



Waste Management Benchmarking Study

A Baseline Assessment

June 2006

Forfás 

Executive Summary

Introduction

Ireland's increasing waste costs were highlighted in the National Council Competitiveness (NCC) Statement on Prices and Costs in September 2004. Cumulative increases between 2000 and 2004 varied from just nine percent in Kildare to 380 percent in Cork. This has serious implications for the competitiveness of businesses and for the attraction of foreign direct investment (FDI) and companies' choice of location. In addition, IBEC's business costs survey (2004) found that waste collection/treatment ranked third in terms of businesses top priorities.

Earlier Forfás reports, *Key Waste Management Issues in Ireland* (2001) and *Key Waste Management Issues in Ireland - Update Report* (2003), highlighted the growing concerns from industry over the lack of adequate waste infrastructure available in the country to cope with the demands from industrial, commercial and household production.

Progress in addressing these infrastructure deficits has been limited with infrastructure improvements mainly in the area of light infrastructure (recycling and segregation). In its January 2005 submission on the NDP, Engineers Ireland highlighted waste management as the area of the NDP where least progress had been made. The investment target for waste management infrastructure in the NDP was €825 million, including €571 million of private investment. However, combined government and private investment to the end of 2005 was of the order of €250 million.

Objectives of Study

In August 2005, Forfás commissioned RPS Consulting Engineers to undertake a benchmarking analysis of the Irish waste management sector. The study had two core objectives:

- To determine and analyse the gaps between Ireland and competitor countries in meeting the needs of industry across a number of key issues such as cost, capacity, and ownership; and
- To review and analyse policies/initiatives in a number of comparable countries in order to inform the identification of actions needed to improve Ireland's competitiveness in meeting the waste management requirements of the enterprise base.

RPS, in consultation with Forfás and the Steering Group, drew up a list of countries to benchmark Ireland against: Austria, Czech Republic, Denmark, Netherlands, New Zealand, Scotland, Singapore and Sweden. Two regions were also included, namely Flanders and Massachusetts. These countries/regions were selected in order to represent a variety of market sizes with different waste management policies and practices as well as markets with similar waste generation patterns.

Data on waste is often of variable quality and tends to be updated on a three or five year cycle. This has led to a dearth of up to date, comparable international data in the waste management area. As a result, one of the major challenges of this benchmarking exercise was to develop robust indicators which would provide a backdrop against which to complete a more detailed analysis of Ireland's comparative waste management performance.

Key Findings

The benchmarking analysis confirmed that Ireland performs poorly relative to a selection of competitor countries in meeting the waste management needs of enterprise. The key findings of the benchmarking analysis are summarised below:

- *Waste Generation:* Ireland has the highest municipal waste generation per capita of the benchmark countries and manufacturing waste generation per employee is also relatively high.
- *Waste Treatment:* Ireland has made much progress in the area of municipal waste management in recent years. The share being recycled has increased considerably from 13 percent in 2001 to 33 percent in 2004. The national target for municipal waste recycling is 35 percent by 2013. Ireland performs poorly relative to the benchmark countries with a recovery rate of 35 percent for industrial waste, highlighting Ireland's dependence on landfill as a waste management solution. A significant amount of the industrial waste is land-filled on-site by the bigger companies rather than being land-filled in municipal landfills.
- *Waste Costs:* Of the 11 countries benchmarked, Ireland has the highest waste management costs for non-hazardous landfill and biological waste treatment. Recycling costs and hazardous waste treatment costs are also higher than most competitor countries because of Ireland's reliance on export markets for the treatment of recyclable materials. Ireland has only one glass, one paper and one plastic reprocessing facility in operation. The vast majority of Ireland's recyclable materials are exported for further treatment. The additional transport costs - estimated at between €25 to €50 per tonne depending on the material - are directly impacting the waste costs for the enterprise sector.
- *Waste Capacity:* Shortfalls in capacity have been identified for both municipal waste and hazardous waste - Ireland exports 30 percent of municipal waste and 70 percent of hazardous waste. The EU Landfill Directive requires reductions in the amount of biodegradable municipal waste being land-filled. This effectively requires the replacement of landfill capacity with infrastructure of a different kind. Many of Ireland's competitors have already put in place such infrastructure and will have a competitive edge in this regard until such time as the waste treatment capacity required in Ireland is delivered.
- *Ownership of Waste Collection:* Ireland is almost unique among the benchmark countries in having private services directly involved in the collection of waste without any municipal involvement in establishing the contract and determining what happens to the waste.

Overview of Ireland's Waste Management Performance

Ireland's approach to waste management is based on the internationally adopted hierarchy of options that has been embraced by the European Union since 1989 as the cornerstone of its waste management policy. The waste management hierarchy states that the most preferred option is prevention and minimisation, followed by re-use and recycling, energy recovery and, least favoured of all, disposal. The table below summarises Ireland's performance across the waste hierarchy for each of the three waste streams examined in this benchmarking study¹.

	Minimisation/ Prevention	Recycling/ Reuse	Energy Recovery	Disposal (Landfill)
Municipal (household + commercial)	Highest per capita waste but growth in per capita waste lower than GDP growth	Improving but still lags leading benchmark countries	No thermal treatment facilities	Very high dependence on disposal Highest landfill cost
Industrial	Relatively high per capita waste Waste volumes only increased by 6.9% between 2001 and 2004	Rate of recovery (recycling/reuse + energy recovery) is improving but still low relative to the benchmark countries No thermal treatment facilities		Very high dependence on disposal Highest landfill cost
Hazardous	Heavy reliance on exports - 70% of hazardous waste is exported			

Policy Priorities

The benchmarking analysis has highlighted a range of areas where Ireland performs poorly compared to the other selected countries in meeting the waste management needs of the enterprise base. The policy priorities from an enterprise perspective are set out below:

Waste Prevention and Minimisation

Ireland has the highest level of municipal waste generation per capita of all the benchmark countries and manufacturing waste generation per employee is also relatively high.

Waste management and the associated costs continue to be a key issue for enterprise in Ireland. By not generating waste, we can eliminate the need to handle, transport, treat and dispose of waste. We can also avoid having to pay for waste management services. Therefore, investing resources in waste prevention and minimisation offers potential long-term benefits for the competitiveness of enterprises of all types.

The main objectives of Ireland's *National Waste Prevention Programme 2004-2008*, which was launched in 2004, are to reverse current trends in waste production, decouple waste generation from economic growth and minimise the environmental impact of waste. Sustained

¹ There are seven priority waste streams. The others include: packaging waste; construction & demolition waste; waste from end-of-life vehicles and waste oil. The final waste stream is Waste Electrical and Electronic Equipment (WEEE). As measurement of WEEE is very recent, there was very little of data available therefore, no WEEE indicators are included in this report.

efforts over many years will be required to achieve these goals. It is imperative for Ireland's future competitiveness and environmental sustainability that the necessary resources and commitment to realise these objectives are provided.

Infrastructure Deficits

While significant progress has been made in recent years to increase the percentage of waste generated being recycled, Ireland's dependence on landfill remains high relative to other countries. This is mainly due to the limited progress that has been made in delivering waste infrastructure in preferred waste treatment options such as thermal treatment and biological treatment. Ireland's comparatively poor performance on key indicators such as costs and capacity can be traced back to the failure to deliver key waste management infrastructure in recent years.

Ireland's infrastructure deficits are also likely to affect Ireland's ability to meet the targets set down in the EU Landfill Directive. Ireland will be restricted to landfilling 75 percent of the municipal biodegradable waste produced (by weight) in 1995 by 2010. Given that in 2004 the amount of biodegradable municipal waste land-filled in Ireland was 101 percent of the 1995 baseline, we face significant challenges in meeting the 2010 target².

Effectiveness of Existing Implementation Mechanisms

The lack of national co-ordination on waste management issues in Ireland was identified in discussions with stakeholders as a major challenge from an enterprise/competitiveness perspective. Up to now, decisions on the roll-out of infrastructure have been made mainly within county boundaries, rather than being based on national criteria such as industry economies of scale, the development of critical mass and the existence of transport corridors. There also appears to be a lack of urgency at a local level in the implementation of the waste plans.

Specific infrastructure requirements have been identified in the *National Hazardous Waste Management Plan* and the *National Strategy on Biodegradable Waste* as well as in the regional waste management plans. But they have not been implemented. This is mainly due to lengthy delays in the planning process. The publication of the Strategic Infrastructure Bill is therefore a welcome development. However, as noted by the Minister for the Environment, Heritage and Local Government when announcing the publication of the Strategic Infrastructure Bill in February 2006, a lot of the most protracted delays to decisions on infrastructure in recent years have been due to legal challenges. This needs to be addressed if the planning process for major infrastructure projects is to be expedited.

