liner</u>	
<ul style="list-style-type: none"> • <i>The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.</i> 	<ul style="list-style-type: none"> • “5 m of materials taken on site from quarry, compacted to obtain a permeability of 1×10^{-6} m/s, 1 m of clay loam, taken on site from quarry, and compacted to obtain a permeability of 1×10^{-9} m/s, geotextile to protect the geomembrane, 2 mm geomembrane of PEHD.”
<u>Cap</u>	
<ul style="list-style-type: none"> • <i>If the prevention of leachate formation is necessary a surface sealing may be prescribed</i> 	<ul style="list-style-type: none"> • “1 m clay loam taken on site and compacted to obtain a permeability of 1×10^{-9} m/s, layer of drainage materials (0.5 m) equipped with drainage network to collect storm water, layer of soil (0.5 m), layer of topsoil (0.6 m).”
Gas control	
<ul style="list-style-type: none"> • <i>Landfill gas shall be collected from</i> 	<ul style="list-style-type: none"> • There are “two lines to produce electricity.” “The

all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.

first line is composed of three boilers” connected “to a steam turbine.” “The second line is composed of a gas turbine.” When either of the two lines are down for maintenance the gas is flared.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- There have been complaints regarding “odours and birds.” Operating procedures have been “put in place to avoid the release of odours.” The site has also been equipped with cages to trap crows.

5.7.4 Assessment of compliance with the Landfill Directive

There was insufficient information available to assess the lining system beneath those cells that were constructed prior to the implementation of the Landfill Directive.

The current design for the lining system appears to be in line with the requirements of the Landfill Directive because it includes a mineral lining system of sufficient thickness and at the required specification (1 m at 1×10^{-9} m/s) and an artificial sealing liner.

The cap includes an impermeable component (1 m at 1×10^{-9} m/s) overlain by a surface water drainage layer. However, the cap specification does not appear to include a gas drainage layer. Whether this meets the requirements of the Landfill Directive will then depend on the appropriate risk assessment.

Water control and leachate management appears to fulfil the requirements of the Landfill Directive, because surface water and groundwater is prevented from entering the landfill and active leachate management, treatment and disposal is taking place. No environmental problems have been identified at the site.

Adequate mitigating measures appear to have been made to minimise problems that would cause nuisance to the neighbours.

5.8 Germany

5.8.1 Basic information

Name of the site	Confidential
Address of the site	Confidential
Date of creation	August 1988
Type of Landfill	Non-Hazardous
Total capacity	max. 16,500,000 m ³ in 5 sections
Remaining void space (at the time of the interview)	3,000,000 m ³ (Section 1 and 2, remaining section not yet planned)
Site area	136.5 ha (of which 80 ha is landfill area)

5.8.2 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

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| <ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> • <i>Treat contaminated water and leachate</i> | <ul style="list-style-type: none"> • “Surface water from the preliminary covered section 1 as well as all surface water from traffic areas and sewerage flows to a waste water treatment facility.” • “0.45 m thick gravel layer at the base of the deposited waste, peripheral and cross-sectional pipework for each section.” “Leachate is collected in a peripheral pipeline with a diameter of 0.3 m.” • “Leachate flows directly to the waste water treatment facility.” The on-site “treatment facility consists of a 2 fold biological treatment followed by flocculation and filtration.” |
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Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- Water entering the landfill body is controlled through the construction of a cap.
- Leachate and contaminated water is collected and sent to the waste water treatment facility.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- Cell 1: “3 mm HDPE seal upon 2 layers of clay seal (permeability 1×10^{-10} m/s)”.
- Cell 2: “3 mm HDPE seal upon 3 layers of clay seal (permeability 1×10^{-10} m/s)”.

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- “0.3 m soil upon HDPE seal” over gravel acting as a gas collection layer.

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- There are “8 temporary gas abstraction wells in section 1” sending gas to two combined heat and power generators.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- Complaints have only been received regarding litter and mud on the road. Any complaint is immediately acted upon.

5.8.3 Assessment of Compliance with the Landfill Directive

The existing landfill was constructed prior to the implementation of the Landfill Directive. However the mineral component of the liner has been constructed to a higher standard than required (equivalent to 1 m thick at permeability of 1×10^{-9} m/s). All cells have been constructed with an artificial sealing layer. Therefore the lining system at this site appears to meet the requirements of the Landfill Directive.

The specification of the cap includes a gas drainage layer, impermeable layer and cover soils. However the Landfill Directive requires a surface water drainage layer for non-hazardous sites, which is not specified, and cover soils are proposed to be 0.3 m thick compared with the Landfill Directive requirement of a thickness of 1 m. Therefore, unless a specific environmental risk assessment has determined otherwise the cap does not appear to be in line with the requirements of the Landfill Directive.

Leachate is actively managed, treated and disposed of; however the leachate drainage blanket is 0.45 m thick compared with the required thickness of leachate drainage blanket of 0.50 m. It is unknown if this has been justified on the basis of an appropriate risk assessment.

The leachate abstraction system and operation of a waste water treatment facility on the site reportedly prevents significant impacts to surface water.

There is no evidence of gas migration at the site; the installed gas abstraction system reportedly prevents significant emissions of landfill gas.

In Germany since 1 June 2005, all non-compliant MWS landfills or sections of landfills respectively have been closed in accordance with “Abfallablagungsverordnung” (the relevant waste legislation). The German Environmental Agency does not report on landfill compliance because as the responsibility for this is placed on the authorities of the Federal States.

5.9 Greece

5.9.1 Basic information

Name of the site	Patras Landfill
Address of the site	Kserolaka Achaiais
Date of creation	1997
Type of Landfill	Non-Hazardous
Total capacity	3,000,000 m ³
Remaining void space (at the time of the interview)	700,000 m ³
Site area	70,000 m ²

5.9.2 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- *Treat contaminated water and leachate*
- Storm water that falls on the active cells is gathered by the leachate management system. For all other runoff there is a perimeter ditch which feeds a local stream.
- “There is a 40 cm thick drainage layer of non-carbonated gravel.” Perforated pipes in a herringbone pattern collect the leachate.
- A proportion of the leachate is recirculated in the temporarily capped non-operational areas of the landfill. The rest of the leachate is pumped to an aerated tank followed by a settlement tank after which it is either recirculated or discharged to the sewerage system.

Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- Water entering the landfill is controlled through the construction of a cap. Currently there is only a temporary cap.
- Water entering the landfill is collected through the leachate drainage layer.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- “Compacted layer, min. thickness 50 cm and hydraulic conductivity equivalent with a layer of clay with 1 m thickness and permeability 1×10^{-9} m/s.” “HDPE geomembrane (thickness 2 mm).” “Geotextile layer above the HDPE liner for protection.”

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- Currently only temporarily capped with “sandy clay with hydraulic conductivity 1×10^{-6} m/s and min thickness 50 cm.”

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- Currently “two biogas flares are used” on site.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- There have been some complaints regarding odour when the wind is blowing from the working face towards nearby houses.

5.9.3 Assessment of Compliance with the Landfill Directive

Although the site was constructed before the implementation of the Landfill Directive the lining system has both a mineral component and an artificial sealing liner. The mineral component of the liner is of minimum thickness 0.5 m but is equivalent to a 1 m liner with a permeability of 1×10^{-9} m/s. Therefore the lining system appears to be consistent with the requirements of the Landfill Directive.

The site is currently temporarily capped. It is noted that the cap design will be in line with the requirements of the Landfill Directive.

The leachate drainage blanket comprises a 0.4 m thick layer of drainage stone with a herringbone arrangement of drainage pipework. The Landfill Directive requires a drainage blanket thickness of 0.5 m; therefore, further justification of the drainage blanket thickness would be required to confirm that it fulfils the requirements of the Landfill Directive.

Leachate is actively managed, processed and disposed of to sewer. There is no recorded impact of the site on the surrounding environment.

The site appears to have gas control in line with the requirements of Annex 1 because the excess gas is being managed by flaring. Apart from occasional odour complaints, adequate measures appear to have been taken to minimise nuisance and hazards.

5.10 Ireland

5.10.1 Basic information

Name of the site	KTK Landfill
Address of the site	Brownstown and Carnalway, Kilcullen, Co. Kildare
Date of creation	December 1999
Type of Landfill	Non-hazardous
Total capacity	2 M to 2.5 M tonnes
Remaining void space (at the time of the interview)	Based on the current annual tonnage restrictions and the planning permit conditions, the landfill is expected to close in October 2008.
Site area	25 Hectares

5.10.2 Background

The landfill began operations in 1999 and is one of a growing number of landfills in Ireland that is privately owned and operated. The landfill is classified as a non-hazardous landfill site, and currently accepts non-hazardous commercial and industrial wastes. Some construction wastes containing asbestos is accepted at a specially engineered cell. The disposal of putrescible wastes is not permitted under the terms of the licence.

5.10.3 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

- *Control water entering the landfill body*
- Leachate from the hardstanding areas and the landfill cells is diverted to the leachate holding tank. Surface water from all other areas is sent by interceptors to a subway permitted discharge.

- *Collect contaminated water and leachate*
- *Treat contaminated water and leachate*
- “The drainage blanket is comprised of 20 mm nominal size non-calcareous rounded gravel with slotted HDPE herringbone pipework across the floor.” “Leachate is abstracted via two sideslope risers” per sump. The leachate is “pumped to an underground concrete holding tank, about 20 m³.”
- Leachate is recirculated and tankered off site to the local waste water treatment plant.

Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- There is no control on water entering the landfill as it is not currently capped.
- Leachate is collected via the drainage blanket.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- “1 m thick boulder clay at 1x10⁻⁹ m/s permeability.” “HDPE liner 2 mm.” “0.5 m drainage blanket.”

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- No final cap has been installed yet. Only temporary intermediate capping has been installed.”

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- “2 x 1.2 MW Deutz engines are currently installed awaiting connection to the electricity grid.” There are currently 4 flares being used on site.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- Complaints have been received regarding odour from the site due to wind blowing in that direction.

5.10.4 Assessment of compliance with the Landfill Directive

The existing landfill lining system was constructed before the Landfill Directive came into force and therefore it is not possible to determine the effect of the Landfill Directive on the protection of soil and water by the lining.

The specification of the geological barrier component of the liner is adequate with regard to thickness and permeability and appears to be in line with the requirements of the Landfill Directive. An artificial sealing liner is present.

The site is currently un-capped and designs for the cap were not available at the time of the site visit.