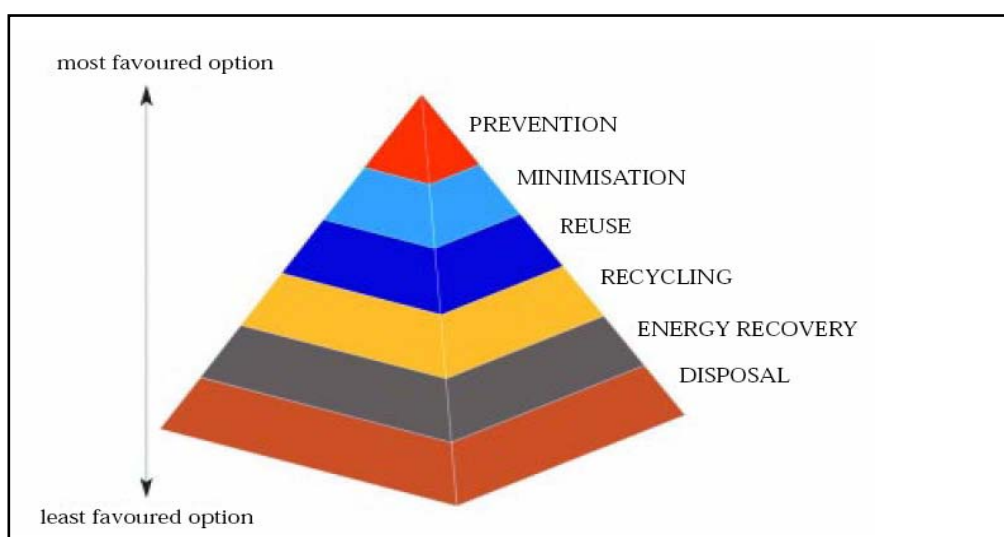
² EPA, National Waste Report 2004, January 2006.

1. Introduction

Maintaining economic progress in Ireland is contingent on a good environment and the availability of modern waste management facilities. Waste management and the associated costs continue to be a key issue for enterprise in Ireland. Investing resources in waste prevention and minimisation offers potential long-term benefits for the competitiveness of enterprises of all types.

Ireland's increasing waste costs were highlighted in the National Council Competitiveness (NCC) Statement on Prices and Costs in September 2004. Cumulative increases between 2000 and 2004 varied from just nine percent in Kildare to 380 percent in Cork. In Dublin, increases in local authority charging varied from 45 percent in Dublin City and South County Dublin Councils to 264 percent in Fingal County Council over the same period. This has serious implications for the competitiveness of businesses and for the attraction of foreign direct investment (FDI) and companies' choice of location. In addition, IBEC's business costs survey (2004) found that waste collection/treatment ranked third in terms of businesses top priorities.

Figure 1: Waste Management Hierarchy



Source: Department of the Environment, Heritage and Local Government, *Changing Our Ways*, 1998.

Ireland's approach to waste management is based on the internationally adopted hierarchy of options via the Waste Management Acts, 1996-2001 and the 1998 Government policy statement, *Changing Our Ways* and the 2004 paper, *Taking Stock and Moving Forward*. This hierarchy, generally embraced by the European Union since 1989 as the cornerstone of its waste management policy, states that the most preferred option for waste management is prevention and minimisation, followed by re-use and recycling, energy recovery and, least favoured of all, disposal (Figure 1).

Earlier Forfás reports, *Key Waste Management Issues in Ireland* (2001) and *Key Waste Management Issues in Ireland - Update Report* (2003), highlighted the growing concerns from industry over the lack of adequate waste infrastructure available in the country to cope with the demands from industrial, commercial and household production.

In spite of its importance, particularly for some of Ireland's key strategic sectors such as pharmaceuticals and life sciences, waste management is the area of the NDP where least progress has been made. The investment target for waste management infrastructure in the National Development Plan (NDP) was €825 million, including €571 million of private investment. However, combined government and private investment to the end of 2005 was of the order of €250 million, most of which has been private investment. In its 2005 submission on the NDP, Engineers Ireland maintained that the level of investment in the current NDP was not sufficient to provide the level of infrastructure envisaged in the regional waste management plans and estimated that it will require a minimum investment of €2 billion to deliver the main elements of these plans³.

2. Methodology

In August 2005, Forfás commissioned RPS Consulting Engineers to undertake a benchmarking analysis of the Irish waste management sector. The study had two core objectives:

- To determine and analyse the gaps between Ireland and competitor countries in meeting the needs of industry across a number of key issues such as cost, capacity, and ownership; and
- To review and analyse policies/initiatives in a number of comparable countries in order to inform the identification of actions needed to improve Ireland's competitiveness in meeting the waste management requirements of the enterprise base.

Forfás established a Steering Group to oversee this project, comprising representatives from the Department of Enterprise, Trade and Employment (DETE), DEHLG, IDA Ireland, Enterprise Ireland and the Environmental Protection Agency (EPA) as well as business users. During the project, Forfás also consulted the Irish Waste Management Association, which represents private waste operators.

RPS, in consultation with Forfás and the Steering Group, drew up a list of countries to benchmark Ireland against: Austria, Czech Republic, Denmark, Netherlands, New Zealand, Scotland, Singapore and Sweden. Two regions were also included, namely Flanders and Massachusetts. These countries/regions were selected in order to represent a variety of

³ The regional waste management plans have since been reviewed but no analysis on the level of investment required to deliver them has been carried out as the plans have not yet been adopted by the regional authorities.

market sizes with different waste management policies and practices as well as markets with similar waste generation patterns.

Waste data can often be of variable quality and tends to be updated on a three or five year cycle. This has led to a dearth of up to date, comparable international data. As a result, one of the major challenges of the benchmarking exercise was to develop robust indicators that would provide a backdrop against which to complete a more detailed analysis of Ireland's comparative waste management performance.

It should also be noted that Ireland's waste statistics compare well with all 10 countries selected, both in terms of availability and the accuracy of the information available. This is largely due to the continuing improvement of the EPA's 'National Waste Database' reporting system, and to recent improvements in the standards of waste facilities and regulation of waste companies.

It was not possible within the scope of the study to look at all seven priority waste streams. The study therefore focused on the priority waste streams of most relevance from an enterprise perspective - municipal, industrial, hazardous and Waste Electrical and Electronic Equipment (WEEE)⁴. Reported data for municipal and hazardous waste is generally reliable and was found to be consistent for most of the selected countries. Reporting on industrial waste was limited because of data availability and comparability issues. In all cases, any specific caveats or qualifications relating to the data used are highlighted in the analysis of the key performance indicators in Section 3. It emerged in the course of the study that because measurement of WEEE is very recent, there was very little data available. Therefore, no WEEE indicators are included in this report.

3. Key Performance Indicators

In order to assess Ireland's relative performance in meeting the waste management requirements of the enterprise sector, a set of indicators was developed for the selected benchmark countries. These indicators measured:

- waste generation;
- waste treatment options;
- waste costs; and
- capacity and infrastructure.

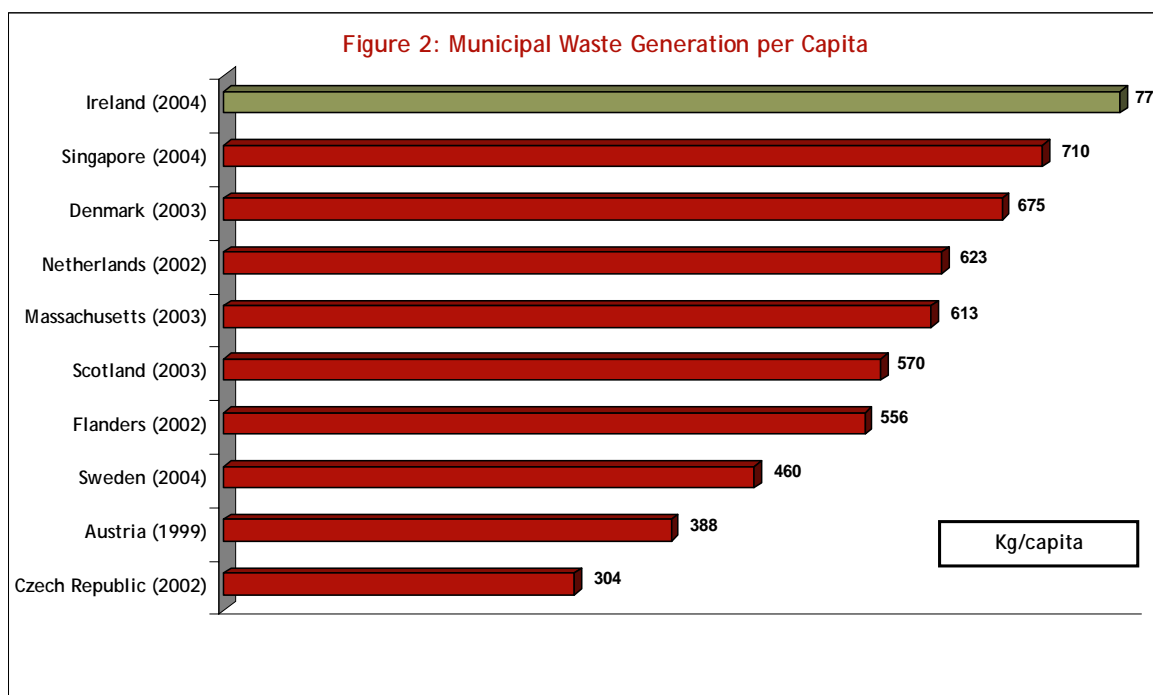
⁴ The other priority waste streams are packaging waste, construction & demolition waste, waste from end-of-life vehicles and waste oil.

3.1. Waste Generation

The accuracy of waste generation data is dependent on the quality of the waste collection system in place in each country, and the consistency of the data across countries. The indicators on waste generation are provided on a 'per capita' or 'per employee' basis to facilitate comparisons between countries. As well as highlighting the differences in the level of waste generation across the selected countries, the waste generation indicators also provide an indication of waste efficiencies and the success of waste prevention policies.

Municipal Waste Generation

Municipal waste in Ireland is defined as household waste as well as commercial and other waste which because of its nature or composition is similar to household waste. Some differences exist between the benchmark countries in their approach to recording municipal waste. In particular, the extent to which waste from commerce is included can vary. In some instances, the reported municipal waste figures mainly represent household waste, with only small quantities of commercial waste included. However, while every effort has been made to ensure that the data is as comparable as possible, there is still a need for caution when comparing municipal waste generation in Ireland with other countries due to the difference in definition.



Sources: Multiple sources used - see Appendix I for details

Notes: Data for Austria is from the Federal Waste Management Plan 2001. An update of this report is underway but was not published when RPS finalised its benchmarking report for Forfás.

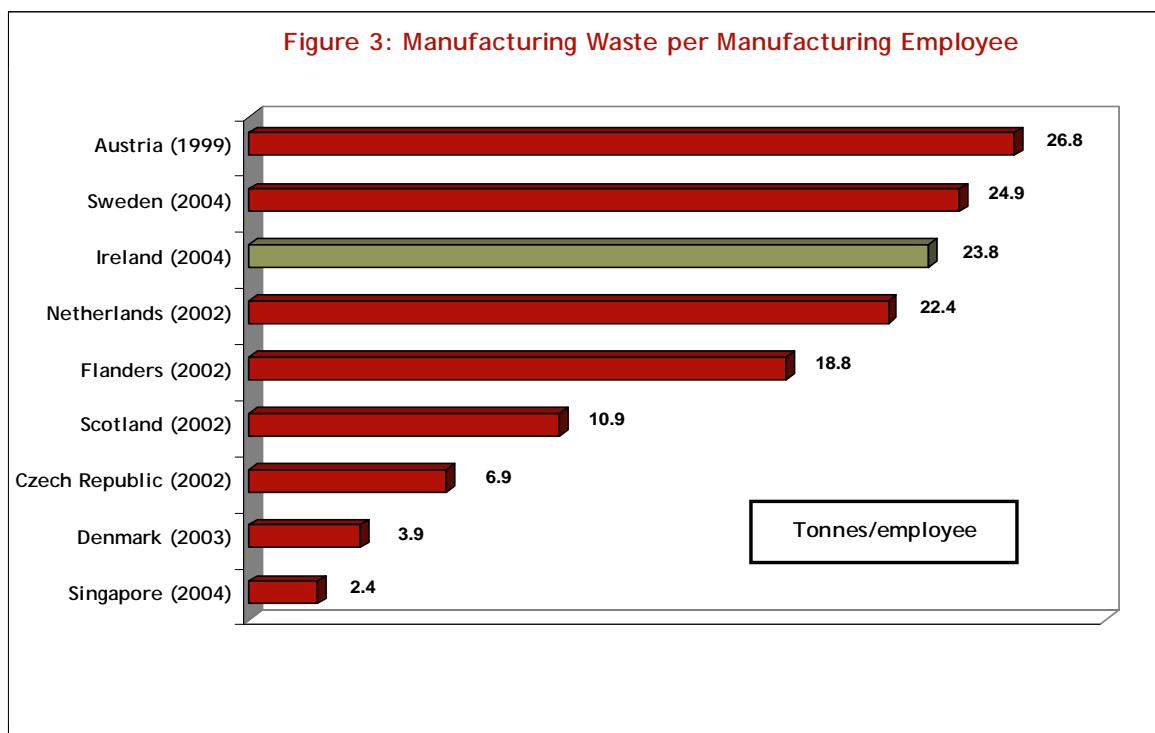
The data caveats above notwithstanding, Ireland has the highest level of municipal waste generation with a figure of 777 kg per capita (Figure 2). While some of the difference may be explained by the broader definition of municipal waste employed in Ireland, it is also a reflection of Ireland's recent economic success.

Industrial Waste Generation

In Ireland, industrial waste is defined as waste arising or produced from manufacturing or industrial activities or processes. The sources of industrial waste are broad and varied and as a result the waste stream is very heterogeneous in composition and can often be misreported in other waste categories e.g. municipal and commercial.

During the course of the study it was found that the definition of industrial waste varies from one country to the next and that data collected was inconsistent⁵. However, data on manufacturing waste was generally available for most of the benchmark countries and is a preferred comparative indicator. That said, caution should be exercised when using the figures for Singapore, as the quality of data was generally poor and as a result may not provide an accurate reflection of manufacturing waste generation.

Of the nine countries benchmarked, Ireland is ranked third highest, generating approximately 24 tonnes of manufacturing waste per manufacturing employee (Figure 3). However, the level of manufacturing waste per employee in Ireland is broadly similar to that in the Netherlands, Sweden and Austria.



Sources: Multiple sources used - see Appendix I for details.

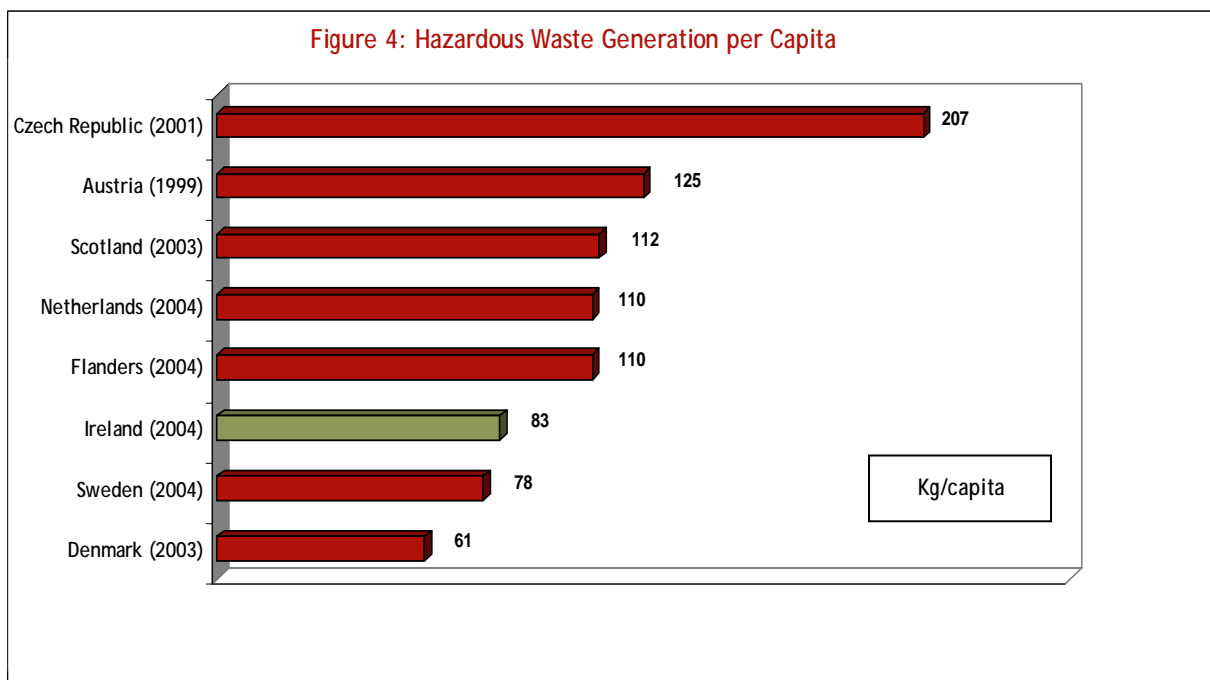
⁵ In Singapore and Massachusetts, industrial waste is recorded using different definitions to that used in European legislation.

Hazardous Waste Generation

Hazardous substances include chemical waste, solvents, waste oil, paint, batteries and clinical waste from hospitals. In Ireland, the National Hazardous Waste Management Plan details the types and quantities of hazardous waste material generated⁶.

Due to the nature and the environmental risk from this waste stream, data reporting on hazardous waste was found to be good, for most of the benchmark countries⁷. The comparative data is given in Figure 4. Singapore and Massachusetts are not included as no data was available.