Leachate is actively managed with leachate heads being maintained between 0.5 – 0.6 m; despite active leachate management, impacts to groundwater, surface water, sewer and land have been reported.

Due to active management of gas at the site for the production of energy there is no evidence of vegetation stress reported.

Steps have been made to manage nuisance and health issues at the site, although some complaints have been received and are logged at the site.

5.11 Italy

5.11.1 Basic information

Name of the site	Casa Rota
Address of the site	Strada provinciale 7 Piantravigne Terranuova Bracciolini (Arezzo)
Date of creation	Initially it was permitted as I class and II class type B landfill, with the Deliberation of the "Giunta Provinciale" of Arezzo n° 340 of 28/07/88. It has obtained the permit for Non-Hazardous waste, according to the new classification, with the Delibera of the "Giunta Provinciale" n° 583 of 4/08/03
Type of Landfill	Non-Hazardous
Total capacity	3,700,000 m ³
Remaining void space (at the time of the interview)	At 31/12/04: 1,601,800 m ³
Site area	196,000 m ² (waste site cell only)

5.11.2 Background

The landfill is divided into two cells: the older cell was completed prior to the Landfill Directive and is compliant with the old legislation, and the new cell compliant with the Italian regulations 2003. Eventually the two landfill bodies will be joined together and there will be only one capped surface.

The landfill is currently permitted for municipal solid waste, wastes produced by selection or treatment plants, special non hazardous waste and treated sludge from wastewater treatment plants.

5.11.3 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

- *Control water entering the landfill body*
- Surface water is collected and transported around the landfill through a system of concrete ditches until it is discharged into the Torrente Riofi which flows on the south side of the site.

-
- *Collect contaminated water and leachate*
 - *Treat contaminated water and leachate*
 - The drainage blanket is composed of: “a woven-non-woven layer to protect the geomembrane; drainage layer (gravel): 50 cm; HDPE primary perforated pipes diameter of 200 mm and thickness class PN10; HDPE secondary perforated pipes diameter of 150 mm and thickness class PN10.”
 - The leachate is stored in “12 tanks made of reinforced fibreglass” with “secondary containment consisting of reinforced concrete” structure before being tankered for off-site treatment.

Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- Water entering the landfill body is controlled through the construction of a cap.
- Leachate is collected from the drainage blanket through a system of wells and pumps

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- New area: “compacted native clay liner, thickness: 100 cm, permeability: $k < 1 \times 10^{-9}$ m/s; HDPE geomembrane (supplier GSE): 2.5 mm.” “Polypropylene woven-non-woven (supplier Polyfelt) (1,200 g/m²).” “Drainage layer (gravel): 50 cm.”
- Sideliner: HDPE geomembrane (supplier GSE): 2.5 mm”
- “Geosynthetic clay liner, thickness: 6 mm, permeability: $k < 5 \times 10^{-11}$ m/s.”

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- “Foundation layer; gas drainage layer (gravel): 50 cm; LDPE geomembrane: 0.3 mm; compacted mineral (clay) layer: 50 cm; drainage layer (gravel or shredding tyres): 50 cm; natural soil fill: 60 cm; top soil layer: 40 cm.”

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- “There are four gas fuelled electricity generating units” with a back up flare.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- The only complaint is with regards to local traffic.

5.11.4 Assessment of compliance with the Landfill Directive

The older parts of the site were constructed prior to the implementation of the Landfill Directive. However the specification of both the old and new components of the site appear to fulfil the requirements of the Landfill Directive; the mineral barrier is 1 m thick with a maximum permeability of 1×10^{-9} m/s. All phases are constructed with an artificial sealing liner.

The site currently does not have a final cap. However, the proposed cap will comprise a gas drainage layer, impermeable layer and surface water drainage layer of the appropriate thicknesses, and will therefore be in line with the requirements of the Landfill Regulations.

Surface water is prevented from entering the site through management of surface runoff by constructed concrete ditches.

Leachate is actively managed, stored and tankered from the site. There are no reported anomalies in groundwater surface water or soil.

Impacts to air are reportedly reduced since the implementation of active gas management at the site to utilise gas for electricity generation; however, local signs of vegetation stress are noted.

Active management of dust and odour combined with site location within a valley may have been factors resulting in no nuisance and health impacts from the site.

Compliance of the landfill is assessed at a local level by the Province Authorities and the Regional Environment Agencies. No centralized control and data collection at national level are in place.

5.12 Luxembourg

5.12.1 Basic information

Name of the site	Landfill of Muertendall
Address of the site	L 6925 Buchholz-Muertendall
Date of creation	19 January 1984
Type of Landfill	Non-Hazardous
Total capacity	300,000 m ³
Remaining void space (at the time of the interview)	-
Site area	-

5.12.2 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- *Treat contaminated water and leachate*
- Surface water is collected in a reservoir and treated biologically to the desired standard and discharged to the nearest communal waste water treatment plant for final treatment.
- Leachate is extracted from the drainage layer in the liner and is then treated on-site.
- The on-site treatment plant consists of two buffer tanks and two aerobic batch reactors after which the treated leachate is discharged to the communal waste water treatment plant.

Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- *Water entering the landfill is controlled through the construction of a cap.*
- *Surface runoff and leachate are both collected prior to being sent for treatment.*
- *The liner consists of a mineral layer, HDPE geomembrane, geotextile, protective layer, drainage layer (derived from figure provided).*

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- *The cap consists of geotextile, mineral layer, HDPE geomembrane, geotextile, protective layer, geotextile, gas drainage layer, covering soil (derived from figure provided).*

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- *“Landfill gas is abstracted by means of 4 multiple pipe wells.” There is currently one flare on site with plans for a gas motor to be installed 2005/2006.*

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- *There have been no complaints regarding the landfill site.*

5.12.3 Assessment of Compliance with the Landfill Directive

The existing landfill lining system was constructed before the Landfill Directive came into force and therefore it is not possible to determine the effect of the Landfill Directive on the protection of soil and water by the lining.

The geological barrier is stated to consist of “60 m thickness of clay like layer with low permeability”. There is no record of permeability measurements on the clay and therefore it is not possible to ascertain if the mineral layer offers protection of soil, groundwater and surface water equivalent to that prescribed by Annex 1 of the Landfill Directive.

The landfill appears to fulfil the requirements of the Landfill Directive to “control water from precipitations entering into the landfill body” with a cap consisting of geotextile, mineral layer, HDPE geomembrane, geotextile, protective layer, geotextile, gas drainage layer, and covering

soil. The landfill has a leachate collection system in line with the requirement to “collect contaminated water and leachate”, although information is lacking to determine whether the drainage blanket thickness meets the Landfill Directive requirement of at least 0.5 m. Leachate is treated to a standard fit for discharge in line with the requirements of the Landfill Directive.

Gas is abstracted and flared at the site fulfilling the requirements of the Landfill Directive. Stressed vegetation had been reported around the site in 2001 and hydrogen sulphide smells have been reported in the leachate discharge. However, it is stated that following repairs to “landfill gas emissions” stressed vegetation was no longer observed. It would therefore appear that there has been an improvement in the impacts on the environment.

There are no reports of complaints and wind blown litter is being managed in line with the Landfill Directive’s requirements to minimise nuisance and hazards.

5.13 Netherlands

5.13.1 Basic information

Name of the site	Nauernache Polder
Address of the site	Nauerna 1, 1566PB, Assendelft
Date of creation	1983 (start operation 1985)
Type of Landfill	Hazardous & non-hazardous
Total capacity	9 million m ³
Remaining void space (at the time of the interview)	1.5 million m ³
Site area	72 Ha

5.13.2 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

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| <ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> • <i>Treat contaminated water and leachate</i> | <ul style="list-style-type: none"> • The site is a land raise surrounded by ditches, canals and high groundwater. The site runoff going to the surrounding drainage network. • The leachate “drainage blanket consists of 0.3 m drainage sand on top of the liner” with HDPE pipe work covered with coarse gravel, fine gravel and drainage sand. • The leachate is treated by a continuous activated sludge system. |
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Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- Water entering the landfill is controlled by the construction of a cap.
- Leachate is collected from the drainage layer.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- “HDPE 2 mm beneath most of the cells, Hypofors beneath cell 1, HDPE + sand and bentonite beneath cell 16a double HDPE beneath cell 16b.”

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- “Gas drainage, trisoplast 7cm; HDPE 2 mm, storm water drainage; 1 m top soil.”

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- There was a combined heat and power plant on site, however this is now no longer used due to the low quantities of gas now generated.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- A low number of complaints are received and the causes are investigated without delay.

5.13.3 Assessment of Compliance with the Landfill Directive

“Both hazardous and non-hazardous waste is deposited in the same compartments together. This is allowed and conforms to their current environmental permit. The aspect of separate landfilling of hazardous and non hazardous waste according to LD-15 is not yet implemented in the Dutch environmental management act” (*person communication with NV Afvalzorg, Haarlem*).

The existing landfill lining system was constructed before the Landfill Directive came into force and therefore it is not possible to determine the effect of the Landfill Directive on the protection of soil and water by the lining.

The waste is underlain by at least 5m of clay and peat. There is no record of permeability measurements and therefore it is not possible to ascertain if the mineral layer offers protection of soil, groundwater and surface water equivalent to that prescribed by Annex 1 of the Landfill

Directive. HDPE artificial sealing liners are present as required by Annex 1 of the Landfill Directive.

Leachate levels appear to be below surrounding groundwater levels and therefore water enters the landfill. There is inadequate information with regard to the management of leachate level to minimise groundwater entry to the waste to ascertain if “appropriate measures” are being taken to “prevent surface water and/or groundwater from entering into the landfilled waste”. It is not known if the monitoring of groundwater and surface water is being carried out in line with the requirements of the Landfill Directive.

The capping of the landfill has a top soil cover of less than 1 m, except for Cell 1, therefore further justification would be required to confirm that the cap fulfils the requirements of the Landfill Directive

The landfill has a leachate collection system although information is inadequate to determine whether the drainage blanket thickness meets the Landfill Directive requirement of at least 0.5m. It is stated that 0.3 m of drainage sand is on top of the liner, but also that HDPE drains are covered with coarse gravel, fine gravel and drainage sand. Leachate is treated to a standard acceptable for discharge in line with the requirements of the Landfill Directive and no impacts are reported on soil and groundwater.

The site appears to have gas control fulfilling the requirements of Annex 1 because the low amounts of gas collected are being flared. There have been complaints (“usually less than ten per year”) regarding nuisances and hazards.