Ireland has the third lowest hazardous waste generation per capita of the eight countries benchmarked, generating 83 kg per capita. Ireland's low per capita hazardous waste level can be attributed to the profile of the industrial base in Ireland and the absence of heavy industrial activity. The largest single hazardous waste category in Ireland is of organic solvents generated by the pharmaceutical and chemical sector. As illustrated in Figure 4, hazardous waste generation per capita in Flanders, Holland, Scotland and Austria is quite similar to levels in Ireland, ranging from 110 - 125 kg per capita.



Sources: Multiple sources used - see Appendix I for details.

The Czech Republic generates the most hazardous waste per capita, which can in part be attributed to its heavy industrial activities such as metallurgy, crude oil processing and

⁶ The National Hazardous Waste Management Plan is currently being reviewed by the EPA. A revised plan is due to be finalised in early 2007.

⁷ The definition of hazardous waste was amended in 2003 with the introduction of a revised European Waste Catalogue and comes in to effect for data compiled from 2004 onwards.

mechanical equipment production. However, there are also some questions over the reliability of the data.

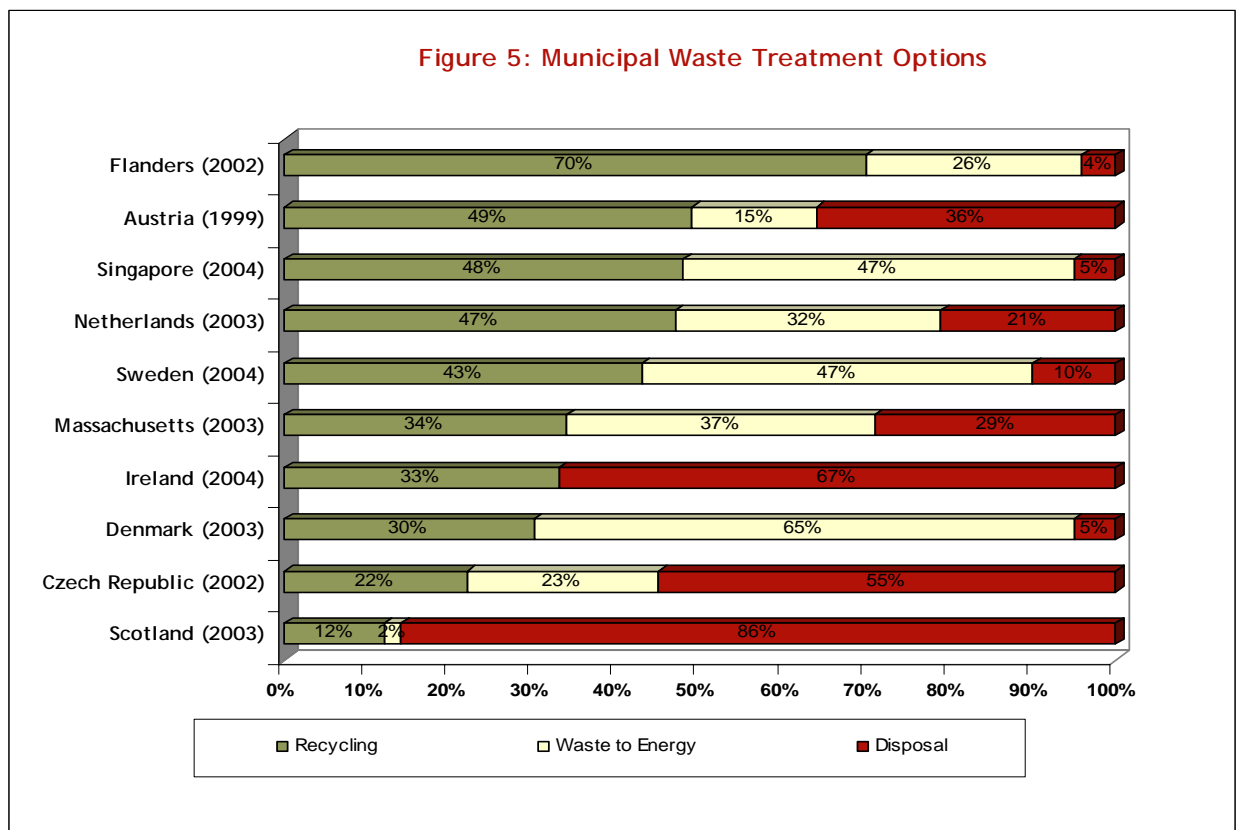
3.2. Waste Treatment Options

As previously mentioned, the waste hierarchy states that the most preferred option concerning waste management is prevention and minimisation, followed by re-use and recycling, energy recovery and, least favoured of all, disposal.

Municipal Waste Treatment

Figure 5 ranks the benchmark countries based on the level of recycling as this is the preferred waste treatment solution. The high level of consistent data available on the municipal waste stream enables an accurate picture of the current treatment solutions in place in each country.

Flanders is ranked first on this indicator with a recycling rate of 70 percent, while the second placed country, Austria, is some distance behind with a rate of 49 percent. Flanders' strong performance is largely due to its long established policy of source separation and the use of economic instruments to incentivise recycling.



Sources: Multiple sources used - see Appendix I for details.

Figure 5 highlights Ireland's continued dependence on landfill and the lack of Waste to Energy Treatment (WTE) options⁸. Of the ten countries benchmarked, Ireland is the only one without WTE infrastructure in place.

Most of the benchmark countries combine high recycling with high WTE and low landfill reliance. Singapore landfills just five percent of its municipal waste reflecting the fact that land is at a premium due to it being a country with a population of four million people in an area equivalent in size to County Carlow.

Although the rate of municipal waste recycling in Ireland has improved significantly in recent years, increasing from 13 percent in 2001 to 33 percent in 2004, Ireland ranks 7th of the 10 countries benchmarked in terms of the proportion of municipal waste recycled.

Industrial Waste Treatment

Data collected on industrial waste treatment solutions is inconsistent and limited across the countries studied, and therefore caution should be exercised with this indicator. Due to the lack of information available, the treatment options have been simplified and are reported in terms of percentage disposal and percentage recovery⁹. Figure 6 represents the best available information but some countries are excluded due to a lack of data.

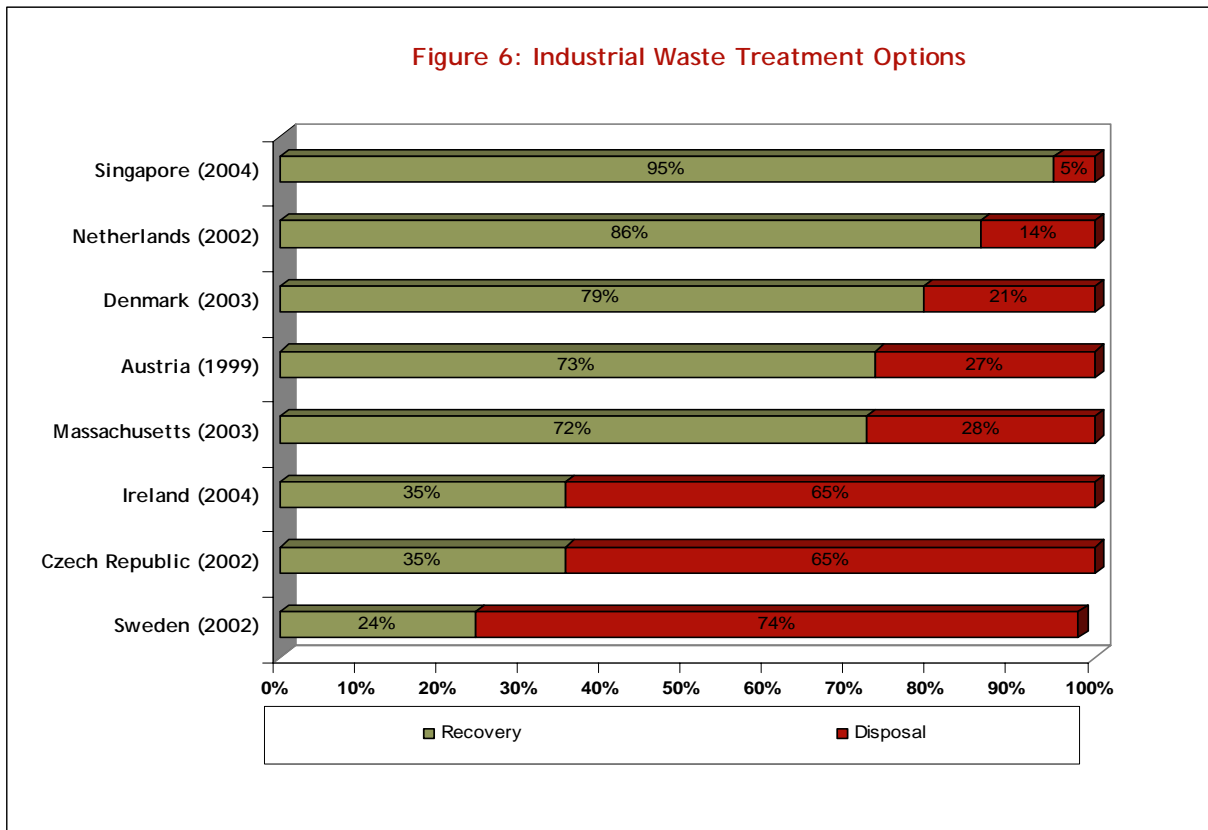
Using the percentage of recovery as a measure, Singapore ranks best of the countries presented with a 95 percent recovery rate for industrial waste. Singapore also land-filled just five percent of its municipal waste as outlined in the previous section.