5.14 Portugal

5.14.1 Basic information

Name of the site	Aterro de Mato da Cruz (Mato da Cruz Landfill)
Address of the site	Mato da Cruz, Calhandriz, Vila Franca de Xira
Date of creation	June 1997
Type of Landfill	Non-Hazardous
Total capacity	Almost 6,000,000 m ³ across two different phases (1 st phase: around 2,000,000 m ³ and the 2 nd phase: almost 4,000,000 m ³)
Remaining void space (at the time of the interview)	The 2 nd phase is not started yet: remaining space – almost 4,000,000 m ³
Site area	47 ha

5.14.2 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- *Treat contaminated water and leachate*
- Surface runoff drains from the site to a series of drainage ditches connected to a nearby water course.
- Leachate is collected through a network of slotted pipes (“225 mm diameter PEHD”) in the bottom of the landfill and through geo-grid installed in the side slopes via gravity to a central sump where it is then pumped to the Treatment Station.
- The Treatment Station consists of a biological sequence batch reactor with flocculation and neutralisation before being discharge to foul sewer.

Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- Water entering the landfill is controlled through the construction of a cap.
- Leachate is collected from the drainage layer.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- Cells for urban waste: “Waterproof bentonite micros-cavas screen (very low coefficient of permeability 5×10^{-11} m/s)” geotextile, “compact local ground with a 0.5 m thickness”, “geomembrane of HDPE with 2.0 mm thickness” over which there is a geo-textile.

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- Cells for urban waste: “A drainage layer for the gases made of bottom ashes - 0.5 m; argillaceous soil layer - 0.5 m; mineral drainage layer - 0.5 m; sand soil layer – 0.7; vegetal soil layer – 0.3 m.”

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- There is a network of gas extraction pipework which currently goes to a flare. The possibility of energy production is currently being investigated.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- There are currently no complaints.

5.14.3 Assessment of Compliance with the Landfill Directive

The existing landfill lining system was constructed before the Landfill Directive came into force and therefore it is not possible to determine the effect of the Landfill Directive on the protection of soil and water by the lining.

The waste is underlain by a waterproof bentonite micros-cavas screen (very low coefficient of permeability 5×10^{-11} m/s)” geotextile, “compact local ground with a 0.5 m thickness” and a “geomembrane of HDPE with 2.0 mm thickness”. While the bentonite geotextile has a low permeability, there is no record of permeability measurements on the compact local ground below

and therefore it is not possible to assess if the mineral layer offers protection of soil, groundwater and surface water equivalent to that prescribed by Annex 1 of the Landfill Directive.

The landfill appears to be in line with the requirements of the Landfill Directive to “control water from precipitations entering into the landfill body” with a cap consisting of soil layers of 2.5 m thickness.

The landfill has a leachate collection system although information is inadequate to determine whether the drainage blanket thickness meets the Landfill Directive requirement of at least 0.5m. Leachate is treated to a standard acceptable for discharge in compliance with the Landfill Directive and no impacts are reported on soil and groundwater. It is not known whether monitoring of groundwater and surface water is being carried out as required by the Landfill Directive.

The site appears to have gas control fulfilling the requirements of Annex 1 because the gas is being flared. Adequate measures (including appropriate site location) appear to have been taken to minimise nuisance and hazards. It is stated that “Since 1999 complaints have been reduced”. There would therefore appear to be an improvement in the impacts on the environment.

5.15 Spain

5.15.1 Basic information

Name of the site	Vertedero de Valdemingómez
Address of the site	Canada real s/n, Valdemingómez, Madrid, Spain
Date of creation	Vertedero de cola de la planta de tratamiento de Valdemingómez: 2000 Vertedero clausurado del Parque Forestal de Valdemingómez: 1978-2000
Type of Landfill	Non-Hazardous
Total capacity	Vertedero de cola de la planta de tratamiento de Valdemingómez: 22.7 M m ³ Vertedero clausurado del Parque Forestal de Valdemingómez: 21.3 M tonnes
Remaining void space (at the time of the interview)	Vertedero de cola de la planta de tratamiento de Valdemingómez: 13 M m ³ Vertedero clausurado del Parque Forestal de Valdemingómez: None
Site area	Vertedero de cola de la planta de tratamiento de Valdemingómez: 82.5 ha Vertedero clausurado del Parque Forestal de Valdemingómez: 110 ha

5.15.2 Background

The active landfill (Vertedero de cola de la planta de tratamiento de Valdemingómez) is expected that it will be operational for another 25 years. Each of the seven planned cells is built once the capacity of the previous one reaches a certain point. It is estimated that each cell provides capacity for 3 to 5 years.

The now closed landfill (Vertedero clausurado del Parque Forestal de Valdemingómez) started its operation in 1978, and was closed in 2000. The closing of the landfill was carried out in accordance with the Landfill Directive, which was transposed into the Spanish legislation through RD 1481/2001. At present a recovery plan for this landfill is being implemented, comprising of four main aspects: capping, degasification, energy generation, and landscape recovery.

In 1978 the animal waste incineration facility started its operation, and in 1987 the hospital waste incineration facility was opened. Both remained operational until 1995. In 1991 a small plastic recovery facility was opened.

5.15.3 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> • <i>Treat contaminated water and leachate</i> | <ul style="list-style-type: none"> • Run-off from the site is sent to the leachate treatment plant. • The drainage layer consists of “a 0.5 m thick gravel layer” containing a network of pipes connected to sumps from where it is pumped to the treatment facility. • Firstly the leachate is filtered through a gravel bed then its pH is adjusted before undergoing three stage reverse osmosis. The resulting liquid is deodorised and pumped into the recycled water storage pond. |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Protection of soil and water

- | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> | <ul style="list-style-type: none"> • Water entering the landfill is controlled through the construction of the cap. • Leachate is collected from the leachate drainage layer. |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Liner

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • <i>The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.</i> | <ul style="list-style-type: none"> • Artificial geological barrier formed by clay with permeability equal or lower than 0.5×10^{-9} m/s, and minimum thickness of 0.8 m. HDPE liner with minimum thickness of 1.5 mm protected on each side by a geotextile. Drainage layer made of calibrated gravel (60 – 100 mm), and minimum thickness of 0.5 m, in which a network of drain pipes is installed” (herring bone pattern). |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Cap

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • <i>If the prevention of leachate formation is necessary a surface sealing may be prescribed</i> | <ul style="list-style-type: none"> • The cap consists of “gravel/clay/gravel/dirt.” |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|

Gas control

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • <i>Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.</i> | <ul style="list-style-type: none"> • Gas extraction is performed through “280 wells and 10 control and regulation stations”. The gas is then used to generate electricity. |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- There have been complaints from local residents regarding odour from the organic phase treatment facility.

5.15.4 Assessment of Compliance with the Landfill Directive

The active landfill was constructed after the Landfill Directive came into force. The geological barrier of the site is in line with the requirements of the Landfill Directive, comprising a minimum 0.8 m clay thickness with a permeability of equal or lower to 0.5×10^{-9} m/s providing an equivalent to that prescribed by Annex 1 of the Landfill Directive for non-hazardous waste. Geotextiles and an HDPE liner provide the sealing liner. No impacts are reported on soil and groundwater. However, insufficient time has elapsed to indicate that the Landfill Directive is having an effect on the protection of soil and groundwater due to the lining requirements.

The active landfill has yet to be capped, and no details were provided regarding the closed landfill. As such, it is not possible to assess whether the landfill capping is adequate to meet the Annex 1 requirements. There is collection and treatment of leachate fulfilling the requirements of Annex 1, with a leachate drainage system 0.5 m thick.

The site appears to have gas control fulfilling the requirements of Annex 1, because the gas is being used to produce energy. Adequate measures (including appropriate site location) appear to have been taken to minimise nuisance and hazards, although complaints have been received regarding odours from the organic phase treatment facility.

5.16 Sweden

5.16.1 Basic information

Name of the site	Sofielunds återvinningsanläggning, "Deponi 2000" (Stage 1), Landfill 2000
Address of the site	Holmträskvägen, Gladö industriområde, Huddinge, Stockholm
Date of creation	2001 (first cell/stage)
Type of Landfill	Non-Hazardous
Total capacity	Void space approximately 4-5 M m ³
Remaining void space (at the time of the interview)	4-5 M m ³ (life until 2025)
Site area	Flat area approximately 200,000 m ²

5.16.2 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> • <i>Treat contaminated water and leachate</i> | <ul style="list-style-type: none"> • Waste water from the old landfill, new landfill and other areas where waste is deposited or treated is discharged to three waste water basins which are connected to the foul sewer. • Leachate drainage layer consists of "0.05 m stone powder (0 – 2 mm) close to the plastic liner, 0.15 m rockfill (4 – 16 mm) and drainage pipes, 0.3 m filter/drainage layer (peat and rockfill 4 – 16 mm), 0.3m (rockfill 16 – 32 mm)." The pipes in the drainage blanket are connected to a central pipe leading to the waste water treatment basin. • Leachate is discharged to foul sewer for treatment at local waste water treatment plant. |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- Water entering the landfill is controlled through the construction of a cap.
- Leachate is extracted from the leachate collection layer.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- Leachate drainage layer over “1.5 mm PE plastic liner” over “0.25 m of bentonite clay mixed with stone powder (permeability 1×10^{-11} m/s)” and “0.25 m stone powder mixed with peat (permeability 1×10^{-9} m/s”.

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- “0.5 m engineered clay liner, 0.2 m drainage layer (crushed crystalline rock), geotextile, 1.1 m restoration soil.”

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- “Gas extraction wells from the old landfill are connected to a district heating network.” It is not anticipated that the new landfill will accept a significant amount of biodegradable waste.

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- Complaints regarding odour problems were associated with composting being carried out on site. It is not anticipated that this will be a problem with the level of organics being accepted is anticipated to be low.

5.16.3 Assessment of Compliance with the Landfill Directive

The active landfill was constructed after the Landfill Directive came into force. The geological barrier of the site does not appear to meet the requirements of the Landfill Directive, because the engineered geological barrier, as stated, does not provide an equivalent to that prescribed by Annex 1 of the Landfill Directive for non-hazardous waste. Problems are identified with applying “vertical liners on the side slopes of the former quarry”. This may indicate that the new landfill does not meet the Annex 1 requirements of the Landfill Directive in relation to stability.

The active landfill has yet to be capped, however details are given regarding the capping of the existing old landfill which is adequate to meet the Annex 1 requirements. There is collection and

treatment of leachate fulfilling the requirements of Annex 1, with a leachate drainage system of at least 0.5 m thickness.

Whilst gas is being extracted from the old landfill site, no extraction is planned for the new landfill. If this situation persists it will not fulfil the requirements of Annex 1, which requires landfill gas to be collected from all landfills receiving biodegradable waste. This is because the site is expected to receive only residual waste from a municipal waste treatment facility (presumably MBT or similar). This residual waste is expected to be “less than 5% organic approximately”. It is stated that “the amount organic matter will, after the automatic sorting facility, be less than 5%” and that the site will operate in accordance to Swedish law (paragraph 10 of SFS 2001:512).

It is unknown whether adequate measures (including appropriate site location) have been taken to minimise nuisance and hazards as required by the Landfill Directive. It is known that odour and noise complaints have been received. Impacts to groundwater and surface water have been identified from the old landfill.

5.17 United Kingdom

5.17.1 Basic information

Name of the site	ICI No 3 (Teesport) Landfill
Address of the site	BV 1917 – Middlesborough
Date of creation	Old landfill, 1800; Hazardous waste landfill, January 2005
Type of Landfill	Hazardous
Total capacity	2.35 M m ³
Remaining void space (at the time of the interview)	2.15 M m ³
Site area	120,000 m ²

5.17.2 Background

The hazardous landfill site was permitted in 2005 under the new PPC Regulations. All the waste is pre-booked and given a unique identification number. There is a requirement to have an approved signature to accept the waste. All the acceptance of waste is computerised. The truck arrives at the weighbridge where a visual checking is taking place. The truck access the landfill and is unloaded on the tipping face where a second inspection of the waste is undertaken by the driver. If there is an abnormal load there is a procedure in place to place the waste in quarantine until the necessary controls are made to check the nature of the waste. The waste is then compacted by a compactor. Other non pulverulent waste is used as daily cover.

5.17.3 Site engineering and operations

Landfill Directive Requirements

Site Specific Implementation

Water control and leachate management

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • <i>Control water entering the landfill body</i> • <i>Collect contaminated water and leachate</i> • <i>Treat contaminated water and leachate</i> | <ul style="list-style-type: none"> • All surface water is directed to a granular fill off-site. • The leachate is collected via a drainage blanket of “0.5 m of graded slag” with pipework for lateral drainage. • All leachate is treated on site by a reedbed system. |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Protection of soil and water

- *Control water entering the landfill body*
- *Collect contaminated water and leachate*
- Water entering the landfill is controlled through the construction of a cap.
- Leachate is collected from the drainage layer.

Liner

- *The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements.*
- “2 m clay locally sourced with 1×10^{-10} m/s to 1×10^{-11} m/s permeability; 8 cells built with leak detection layer; 2 mm HDPE welded membrane; geoprotection layer; 0.5 m drainage blanket; 20 cm -40 cm graded slag.”

Cap

- *If the prevention of leachate formation is necessary a surface sealing may be prescribed*
- “300 mm gas drainage blanket – gas collection; 300 mm clay layer; 1 mm LLDPE welded membrane; geocomposite drainage layer 20 mm; 1 m soil protection layer.”

Gas control

- *Landfill gas shall be collected from all landfills receiving biodegradable waste, this must be treated and used. If not used to produce energy it must be flared.*
- Landfill gas abstraction wells have yet to be installed. A flare will then be installed when sufficient gas is being generated

Nuisance and hazards

- *Measures shall be taken to minimise nuisance and hazards from the landfill*
- There have been no complaints and there are procedures to reduce noise, dust and odour impacts.

5.17.4 Assessment of Compliance with the Landfill Directive

The active landfill was constructed after the Landfill Directive came into force. The geological barrier of the site is in appears to fulfil the requirements of the Landfill Directive, comprising the 2 m clay thickness with a permeability of equal or lower to 1×10^{-10} m/s providing an equivalent to that prescribed by Annex 1 of the Landfill Directive for hazardous waste. Geotextiles and an HDPE liner provide the sealing liner and a leak detection layer is included for further protection. No impacts are reported on soil and groundwater. However, insufficient time has elapsed to indicate that the Landfill Directive is having an effect on the protection of soil and groundwater due to the lining requirements.

The planned capping will be adequate to meet the Annex 1 requirements to “control water from precipitations entering into the landfill body. There is collection and treatment of leachate in compliance with Annex 1, with a leachate drainage system 0.5 m thick.

The site will be installed with gas abstraction wells to enable the gas control to be in line with the requirements of Annex 1, a flare will be installed when it is required. Adequate measures (including appropriate site location) appear to have been taken to minimise nuisance and hazards in line with the requirements of the Landfill Directive.

5.18 Conclusions

Task 4 of the Technical Annex to the tender documentation requires this study to ‘assess examples of existing landfills in Member States that already fully comply with the Directive, identify possible problems and give information on the impact of these landfills on the environment assessing in particular the benefits due to the Landfill Directive in comparison to previous landfilling practises. A summary regarding the examples are detailed above and this section will discuss these details in relation to the implementation of the Landfill Directive.

Table 10 summarises some of the key facts associated with the individual landfill site visits and questionnaires. Whilst it is acknowledged that these probably represent some of the better landfills in each country, the table provides good evidence that there have been important developments in the standard of engineering of landfills across Europe over the past few years. The Landfill Directive has brought some consistency to the principles of engineering design and has encouraged many operators to develop high-standard compliant landfills, perhaps becoming one of the first to do so whilst knowing that the Landfill Directive will ensure that ultimately competitors will need to follow. The study has shown that landfill design and construction is now incorporating sophisticated methods of capping, lining and environmental controls.

As can be seen, across Europe the principles of containment have been adopted. Surface water and groundwater are being controlled by caps and liners. Leachate collection systems have been installed and a variety of leachate treatment systems have been installed. Ten of the fifteen representative landfills utilised the local municipal waste-water treatment works for final disposal, either directly by sewer or by tankering. At least three of these ten incorporated some on-site pre-treatment such (aerobic or biological). The examples in France and Spain used reverse osmosis technology, which is usually the most expensive form of treatment, such as when there are no local sewers available in rural areas and effluent must be of stream or river quality.

In many cases, it appears that some surface waters are also directed to the leachate treatment systems where there may be a risk that these surface waters have passed over landfilled areas or become contaminated with other leachate.

It is interesting to note the sophistication of some of the landfill liner systems. Whilst some of the completed questionnaires have failed to give precise details of the leachate collection pipes or

Table 10: Summary of landfill case study specification

		Austria	Belgium	Denmark	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	UK
Hazardous (H) and or Non-hazardous (NH)		NH	H and NH cells	H and NH cells	NH	NH	NH	NH	NH	NH	NH	H and NH	NH	NH	NH	H
Surface water control		y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
Leachate control		y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
Leachate treatment	On-site pretreatment		y	y			y, BT	y			y, A		y, SBR			
	On-site full treatment					y, RO						y, AS		y, RO		y, RB
	MWWTP	y	y	y	y			y	y	y	y		y		y	
Surface water included?		y	n	y	*	n	y	y	y	n	y	n	n	y	y	n
Liner	LCS	y						y	y	y	y	y	y	y	y	y
	Clay only			y (5-8 m)												
	Clay and HDPE	y				y (5 m)	y	y	y	y	y		y	y		y
	HDPE		y									y			y	
	GCL		y							y			y			
	BES											y			y	
	Asphalt				y											
Cap	Presence							TO	TO							
	Top soils		y		y	y	y			y	y	y	y	y	y	y
	Drainage			y	y	y				y		y	y	y	y	y
	PE/artificial		y		y		y			y	y	y				y
	GCL		y				y									
	Clay/mineral	y	y	y	y	y	y			y	y		y	y	y	y
	Gas drainage				y					y	y	y	y	y		y
Landfill gas	Control	y	n, NG	n, NG	y	y	y	y	y	y	y	y	y	y	y	F
	Flare							y	y		y	y	y			
	Energy					y			F	y	F		F	y		
	CHP	y			y		y					y, FI			y	

Legend: * if necessary, A - aeration, AS - activated sludge, BT - biological treatment, F - future, FI - finished, NG - no gas, RB - reed bed, RO - reverse osmosis, SBR - Sequence Batch Reactor, TO - temporary only,

y - yes (confirming presence of control measure), n - no (stating absence of control measure)

drainage blankets, it is clear from the previous answers that there are leachate collection systems (LCS) in every site.

Only one of the examples, in Denmark, relied entirely upon a mineral-only liner system, but this was where the natural geology provided at least 5 to 8 metres of natural clay. Interestingly, the same site was the only one that retained a permeable cap by design because of the philosophy of allowing ingress of rainwater to speed up bio-degradation. This is not in line with the requirements of the Landfill Directive unless a specific risk assessment has been accepted by the authorities.

Most sites (10) incorporated a natural clay/mineral with an additional HDPE layer as their composite liner. Two of these (Italy and Portugal) added a further layer of a geo-synthetic clay liner (GCL) to provide an additional level of safety.

Two of the sites (Netherlands and Spain) incorporated the use of bentonite-enriched sand (BES), usually an expensive process necessary when there is little or no natural clay or low-permeability mineral available. Finally, the example in Finland quoted the use of “waterproof asphalt”, presumably dense asphaltic concrete (DAC) which is a more robust form of construction beginning to become popular in a number of specific types of locations such as hard-rock quarries.

With regard to capping systems, again there appears to be strong evidence of the positive effects of the Landfill Directive. Designs are now beginning to incorporate not only artificial low permeability membranes to minimise surface water ingress (and therefore leachate production) but also several have recognised the need to include drainage systems above these low permeability layers in order to maximise the volumes of run-off. Nine of the fifteen examples incorporated this drainage layer which illustrates a growing tendency towards high-specification design. Similarly, six of the fifteen incorporated membranes in addition to natural layers and seven included a gas drainage layer beneath the cap.

Twelve of the fifteen used natural materials, mostly clay, beneath their artificial membranes and eleven described topsoils although this could be due to the fact that the questionnaire discussed ‘caps’ which some practitioners define as only the low-permeability layers. In general, the standard of cap design and construction appears to be very high and is likely to be mostly due to the Landfill Directive.

Finally, it can also be seen that, where appropriate in non-hazardous (probably municipal) landfills, there was a high number of sites that incorporated positive landfill gas control. Only 2 of the fifteen had no control but stated that measured quantities of gas indicated there was no need. Eight of the sites already convert landfill gas to energy (5 of which are combined heat and power systems) and three more have plans to do this in the future.