Of the European countries, the Netherlands has the highest rate of recovery with a rate of 86 percent recorded. The high level of recovery reflects the Netherlands' long established policies of incentivising preferred treatment options such as recycling and energy recovery as well as using economic instruments to discourage landfill. The use of economic instruments will be discussed in more detail in Section 3.3.

Ireland performs poorly relative to the benchmark countries with a recovery rate of 35 percent, again highlighting Ireland's dependence on landfill as a waste management solution. A significant amount of the industrial waste is land-filled on-site by the bigger companies rather than being land-filled in municipal landfills. It should be noted that Ireland's recovery performance has improved; in 2001, only 25 percent of industrial waste was being recovered.

⁸ Waste to energy treatment facilities use waste to produce energy in the forms of steam, hot water, and electricity.

⁹ Recovery is defined as any waste management operation that diverts a waste material from the waste stream and which results in a certain product with a potential economic or ecological benefit. Recovery mainly refers to material recovery, (i.e. recycling), energy recovery, (i.e. re-use a fuel), biological recovery, (e.g. composting) or re-use. Direct recycling or reuse within industrial plants at the place of generation is excluded.



Sources: Multiple sources used - see Appendix I for details.

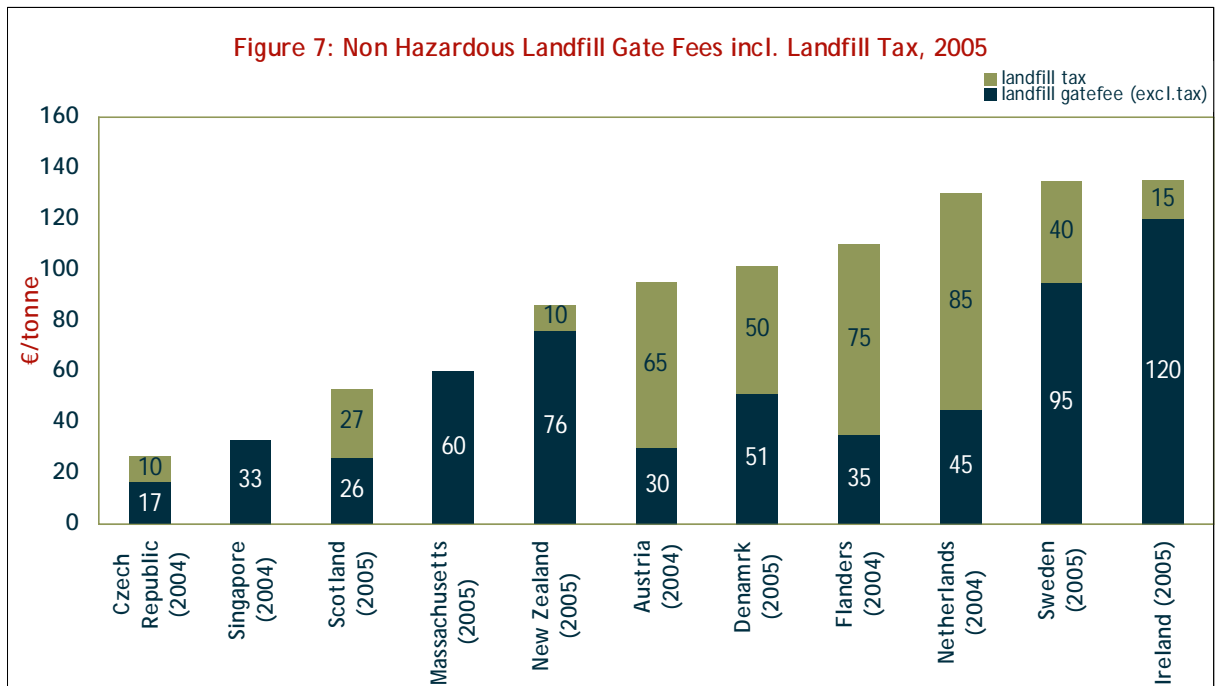
3.3. Costs

Over the last number of years waste management costs have increased significantly for the enterprise sector in Ireland, as documented by the NCC in various publications. This section reviews Ireland's costs relative to those in the benchmark countries to determine if cost competitiveness in waste management is an issue for Ireland's enterprise base.

Non-Hazardous Landfill Gate Fees

Landfill disposal is in operation in all of the benchmark countries and for some countries, including Ireland and Scotland, it remains the primary waste treatment solution. The data collected on landfill gate fees represent the current (average) costs for disposal in each of the selected countries for non-hazardous municipal and industrial waste. The data is considered to be consistent and accurate for all countries.

Ireland, along with Sweden and the Netherlands, has the highest non-hazardous landfill gate fees of the 11 benchmark countries (Figure 7). The average gate fee in Ireland is approximately €135 per tonne, including the landfill tax surcharge of €15, although gate fee prices in certain parts of the country can be as high as €185 per tonne. The lack of alternative treatment options means that many companies are directly affected by the high landfill costs. It may also explain why a high proportion of industrial waste is land-filled on-site by companies.



Sources: Multiple sources used - see Appendix I for details.

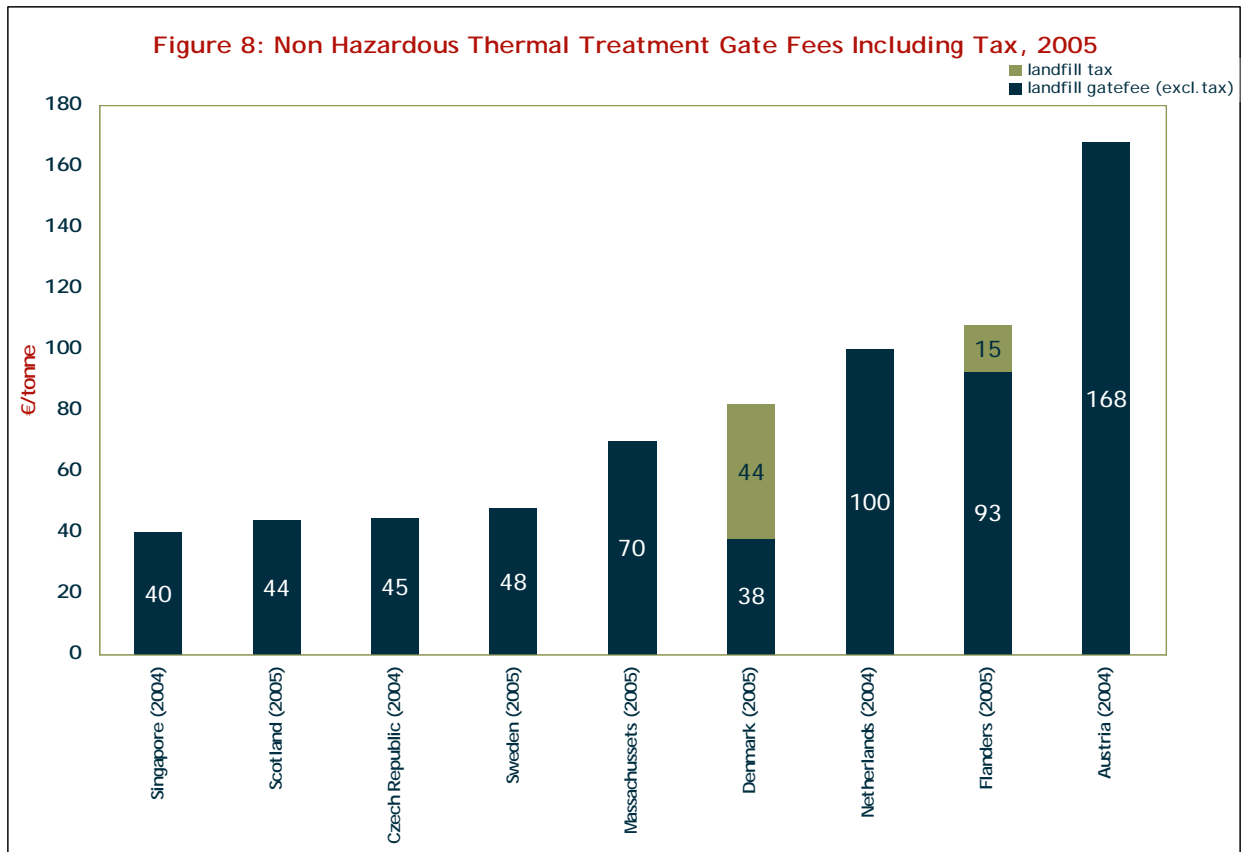
Reflecting the environmental costs of landfill, many of the benchmark countries have set high landfill taxes in order to minimise disposal to landfill and to incentivise the use of preferred treatment solutions such as thermal treatment and recycling. Although Ireland has the highest landfill charge, it has one of the lowest tax surcharge rates for landfill. Consideration therefore needs to be given to the use of the landfill tax as an effective tool in rendering alternative, more environmentally friendly solutions more attractive commercially and as to why Ireland's landfill gate fees are so high even with a low landfill tax.