Overall, it can be concluded that every Member State has a good example of how a modern landfill should be designed and operated within the specifications of the Landfill Directive.

Whilst there are some localised examples of one specification or another, on the basis of the information provided, not completely fulfilling the requirements of the Landfill Directive, this may be due to a lack of information or understanding or there may be site-specific risk assessments which could not be assessed within the confines of this study.

6.0 IMPLEMENTATION OF WASTE ACCEPTANCE CRITERIA

6.1 Introduction

The Landfill Directive requires that:

"the waste in question can be accepted at the site according to the condition set in the permit, and that it fulfils the acceptance criteria set out in Annex II." (Article 11(1)a)

"The composition, leachability, long-term behaviour and general properties of a waste to be landfilled must be known as precisely as possible." (Annex II,2.)

Annex II of the Landfill Directive describes the general principles for acceptance of waste at the various classes of landfills upon which the future waste classification should be based. It also states that until the Waste Acceptance Criteria (WAC) are fully completed, only Level 3 (on-site verification) testing is mandatory and Level 1 (basic characterisation) and Level 2 (compliance testing) applied to the extent possible.

The WAC are now fully defined within "Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC" (2003/33/EC). The requirement is for Member States to apply the criteria within Section 2 (compliance testing) of the Annex to this Directive by the 16 July 2005.

This study therefore concentrated, initially, on the implementation of Section 1 of this Annex (procedure for the acceptance of waste at landfills) constituting basic characterisation, compliance testing and on-site verification as first put forward in Annex II of the Landfill Directive. Directive 2003/33/EC requires this to take effect from 16 July 2004.

The information detailed in this Chapter is derived from the case study site visits and therefore looks at the implementation of the WAC at a site level at only one location in each Member State. From this single example it was hoped to establish if the WAC has been transposed into national legislation and if it is being implemented.

The information provided in Table 11 are in relation to a waste regularly generated in the same process that is accepted at the landfill taken as a case study (case studies are further detailed in Chapter 5). This was done to provide some consistency between landfills. The particular waste stream chosen by the landfill operator is different for each landfill. The exact nature of the waste stream is not pertinent to this study as it was chosen solely to illustrate how the procedures are implemented.

6.2 Procedure for the acceptance of waste at landfills

The table below details whether the practises fulfil the requirements listed in Directive 2003/33/EC, listed for:

Functions of Basic Characterisation

- basic information on the waste (e.g. type, origin, composition, consistency and leachability);
- basic information for understanding the behaviour of waste in landfills and options for treatment;
- assessing the waste against the limit values; and
- detection of key variables for compliance testing and options for simplification of compliance testing.

Fundamental Requirements for Basic Characterisation of the Waste

- source and origin;
- process producing the waste;
- waste treatment applied;
- composition and leaching behaviour;
- acceptance (physical characteristics);
- EWC code;
- hazardous properties where relevant;
- landfill class where the waste may be accepted;
- any additional precautions to be taken; and
- check on whether the waste can be recycled or recovered.

Testing (for wastes regularly generated in the same process)

- compositional range for the individual wastes;
- range and variability of characteristic properties;
- leachability of the test; and
- key variable to be tested against.

Table 11: Fulfilment of Waste Acceptance Procedures (WAP) – Level 1**(as implemented on the ground at the landfills detailed in the Case Studies)**

Country	Functions of basic characterisation <i>(2003/33/EC Annex Section 1.1.1)</i>	Fundamental requirements for basic characterisation <i>(2003/33/EC Annex Section 1.1.2)</i>	Testing for wastes regularly generated in the same process <i>(2003/33/EC Annex Section 1.1.3)</i>
Austria	Yes	Yes	No
	Testing of the waste is defined in the law but in practise there are some difficulties. “The chemical analyses are done according to the national Landfill Ordinance.”		
Belgium-Flemish	Yes	Yes	Yes.
	The fundamental requirements are “good practise but still not formalised.” “The landfill company has its own laboratory to double check the external laboratories results and the analyse samples taken at the gate.”		
Belgium-Walloon	No	No.	No
	The operator understood that the WAC had not been approved and publicly released yet and therefore could not fulfil their requirements.		
Denmark	No	No	No
	Chemical composition is not analysed apart from certain types of contaminated soils. WAP and WAC have not been implemented in Denmark. The landfills do not execute any form for testing of disposed materials. Visual inspections are done in a minor scale on the landfill sites. The authorities in Denmark are prior to disposal at Landfills obliged to classify the waste and determine whether the waste can be used for recycling or what type of landfill that it is approved to handle the waste. The authorities can order the waste producer to perform tests of the waste, (such as for asbestos, PCB, Mercury, Organic compounds etc). in order to classify the waste. There are no general demands on what testing that should be done for waste. Demands for testing depend on the type of material and the risk for different contaminants to occur in the different materials.		
Finland	No	No	No
	Guidance has not yet been produced regarding WAP and WAC. A waste acceptance certificate is required based on determination of chemical composition for regularly accepted wastes.		
France	No	No	No
	The information obtained is often superficial and not complete and just necessary for current French regulations. Any analysis is “done by an independent and qualified institution but the sampling is done out by the client” with no controls.		

Country	Functions of basic characterisation <i>(2003/33/EC Annex Section 1.1.1)</i>	Fundamental requirements for basic characterisation <i>(2003/33/EC Annex Section 1.1.2)</i>	Testing for wastes regularly generated in the same process <i>(2003/33/EC Annex Section 1.1.3)</i>
Germany	Yes	No	No
<p>Generally the basic characterisation is based on a representative sampling with a single analysis of each relevant parameter so that the range and variability of properties cannot be described. It is mandatory to repeat the basic characterisation in the case of significant changes of the waste generating process.</p> <p>In Germany, a draft ordinance regarding the implementation of all requirements of the WAC was released by the German Environmental Ministry on 26 September 2005. This ordinance serves to amend the existing waste legislation in order for landfills to achieve full compliance with the WAC.</p>			
Greece	No	No	No
<p>Although the Landfill Directive has been transposed into national legislation in practise the landfill sites are not implementing the WAC or WAP.</p> <p>According to waste operators in Greece, in some cases only there is limited visual inspection just to make sure that very hazardous waste is not landfilled (<i>personal communication</i>).</p>			
Ireland	Yes	Yes	Yes
<p>The site in Ireland has strict waste acceptance procedures for the disposal of wastes. The following information is required to be submitted before authorisation for disposal is issued:</p> <ul style="list-style-type: none"> • Copy of the waste collection permit • Complete form with client information and other details • Completed waste transfer note • Completed waste acceptance control form • Consultants waste classification report including six digit EWC code for each waste • Compliance testing of waste. <p>The operator of the landfill site in Ireland requires that independent laboratory long term leachability compliance testing must be carried out as per the requirements of Section 3 of Council Decision 2003/33/EC, including leaching test method EN 12457/1-4 with a L-S ratio of 10 and analysis methods ENV 12506 and ENV 13370. Parameters and limit values for leachability testing are as to be as per the requirements of Section 2.2.2 of Council Decision 2003/33/EC.</p>			

Country	Functions of basic characterisation <i>(2003/33/EC Annex Section 1.1.1)</i>	Fundamental requirements for basic characterisation <i>(2003/33/EC Annex Section 1.1.2)</i>	Testing for wastes regularly generated in the same process <i>(2003/33/EC Annex Section 1.1.3)</i>
Italy	No	No	No
	<p>“The relevant national law (D.M. 13/03/2003) was issued at the same time of the Council Decision, therefore it is not fully compliant with the Decision itself. A new decree to fix this problem is due to be issued. At the moment WACs applied to landfills in operation are different from those required by the Decision; moreover with the Decreto Legge of the 24/06/2005, the Council Decision deadline of the 16/07/2005 has been extended to the 31/12/2005.</p> <p>At the moment waste acceptance criteria, in Italy, are regulated by the D. Lgs 36/03 and the D.M. 13/03/03.”</p>		
Luxembourg	Yes	Yes	Yes
	Only municipal and non-hazardous waste is accepted from the same producers.		
Netherlands	No	No	No
	Waste acceptance and treatment procedures are in place at the landfill but these do not fulfil all of the requirements of the Landfill Directive		
Portugal	Yes	Yes	Yes
	“The Portuguese law has well defined the methodologies and the criteria (annex III) that should be done to accomplish the waste acceptance criteria defined on the European legislation.”		
Spain	Yes	Yes	Yes
	Sampling and testing for basic characterisation and compliance testing in Valdemingómez Municipal Solid Waste Treatment Center is carried as show the Directive in L 11 / 40; Official Journal of the European Communities (16.1.2003).		
Sweden	No	No	No
	“No characterisation done yet on waste going to the new Landfill 2000! However, a characterisation form has been prepared.”		
UK	Yes	Yes	Yes
	“Sampling is undertaken by the waste producer and an independent verifier but is not undertaken by the site operator. A copy of the waste analysis is required by the site operator to the waste producer before waste is accepted at the landfill. The operator is checking the analyses to ensure that there is no banned substance in the waste load.”		

It can be seen that the implementation of the waste acceptance procedures are sporadic throughout the Member States. In some countries, such as Denmark, they have not yet been transposed into national legislation and therefore there is no incentive for the operator to implement the procedures. In other countries such as Greece the Landfill Directive has been transposed into national legislation however this is not being complied with at the site level.

One of the possibilities for this variability in compliance is the difficulty and financial expense for sites to comply. Few independent operations are prepared to be at the forefront, otherwise they will be commercially disadvantaged. It has been noted that in certain countries there still exists a transition phase for the implementation of the waste acceptance procedures and criteria allowing some landfills to accept waste that other sites, who have fully implemented the procedures and criteria, are not allowed to accept. Thus until the procedures and criteria are consistently and uniformly enforced, the operators will be reluctant to fully comply with this aspect of the Landfill Directive.

6.3 Sampling plan and testing

Section 3 of Directive 2003/33/EC details the requirements for sampling and test methods. The Annex states that “for the sampling of waste – for basic characterisation, compliance testing and on-site verification testing - a sampling plan shall be developed according to part 1 of the sampling standard currently developed by CEN.”

The main document that provides waste operators with guidance on establishing criteria and procedures for the acceptance of waste at landfills is the CEN standard (“Characterisation of Waste - Sampling of Waste Materials: Framework for the Preparation and Application of a Sampling Plan”). It was indicated that this document would be published in June 2005. However, the British Standard Institute (BSI) has stated recently that this document will not be published until May 2006.

Section 3 of the Annex to Directive 2003/33/EC states that “as long as a CEN standard is not available as formal EN, Member States will use either national standards or procedures or the draft CEN standard, when it has reached the prEN stage.” The European draft standard (prEN) was produced by BSI within the UK on the 6 April 2004. It is assumed that this was available at the same time in the other Member States.

Draft Standard prEN 14899 states that:

“The Sampling Plan shall be prepared under the direction of a project manager in consultation with all appropriate involved parties. Such parties include for example: the sampler; the analyst; the client; the regulator and the producers of the material.”

“The main considerations in defining a Sampling Plan are:

- a) the identification and agreement of the proposed sampling design through consultation with involved parties;
- b) those actions that record the mechanics of when, where, by whom and how the samples are taken and collected;
- c) the precautions that are to be taken to protect the sampler;
- d) the precautions that are to be taken to ensure the reliability of any samples during sampling and subsequent sub-sampling and handling; and
- e) the Sampling Plan shall recognise the requirements arising from other key steps in the testing programme.”

6.3.1 Implementation of sampling plans

(as implemented on the ground at the landfills detailed in the Case Studies)

A summary of the responses provided by the landfill operators on whether a sampling plan had been produced is listed below.

- Austria a sampling plan was available. The Austrian Landfill Ordinance is currently being amended and will take the CEN Standard into account.
- Belgium-Walloon no sampling plan was available.
- Belgium-Flemish a sampling plan was available however this requirement is implemented through training rather than formalised on paper.
- Denmark no sampling of waste is performed apart from certain types of contaminated soils. These samples are taken by the waste producers and not by AV Miljø.
- Finland no sampling plan was available. As soon as there is guidance about sampling at a national level, there will be instructions at each landfill also.
- France no sampling plan was available.
- Germany a sampling plan was available.
- Greece no sampling plan was available.
- Ireland no sampling plan was available. The sampling plan is left to the waste originator to devise when taking samples. The landfill operator does not seek to influence this sampling procedure and allows the waste originator to assume full responsibility for the sampling procedures.
- Italy no sampling plan was available.

-
- Luxembourg tailor made sampling plans were available. No draft standard sampling plans are available. In general the tailor made sampling plans shown to the consultant contained all the key elements.
 - Netherlands no sampling plan was available.
 - Portugal no sampling plan was available. They were aware of the CEN standard. However the CEN is only a draft when it is operational they will study how to adopted their process to conform with the CEN.
 - Spain no sampling plan was available.
 - Sweden no sampling plan was available. The production of a national “handbook” for sampling (in accordance with the CEN Characterisation of Waste) plans is in progress initiated by the Swedish EPA.
 - UK no sampling plan was available. A sampling is currently been drafted but the operators are waiting for the publication of the CEN standard (not published at the time of the interview) to implement it.

It can be seen from the above summary that the majority of Member States are not implementing this requirement as they are waiting for the final CEN standard to be available. The Member States seem unaware of the requirement to use the draft CEN standard and have therefore not carried out any programme of awareness raising regarding this issue with the landfill operators.

In many countries the testing requirement is placed on the producer with the operator reviewing the information provided. It is therefore likely that in certain instances it will be the producer who will be required to produce the sampling plan with the operator making them aware of this requirement.

6.4 Conclusions

Task 5 of the Technical Annex to the tender documentation requires this study to ‘describe how the procedures for the acceptance of waste in landfills are implemented and identify possible problems with the implementation’. The procedures have been identified above in line with the requirements of Task 5 while the Section below discusses the problems associated with the implementation.

Annex II of the Landfill Directive describes the general principles for acceptance of waste at the various classes of landfills upon which the future waste classification should be based. It also states that until the Waste Acceptance Criteria (WAC) are fully completed, only Level 3 (on-site verification) testing is mandatory and Level 1 (basic characterisation) and Level 2 (compliance testing) should be applied to the extent possible.

The WAC are now fully defined within “Council Decision of 19 December 2002 establishing criteria and procedures for the acceptance of waste at landfills pursuant to Article 16 of and Annex II to Directive 1999/31/EC” (2003/33/EC). The requirement is for Member States to apply the criteria within Section 2 (compliance testing) of the Annex to this directive by the 16 July 2005. This date was after the main field work for this study.

This study concentrated primarily on the implementation of Section 1 of this Annex (procedure for the acceptance of waste at landfills) constituting basic characterisation, compliance testing and on-site verification as first put forward in Annex II of the Landfill Directive. Directive 2003/33/EC requires this to take effect from 16 July 2004.

The single landfills selected by each Member State for this study were deemed to be representative of or compliant with the Landfill Directive. Hence, the utilisation or otherwise of the relevant parts of the new waste acceptance criteria (WAC) at these sites should indicate the best possible example in each Member State.

The implementation of the waste acceptance procedures would appear to be slow and sporadic Europe, and appears to be still on-going in most countries. Nine of the sixteen Member States in the study (counting 2 for Belgium-Flemish and Belgium Walloon) had yet to implement any of the 3 key sections of Level 1. Only 6 Member States (Belgium-Flemish, Ireland, Luxembourg, Portugal, Spain and UK) claim to have implemented all 3 sections of Level 1.

In some countries, such as Denmark, where the WAC have not yet been transposed into national legislation, there is no requirement or incentive for the operator to implement these procedures. In other countries, such as Greece, where the Landfill Directive has been transposed into national legislation, the WAC are not yet implemented at the landfill site level. Some Member States, such as the Netherlands, have had their own waste acceptance criteria for some time but acknowledged that, as yet, these did not fully comply with the requirements of the Landfill Directive.

A number of reasons have been suggested as to why there is such a sporadic implementation of these WAC across Europe. There may have been difficulties in local definitions and characterisation of wastes, and particularly in moving from the original country system, commonly understood amongst operators, to another less well understood system. Secondly, it is widely recognised that it can be difficult and costly for site operators to comply with the new Landfill Directive WAC, in which case many appear to be reluctant to do so until they feel confident that all other operators are doing the same (i.e. there is a level playing field).

The study also looked at the implementation of Section 3 of the Directive 2003/33/EC which details the requirements for sampling and test methods. The Annex states that “for the sampling of waste – for basic characterisation, compliance testing and on-site verification testing - a sampling plan shall be developed according to part 1 of the sampling standard currently developed by CEN.”

The main document that provides waste operators with guidance on establishing criteria and procedures for the acceptance of waste at landfills is the CEN standard (“Characterisation of Waste - Sampling of Waste Materials: Framework for the Preparation and Application of a Sampling Plan”). It was originally indicated that this document would be published in June 2005. However, the British Standard Institute (BSI) has stated recently that this document will not be published until May 2006.

Section 3 of the Annex to Directive 2003/33/EC states that “as long as a CEN standard is not available as formal EN, Member States will use either national standards or procedures or the draft CEN standard, when it has reached the prEN stage.” The European draft standard (prEN) was produced by BSI within the UK on the 6 April 2004. On this basis, most Member States should have been able to work to this draft since that time. The evidence suggests that most had not done so by the time of the study in early 2005.

The questionnaire asked the landfill operators at the selected sites if a Sampling Plan had been produced. Most replies indicated that no Sampling Plan was available. The 4 Member States where a Sampling Plan was available were Austria, Belgium-Flemish, Germany and Luxembourg. All other replies indicated that operators would comply when there was a clear national guidance or as and when the CEN is issued in full rather than draft.

7.0 DIVERSION OF WASTE TYRES FROM LANDFILL

7.1 Introduction

The Landfill Directive states that:

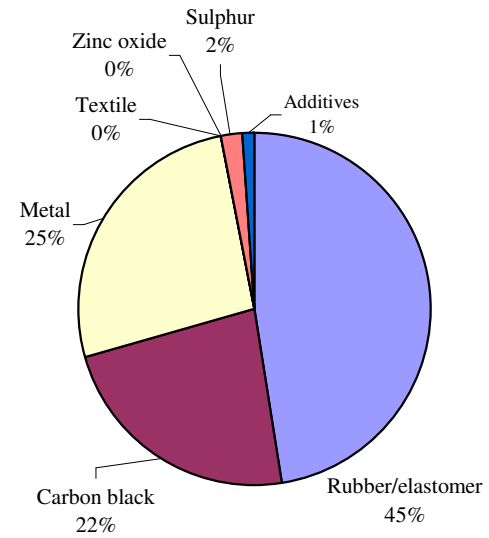
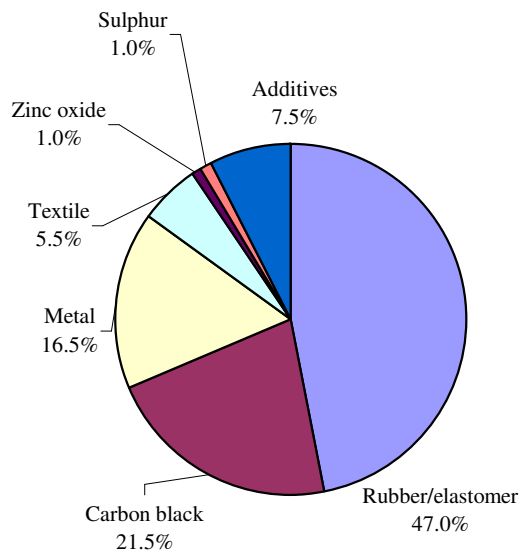
"Member States shall take measures in order that the following wastes are not accepted in a landfill:

(d) whole used tyres from two years from the date laid down in Article 18(1), excluding tyres used as engineering material, and shredded used tyres five years from the date laid down in Article 18(1) (excluding in both instances bicycle tyres and tyres with an outside diameter above 1 400 mm)" (Art. 5.3(d))

The Landfill Directive stipulates a ban on whole tyres by 16 July 2003 and shredded tyres and tyres for engineering by 16 July 2006. In all cases bicycle tyres and tyres with an outside diameter above 1,400 mm are excluded. Tyre producers appear to be working intensely on the achievements of these targets not only in existing Member States but also in the new EU Member States.

Tyres consist mainly of steel, rubber compound and textiles. The breakdown of materials (by percentage weight) for a typical passenger car tyre (left) and a truck tyre (right) is shown in the following graphs.