Thermal Treatment Gate Fees

Thermal treatment is in operation in nine of the 10 countries benchmarked. The data presented represents the current (average) costs of treatment for non-hazardous municipal and industrial waste type waste. The data is considered to be consistent and to reflect accurately the current cost of thermal treatment in the selected countries.

Singapore has the lowest thermal treatment gate fee at €40 per tonne while Austria has the highest with the thermal treatment fees ranging from €100 to €250¹⁰. There are no thermal treatment facilities in operation in New Zealand and Ireland for municipal waste. As previously mentioned, New Zealand has adopted an overall strategy based on the 'zero waste' philosophy and has excluded thermal treatment as a waste treatment solution.

¹⁰ Because of the range of thermal treatment gate fees in Austria, an average fee is used in Figure 8.



Sources: Multiple sources used - see Appendix I for details

Two facilities in Ireland have been granted planning permission, one in Meath (capacity of 150,000 tonnes p.a.) and the other in Cork (capacity of 100,000 tonnes p.a.) but both are currently subject to a court appeal. A planning application is expected in 2006 for a facility in Dublin (capacity of 400,000 - 600,000 tonnes p.a.). The Dublin Waste Management Plan 2005-2010 suggests the WTE gate fee will be in the region of €90 - €110 per tonne.

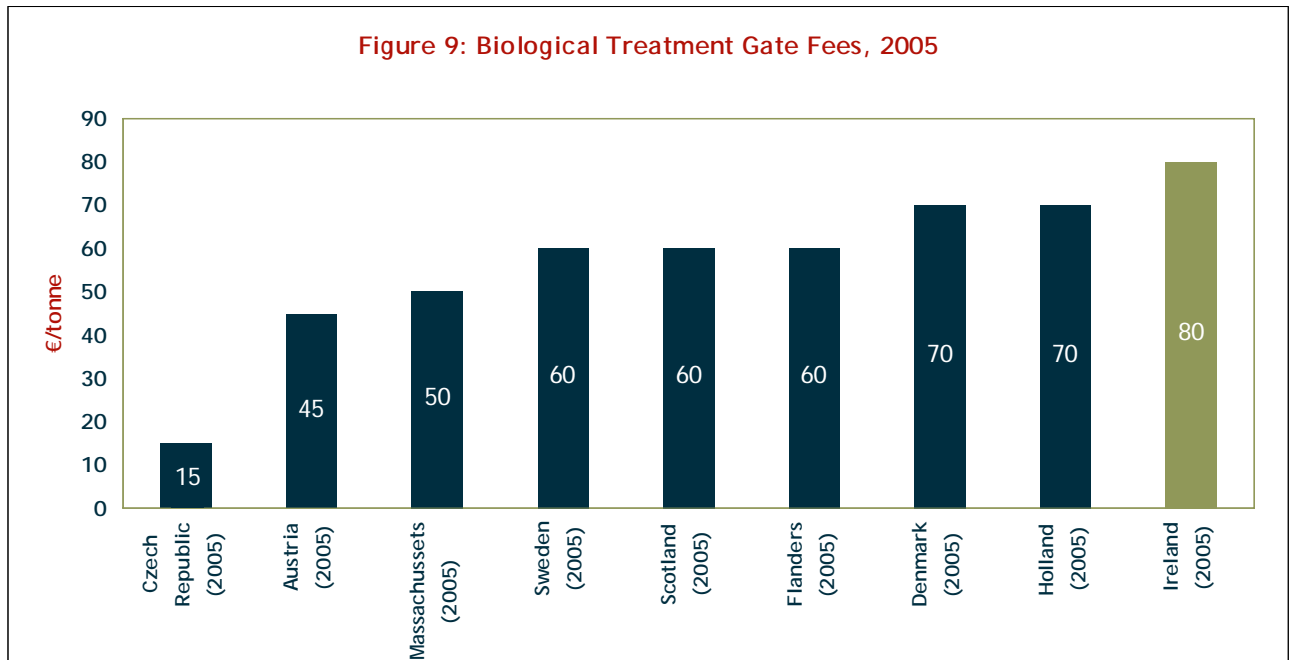
Lower thermal treatment costs in Denmark and Sweden are partly due to the high return from energy in facilities in these countries. The competitive costs in Singapore and Massachusetts reflect the economies of scale achieved by large facilities, but it is also possible that emissions controls in these countries are not as stringent as those set down in the EU Incineration Directive. Thermal treatment taxes are in place in only two of the nine countries (Denmark and Flanders).

The cost of thermally treating hazardous waste depends on the waste type and limited data was available on specific costs in what is a competitive environment. In Denmark, waste oil costs €150 per tonne to treat, while Polychlorinated Biphenyls (PCBs) can cost as much as €3,600 per tonne.

Biological Treatment Gate Fees

Biological treatment facilities are in operation in all 11 countries, and the gate fee costs associated are presented in Figure 9. Biological treatment is a preferred waste hierarchy

treatment solution and these facilities can contribute significantly to diverting material from landfills and achieving recycling targets. The costs given represent the current costs for the treatment of municipal and industrial bio-waste.



Sources: Multiple sources used - see Appendix I for details.

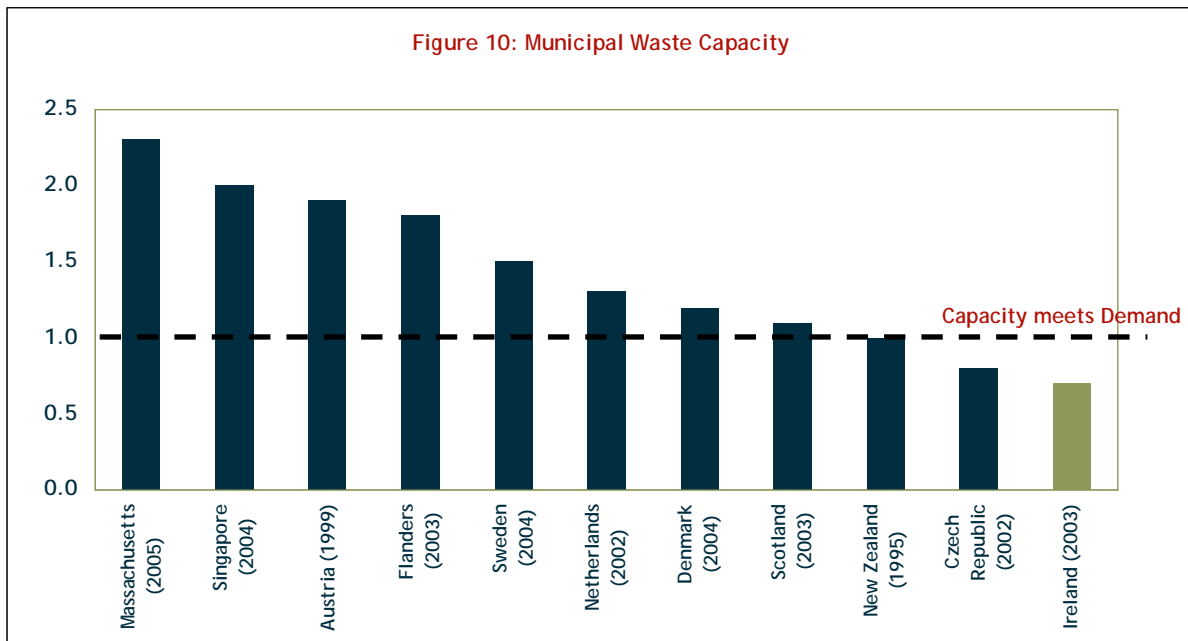
Ireland has the highest biological treatment gate fees at €80 per tonne but, as illustrated in Figure 9, it is not significantly more expensive than most of the benchmark countries. To date, biological treatment facilities established in Ireland are small (capacities < 10,000 tonnes), and this contributes to the higher gate fees. Accordingly, there is potential to reduce costs for biological treatment by establishing bigger facilities that can achieve greater economies of scale.

In order to incentivise waste producers to use biological treatment solutions and divert them away from landfill and thermal treatment, none of the countries benchmarked have introduced biological treatment taxes

3.4. Capacity and Infrastructure

The delivery of adequate national capacity to treat all types of waste is essential for meeting the needs of a growing economy and attracting FDI. Spare capacity can encourage competition and drive down prices, whereas a lack of capacity tends to result in higher prices.

Ireland has adopted the proximity principle, which says waste should be treated as close as possible to the source of generation¹¹. However, large quantities of waste continue to be exported because of infrastructure deficits. The lack of national treatment facilities could potentially restrict economic development if the necessary range of treatment capacities are not accessible.



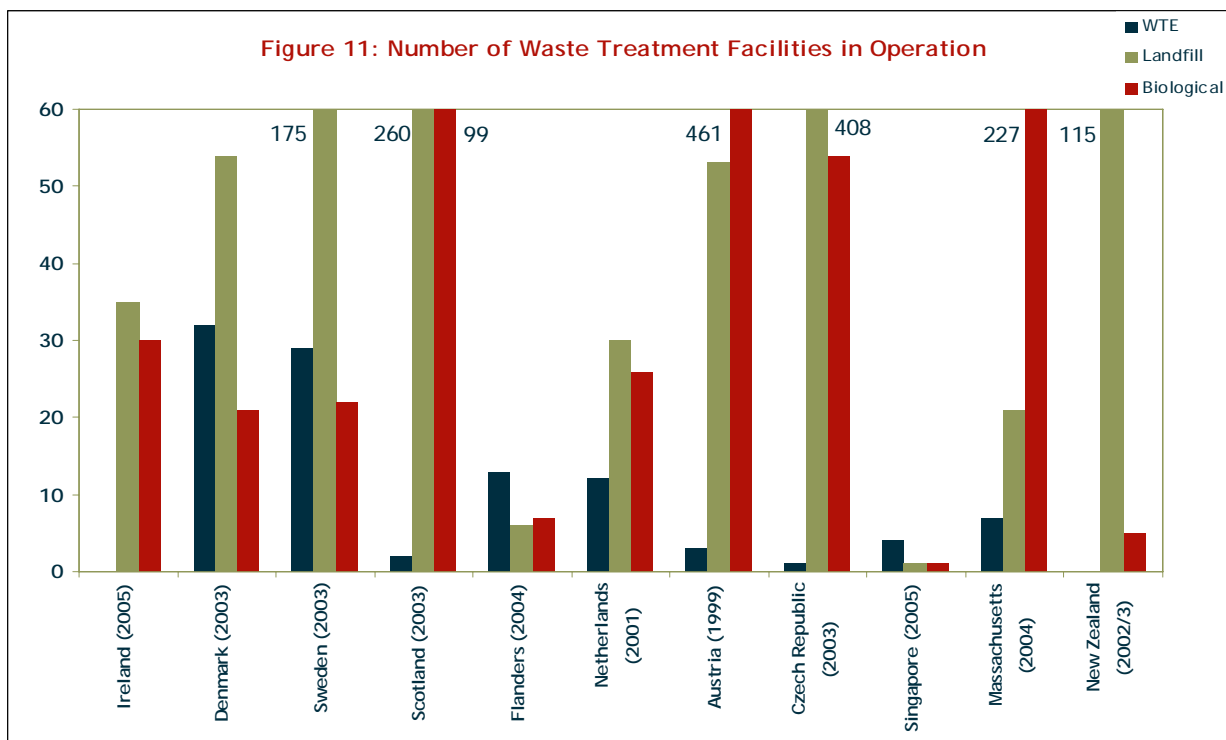
Sources: Multiple sources used - see Appendix I for details.

The indicator in Figure 10 shows the ratio of waste generation to municipal waste treatment capacity. The ratio has been calculated by totalling the available annual treatment capacity for municipal waste, and comparing this with the annual waste generation figure. The black broken line in Figure 10 indicates the point at which treatment capacity supply meets waste generation demand.

In terms of available municipal waste treatment capacity, Ireland has an annual landfill capacity of about 1.8 million tonnes, and a biological treatment capacity of about 100,000 tonnes. Municipal waste generation in 2004 stood at just over three million tonnes. Figure 10 confirms that Ireland's capacity does not meet the level of municipal waste generated. Ireland is ranked lowest of the 11 countries on the municipal waste capacity indicators. Figure 10 demonstrates aggregate capacity but it does not give the full picture in terms of the options available: for example, much of Scotland's excess capacity lies in landfill, which is the least preferred waste solution.

¹¹ The proximity principle is set out in EU Framework Directive (91/156/EEC). Member States, in cooperation with other Member States, must establish an integrated and adequate network of disposal installations, so that waste can be disposed of in one of the nearest appropriate installations, by means of the most appropriate methods and technologies to ensure a high level of protection for the environment and for public health.

An indication of the range of treatment facilities available across the benchmark countries is provided in Figure 11. Although this indicator does not take the size of the facility into account, it does highlight the deficits in the existing waste infrastructure in Ireland, in particular the absence of WTE facilities for the treatment of waste.



Sources: Multiple sources used - see Appendix I for details.

Note: This figure is not drawn to scale - where more than 60 facilities of a particular type of treatment are in operation the actual number of facilities is provided.

Ireland has 35 landfills and 30 biological treatment facilities in operation and no WTE plant¹². Comparing this to Denmark, which generates a similar level of municipal and hazardous waste, the corresponding numbers are 54 landfills, 21 biological treatment facilities and 32 WTE facilities¹³.

The limited access to waste treatment solutions is also likely to limit Ireland's ability to meet the targets set down in the EU Landfill Directive. This directive requires reductions in the amount of biodegradable municipal waste being land-filled. This in effect requires the replacement of disposal capacity with infrastructure of a different kind. Member states will be restricted to land-filling 75 percent of the municipal biodegradable waste (by weight) produced in 1995 by 2006, 50 percent by 2009 and 35 percent by 2016. Ireland is availing of the four year derogation allowed under Article 5 of the Directive. This pushes the targets out to 2010, 2013 and 2020 respectively.

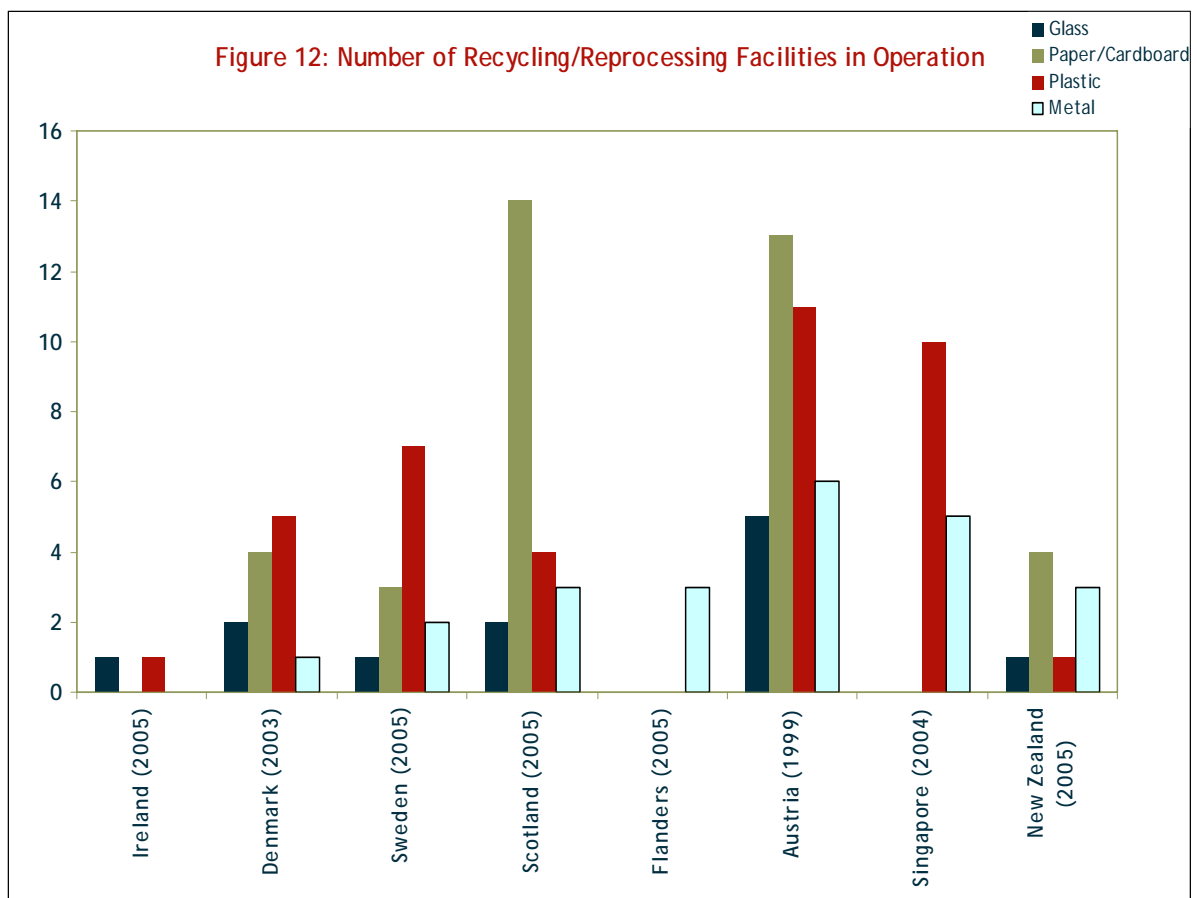
¹² On-site thermal treatment is carried out at six EPA licensed facilities. These facilities are only licensed to treat waste generated on-site and thermal treatment of waste from other sites is not permitted.