Graph 6 - Percentage weight composition of a car tyre (left) and a truck tyre (right)



Source: BLIC November 2004

It can therefore be seen that tyres provide a potentially valuable source of materials that could be re-used or recycled, rather than being lost through landfilling. When disposed of in landfill sites, a number of potential occurrences are perceived to lead to possible problems as follows:

- Tyres in large volumes can cause instability by rising to the surface of the site (generally on sites where there is insufficient capping and restoration cover materials, affecting its long term settlement and therefore posing problems for future use and land reclamation;
- Similarly, older landfill sites where large quantities of tyres had been disposed of in an uncontrolled manner experienced wash-through of soil and fine particles leading to inward collapse and surface failures;
- Rubber materials contain proportions of organic chemicals and little is known about the long-term leaching effects of these materials.
- Tyres in landfills have also been associated with the potential for combustion and fires;
- During degradation the steel reinforcement within some tyres may cause damage to the geo-membrane liners.

Often data provided by the Member States in response to the same questions in this chapter has not been given for the same year of reference; therefore, direct comparisons cannot always be made. The date to which the data pertains is not always reproduced in the tables unless it is felt that there is a clear purpose for doing so.

7.2 Quantities of New Tyres

The table below provides data on the amount of new tyres put onto the market and used tyres produced or collected.

Table 12: Number of new tyres and used tyres

County	New tyres put onto the market (tonnes)	Used tyres produced/collected (tonnes)	Date of whole tyres ban	Date of shredded tyres ban
Austria	No data	55,000 (1999)	1996	1996
Belgium-Flemish Region	76,020 (2003)	45,450 (2001) 51708 (2002) 55914 (2003)	1999	1999
Belgium-Walloon Region	76,020 (2003)	45,450 (2001) 51,708 (2002) 55,914 (2003)	2004	2006
Denmark	51,300 (2005)	42,600 (2005)	2001	2001
Finland	45,000 (2004)	37,000 (2004)	2002	2002
France	405,000 (2004)	221,275 (2004)	2002	2002
Germany	536,000 (2001)	578,000 (2001)	2002	2002
Greece	14,400 * (2005)	19,488* (2005)	2003	2007
Ireland	No data	34394 (2001)	2003	2006
Italy	277,200 (2003)	388.389 (2003)	2003	2006
Luxemburg	No data	1,86	2003	2003
Netherlands	153,000** (2005)	142,660*** (2000) 166,788*** (2002) 177,000*** (2005)	1995	1995
Portugal	205,831** (2004)	177,027*** (2004)	2001	2001
Spain	No data	280,000 (2001)	2003	2006
Sweden	164,390**	24,485***	2001	2001
UK	415,887 (2003)	480,000 (2001) 443,837 (2003)	2003/06	2003/06

* Data for Greece was presented for the period 1 November 2004 to 21 March 2005.

**Figure is calculated from the amount of tyres converted to tonnages (i.e. multiplied by 34 kg, the average weight for a new vehicle tyre).

***Figure is calculated from the amount of tyres converted to tonnages (i.e. multiplied by 29.5 kg, the average weight for a used vehicle tyre).

The Netherlands, Portugal and Sweden have provided data on new tyres and used tyres in number of tyres (unlike the other countries which have provided this data in tonnages). Based on information for statistics in 1999 from the following web site:

<http://www.ntda.co.uk/uploadeddocuments/1999%20Stats/newtyres99.pdf>, the weight of tyres are assumed to be: new car tyre 8 kg, car tyre 6.5 kg, new bus/truck tyre 60 kg and used bus/truck 52.5 kg. The average weight for a new and used vehicle tyre being 34 kg and 29.5 kg respectively.

These weights have been used to calculate the tonnages of tyres for these three countries. This was necessary in order to compare the information obtained from the Member States regarding the amount of new tyres put onto the market and used tyres produced or collected. Furthermore, the data for Greece was provided by the Ecoelastika for a five month period and has been multiplied in the table above to represent one year's worth of data. Furthermore, the data for Greece is based on only 60% of the population.

In Portugal, "according to the goals established to be achieved until January 2007 on the national law (95% collected of the tyres annually produced, 30% on re-treading used tyres of the tyres annually produced and 65% recycled of the tyres annually produced) Valorpneu, a private tyre company, covering almost the entire tyre market in Portugal, achieved the following: 97,3% on collected tyres, 26,1% on re-treading used tyres and 61,4% on recycling tyres" (*Valorpneu Annual Report 2004*) in 2004.

Austria (data provided from the Federal Waste Management Plan from 2001 and homepage of the GVG), Ireland and Spain could not provide data on the quantity of new tyres generated by their countries. The data for both regions of Belgium have been extrapolated from the total number of vehicles in Belgium (*Europool*). The data provided by the Netherlands is with respect to tyres for vehicles which have a weight of less than 3,500 kg only (i.e. this excludes large lorry tyres).

7.3 Treatment of Used Tyres

Future developments into the uses of waste tyres provides the greatest solutions to preventing their disposal to landfill. Ongoing research into improvements in tyre design and construction has resulted in the life expectancy of tyres continuing to lengthen. Used tyres have the following purposes:

- Reuse of part-worn tyres directly on vehicles;
- Reuse through landfill engineering;
- Recycling through retreading;
- Recycling through grinding;
- Recycling through cryogenic fragmentation;
- Recycling through de-vulcanisation;
- Recycling through microwave technology; and
- Energy Recovery;
- Energy Recovery through Pyrolysis;
- Energy Recovery through incineration in cement kilns;

- Other uses of waste tyres include: boat and dock fenders, under road surfaces, sports tracks, weights on silage sheeting on farms, crash barriers at motor racing circuits, children's play surfaces and furniture, protection for young plants and trees, compost heap containers, roof tiles, noise control products, structural support for earth walls, motorway embankments and artificial reefs and coastal defenses.

The table below demonstrates the different treatment methods used for waste tyres in the 15 Member States.

Table 13: Quantities of tyres sent for various treatment methods

Country	Year	Collection	Reuse of partly worn tyres	Reuse through retreading	Recycling for engineering uses	Recycling by shredding and crumbing	Recovery for energy production	Material recovery	Disposal by landfilling	Other
Austria	1999	No data	No data	No data	No data	No data	27,500	No data	No data	No data
Belgium-Flemish Region	2001	45,450	2,938	2,142	No data	No data	24,369	9,293	0	6,999
	2002	51,708	1,629	2,698			23,663	17,398	0	4,359
	2003	55,914	1,439	2,198			25,705	19,271	0	8,460
Belgium-Walloon Region	2001	45,450	2,938	2,142	No data	No data	24,369	9,293	0	6,999
	2002	51,708	1,629	2,698			23,663	17,398	0	4,359
	2003	55,914	1,439	2,198			25,705	19,271	0	8,460
Denmark	2004	50,000	No data	5,000	No data	No data	4,500	40,500	No data	No data
Finland	2004	37,240	No data	1,144	35,261		0	No data	0	No data
France	2004	212,566	15,282	32,317	18,483	55,672	55,628	No data	0	No data
Germany	2001	578,000	58,000	64,000	300,000	105,000	300,000	254,000	9,000	15,000
Greece	2004	8,120	102	0	0	4,780	3,340	0	0	No data
Ireland	2001	No data	No data	186,000	No data	No data	No data	No data	No data	No data
Italy	2003	16,726	53,676	No data	No data	No data	89,199	20,671	198,202	7,000
Luxemburg	No data	No data	No data	No data	No data	No data	No data	No data	No data	No data
Netherlands	2003	108	67	No data	41	No data	No data	No data	No data	
Portugal	2004	76,681.777*	5,997.973*	20,537.567*	33,470.334*	No data	30,086.028*	No data	5,405.020*	No data
Spain	2001	No data	No data	37,800	4,200**		19,600	No data	21,000	8,400
Sweden	2003	76,700	1,300	3,200	4,600	3,400	33,800	22,700	0	7,600
UK	2001	No data	78,217	49,179	16,100	No data	40,000	107,000	87,700	No data
	2003	No data	61,981	51,473	14,500	No data	77,500	160,000	28,200	No data

* Figures from Portugal were presented in an ambiguous manner and for the purpose of this study have been interpreted as presented above.

**Figure includes all types of recycling not only for engineering purposes.

There is only one material recycling plant in Austria, called GVG Gummiverwertungs GmbH, which shreds about 30,000 tonnes of tyres per year, 15,000 to 18,000 tonnes of this is made into rubber granules and about 3,000 to 6,000 tonnes of this is made into rubber meal, the remainder is burned in the cement industry. The total amount of used tyres in Austria is about 55,000 tonnes per year.

In Belgium (both Flemish and Wallon regions combined) data on the quantities of tyres collected and treatment methods is provided over a spread of several years. Belgium experienced a significant 187% increase in recovery of material from tyres from 2001 to 2002 and a further 11% increase from 2002 to 2003. All methods of treatment experienced increased between 2001 and 2003; however, there was a 12% drop in the reuse of partly worn tyres and a 3 % drop in recovery for energy production between 2002 to 2003 and 2001 to 2002 respectively (other than those treatment methods for which no data was provided).

In Finland reuse of partly worn tyres is carried out; however, there are no statistics regarding the treatment methods available. After 1999 no tyres were recovered for energy production, furthermore, tyres were no longer disposed of to landfill.

In 2004 Greece exported 102 tonnes of partly worn tyres for reuse. In Greece the management of used and old tyres is in very early stage of development and as a result not much data about used tyres is available at present. In November of 2002 a non-governmental organization was founded named "ECOELASTICA" which started operation in November of 2004. The members of this organization are: MICHELIN SA, GOODYEAR, EMA, ELASTRAC and PIRELLI. This organization collects and supplies the Ministry for the Environment, Physical Planning and Public Works with all information about used tyres.

The most recently available data on tyre waste in Ireland (National Waste Database 2001 and its accompanying Factsheet 7) details the amount of waste tyres generated; however, the disposal route is not detailed. Data for the amount of used tyres collected in Ireland are estimated based on net new tyre import statistics. Of the 34,394 tonnes of tyres collected 52% were car tyres and the remainder were used tyres collected from buses, lorries, aircraft etc. In Ireland in 2001, 150,000 car tyres were reused by re-treading and 36,000 truck tyres were reused by re-treading. Furthermore, data from the National Waste Database 2001 suggest that waste tyres are exported since the other routes such as use by farmers to hold down silage pit coverings, use as an engineering material, or disposal in landfill of shredded tyres, fly tipping, energy recovery and recycling are discounted as either insignificant or not undertaken in Ireland. There appears to be no mention of tyres in the Unauthorised Waste Activity report that was recently published. No further information about waste tyres can be obtained since it appears that this information is not being collected in Ireland. The information for the study into waste tyres generated in Ireland was obtained from the Department of Environment, Heritage and Local Government and two representatives at the EPA.

Two percent of used tyres are exported from Italy in 2003. Disposal of used tyres by landfilling in Italy was 26.4% above the European average; material recovery from used tyres was 25% below the European average and reuse of partly worn tyres and recovery for energy production was roughly on the European average which stands at 12.5% and 24% respectively.

No data has been provided for Luxembourg; the auditor assumes that used tyres are exported as is the case with a large amount of Luxembourg's more difficult waste streams.

Estimates on the amount of used tyres sent for various treatment methods in the Netherlands in 2003 were very difficult to obtain. Partly worn tyres that are sent for reuse may be used as 'push cushions' (presumably fenders) on ships. Recycled tyres for engineering purposes are used as a raw additive material in the cement industry.

The amount of used tyres that are sent for re-treading in Portugal in 2004 includes those imported. According to the national law in Portugal the following goals must be achieved by January 2007: 95% of tyres produced must be collected, 30% of which must be for re-treading and 65% recycled. According to the Valorpneu Annual Report 2004, the following targets were achieved in 2004: 97,3% of tyres were collected, 26,1% were retread and 61,4% were recycling. One of the reasons for the high recycling rates in Portugal may be because Portugal exports shredded tyre products to the USA. The tyres that are shredded in Portugal are sent to the USA where they are used for Astroturf in stadiums. It therefore, appears that Portugal is close to meeting the targets for retreading and recycling.

In Spain in 2001 4,200 tonnes of tyres were recycled and 8,400 tonnes of used tyres were exported.

In Sweden in 2003 the majority of used tyres were recovered for energy production (44 %) and 5,600 tonnes of the materials recovered from used tyres was recycled. Furthermore 10% of used tyres were exported for treatment. These figures were obtained from the Swe EPA report regarding producer responsibility (Uppföljning av producentansvaret för 2003, rapport 5380 2004).

Data in the UK indicates that approximately 2 million new vehicles are registered and a similar number are scrapped every year. Over 50 million tyres (just over 480,000 tonnes) were discarded of which around 80,000 tonnes were disposed of in landfill sites around the UK in 2001 (WasteOnline 2004).

In the UK, 7% more tyres were generated as waste in 2001 than the previous year; however between 2001 and 2003 this figure dropped and 7% less tyres were collected over the two year period. In the UK, the use of tyres in landfill engineering to form leachate drainage layers was common by the late 1990s. However, between 2001 and 2003 the amount of scrap tyres being used for energy production and material recovery (in cement kilns for example) experienced the greatest increase. Grinding is the most widespread materials recovery process in the UK.

There are three different types of system for dealing with end of life tyres within the EU15:

- Free market economy;
- State/tax system; and
- Statutory 'take back' system through a producer responsibility approach.

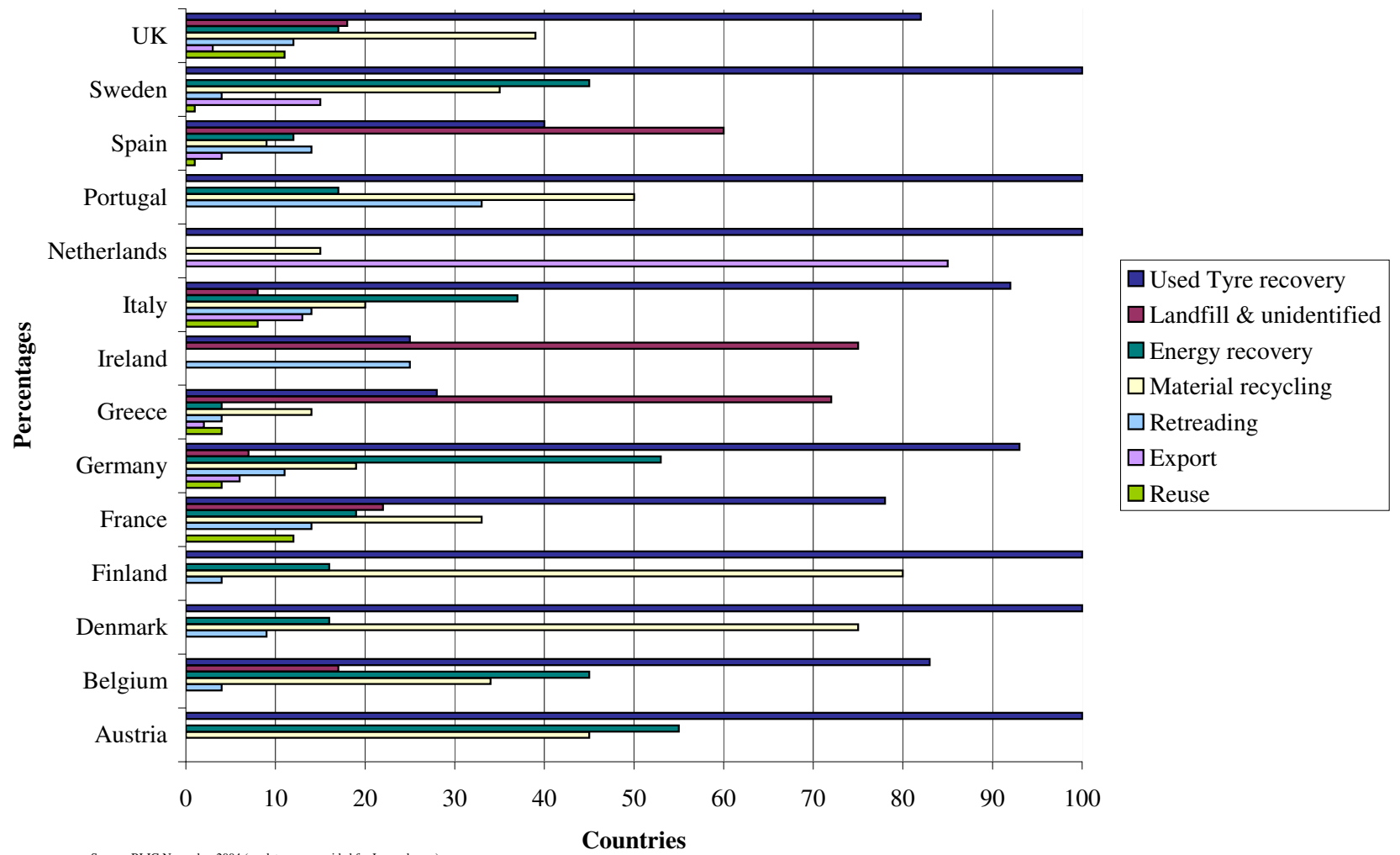
Only Denmark operates a state/tax system all the other Member States operate either through a free market system or a producer responsibility system. Where a producer responsibility system is in operation a company has been set up by the tyre producers to take responsibility for the collection and recycling of end of life tyres.

7.3.1 Overall treatment trends for used tyres

It can be seen from data obtained from the Bureau de Liaison des Industries du Caoutchouc- (BLIC) website, in Graph 7 below that the countries that use scrap tyres mainly for energy recovery are : Austria, Belgium, Germany, Italy and Sweden. Countries that recycle materials from scrap tyres as their main form of treatment are: Denmark, France, Greece, Finland, Portugal and the UK. Only the Netherlands exports 80% of its scrap tyres and Ireland and Spain retread most scrap tyres. Some countries such as Ireland (75 %), Greece (72 %), Spain (60% and France (22 %) landfilled a large amount of waste tyres in 2003.

According to analyses carried out on treatment methods for used tyres in the European Union in 2002 and 2003, the most noticeable difference was in the decrease in the amount of used tyres disposed of to landfill. In 2002, 26 % of used tyres collected in the European Union were landfilled and in 2003, only 18 % were landfilled (BLIC November 2004). All other treatment methods, for used tyres collected in the European Union, remained the same or increased slightly from 2002 to 2003. Energy recovery increased from 27 % to 30 %, material recycling increased from 25 % to 28 %, retreading increased from 11 % to 12 %, exporting of tyres remained the same at 6 % and reuse of used tyres increased from 5 % to 6 % from 2002 to 2003 in the European Union (BLIC November 2004).

Graph 7: Percentage used tyres analyses in 2003 in the European Union



Source: BLIC November 2004 (no data was provided for Luxembourg)

7.4 Conclusions

Task 6 of the Technical Annex to the tender documentation requires this study to describe the measures taken to divert used tyres from landfills based on existing information. The information available has been detailed above with a discussion on the impact of the implementation of the Landfill Directive detailed below.

From the information obtained, most countries appear to be increasing the recovering of energy or recycling waste tyres. Over the past few years, due to the publicity surrounding the Landfill Directive ban on landfilling used tyres, there has been a noticeable decline in the practice of landfilling whole tyres. Principally, the measures taken appear to be to ensure that the ban is clearly transposed into national legislation and to ensure that the licensing and enforcement of landfill operators and tyre processors is carried out effectively.

Tyre manufacturers and the recycling and energy recovery industries generally appear to be acting responsibly and there are also economic factors that now weigh heavily toward the recycling or processing rather than dumping in landfills. As is so often the case in the waste management industry, economic drivers will usually have the most effect and this seems to be the case for tyre re-processing. If the alternative is to pay for landfill disposal, rather than to obtain some credit or rebate due to the potential value of the tyre, clearly most operators will go for the latter.

The countries that use scrap tyres mainly for energy recovery are Austria, Belgium, Germany, Italy and Sweden. Countries that recycle materials from scrap tyres as their main form of treatment are: Denmark, France, Greece, Finland, Portugal and the UK. Only the Netherlands exports 80% of its scrap tyres and Ireland and Spain retread most scrap tyres. Some countries such as Ireland (75 %), Greece (72 %), Spain (60% and France (22 %) landfilled a large amount of waste tyres in 2003.

According to analyses carried out on treatment methods for used tyres in the European Union in 2002 and 2003, the most noticeable difference was in the decrease in the amount of used tyres disposed of to landfill. In 2002, 26 % of used tyres collected in the European Union were landfilled and in 2003, only 18 % were landfilled (BLIC November 2004). All other treatment methods, for used tyres collected in the European Union, remained the same or increased slightly from 2002 to 2003. Energy recovery increased from 27 % to 30 %, material recycling increased from 25 % to 28 %, re-treading increased from 11 % to 12 %, exporting of tyres remained the same at 6 % and reuse of used tyres increased from 5 % to 6 % from 2002 to 2003 in the European Union (BLIC November 2004).