¹³ RPS

Given that, in 2004, the amount of biodegradable municipal waste land-filled in Ireland was 101 percent of the 1995 baseline, Ireland faces significant challenges in meeting the targets¹⁴. Based on 2004 levels, Ireland needs to reduce the amount of biodegradable municipal waste going to landfill by almost 340,000 tonnes in order to meet the 2010 target.

Recycling/Reprocessing Facilities

Figure 12 illustrates the number of recycling or reprocessing facilities in operation and highlights the lack of facilities for treating different recyclable materials in Ireland compared to many of the benchmark countries. Data was not available for the Netherlands, Austria, the Czech Republic and Massachusetts.



Sources: Multiple sources used - see Appendix I for details.

Ireland has only one glass, one paper and one plastic reprocessing facility in operation. The lack of facilities indicates that the vast majority of Ireland's recyclable materials are exported for further treatment. The transport costs alone add an estimated at €25 to €50 per tonne, depending on the material, to the waste costs of the enterprise sector. Scotland, New Zealand and Denmark are comparable countries to Ireland in terms of population and waste generation but have developed a wider range of indigenous reprocessing.

¹⁴ EPA, National Waste Report 2004, January 2006.

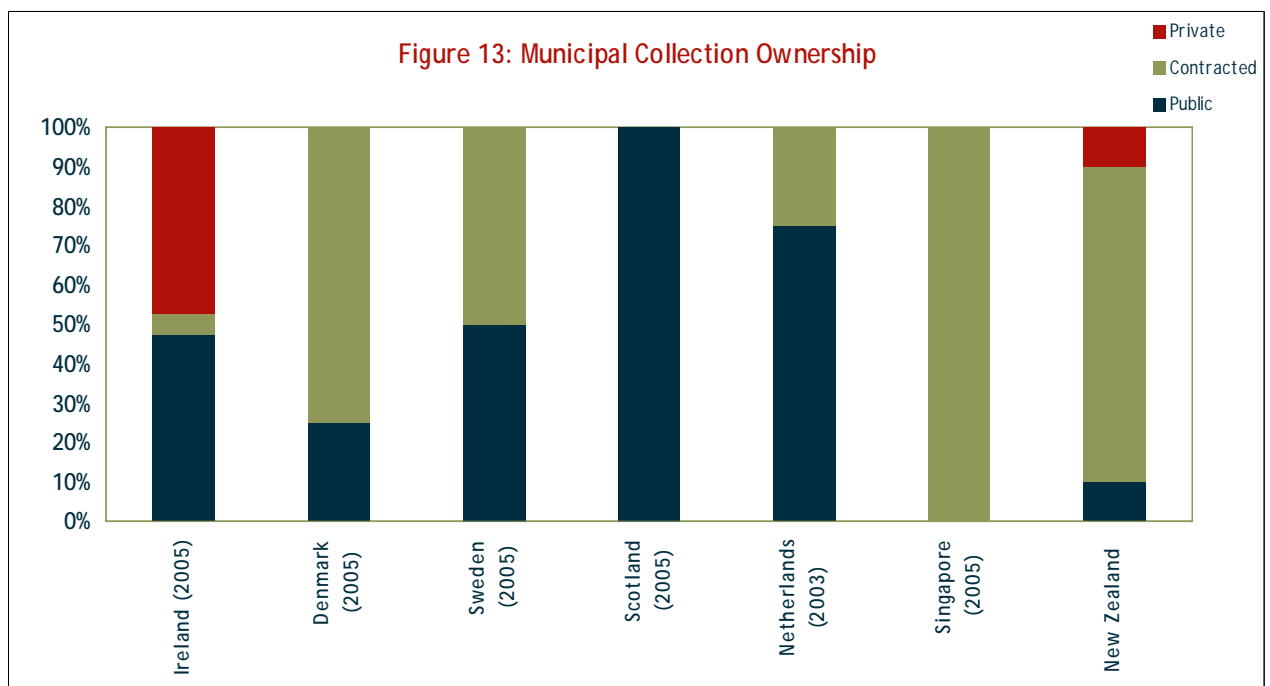
3.5. Ownership - Municipal Collection

The collection and treatment of waste tends to be operated to varying degrees by the public and private sector across the benchmark countries. This leads to country differences in waste costs, in the intensity of competition, and in the presence of recycling and recovery infrastructure.

The following indicator highlights the different types of ownership systems in each country for the collection of municipal waste. Three categories were identified:

- purely public collection ('public');
- publicly controlled but employing a private contractor under contract ('contract'); and
- purely private collection ('private')

Direct collection of waste by municipalities is common in most of the EU countries benchmarked. This comprises mainly household waste but in some cases some commercial waste is also included. Ownership data was also collected for industrial waste and hazardous waste for a selection of the benchmark countries. The private sector is primarily responsible for collecting and treating these waste streams.



Sources: Multiple sources used - see Appendix I for details.

In Ireland the collection of municipal waste is almost evenly split between the public and private sector. While the public sector has ceased involvement in waste collection in many areas, the local authorities continue to collect waste in some of the bigger urban areas - including Dublin, Galway, Cork, and Waterford.

As illustrated in Figure 13, Ireland is almost unique among the benchmark countries in having private services directly involved in the collection of waste without any municipal involvement in establishing the contract and determining what happens to the waste. In most other countries, competitive tendering for waste collection is common, on the basis that it enables value for money to be achieved from competing private sector contractors. "Competition for the market" as opposed to "competition in the market" seems to be more efficient in the municipal waste industry.

Following extensive enquiries into household waste collection in 2005, the Competition Authority is of the view that the market for household waste collection in Ireland is not working well for consumers¹⁵. Following a review of international experience, it concluded that competitive tendering, and not price regulation, is the best method of ensuring that household waste collection providers deliver consumers good service at competitive prices. It was outside the scope of the benchmarking analysis to assess the implications of competitive tendering and price regulation for the enterprise base.

4. Waste Prevention and Minimisation Initiatives

Waste prevention represents the most favourable waste management option. By not generating waste, we can eliminate the need to handle, transport, treat and dispose of waste. We can also avoid having to pay for waste management services. Therefore, investing resources in waste prevention and minimisation offers potential long-term benefits to competitiveness for business and industry of all types. When a company analyses and identifies wasteful practices it often becomes aware of other inefficiencies in its operations - for example poor management or storage of raw materials, inefficient machinery or poorly trained staff, or supply chain systems that create a lot of excess packaging waste.

Of the benchmark countries, New Zealand stands out in terms of its multi-faceted and collaborative approach to waste prevention and minimisation in the business and industrial sectors. The drive for better environmental performance is being delivered through industry-led initiatives, rather than imposed solutions. Among the initiatives in place are:

- *New Zealand Business Council for Sustainable Development* - Incorporated company that assembles top-level executives from leading businesses in New Zealand to "provide business leadership as a catalyst for change toward sustainable development, and to promote eco-efficiency, innovation and responsible entrepreneurship".
- *Enviromark Scheme* - participating companies take actions to improve environmental and health and safety performance and are awarded a bronze, silver, gold quality mark depending on scheme achievements. This logo can be used to demonstrate good practice to clients and customers.

¹⁵ The Competition Authority, Enforcement Decision: Alleged excessive pricing by Greenstar Recycling Holdings Limited in the provision of household waste collection services in northeast Wicklow, August 2005.

- ***Environmental Choice Labelling*** - New Zealand eco-labelling trust is a voluntary environmental labelling programme initiated by Government. The label recognises the manufacturers that work to reduce the environmental impacts of their products and provides a credible and independent guide for consumers.

In contrast, the Austrian government has introduced more direct regulation, requiring all companies with more than 100 employees to nominate an adequately trained 'waste officer' with responsibility for in-house waste prevention and recycling. Austria supports the development of Eco-Management & Audit Schemes (EMAS), which involves a rigorous certification and auditing process¹⁶.

In the Netherlands, a series of demonstration programmes have been carried out through government agencies with a view to encouraging waste prevention in industry and business. These include 'the industrial successes with waste prevention project', the 'waste prevention in industrial activities programme', 'the much to be gained from prevention implementation strategy' and 'the cleaner production' programme. Financial instruments have also been used to encourage waste prevention, such as the 'green investment' and 'voluntary depreciation of environmental investment' schemes.

Flanders' waste prevention plan has been co-ordinated by OVAM, the waste agency for the region and is being implemented on a phased basis. OVAM provides guidance and funding to local authorities to implement the waste prevention action plans. While the focus initially was on the household sector, it is now turning its attention to small enterprises. Since 1999, Flanders has succeeded in decoupling household waste and GDP growth.

The existence of a prevention programme is not the only indication of a country's commitment to waste prevention and minimisation. For example, there is no national waste prevention programme in Sweden. But the beverage industry operates a take-back and reuse scheme for 460 million glass bottles, and 70 million plastic bottles, achieving a return rate of over 90 percent.

Ireland's *National Waste Prevention Programme 2004-2008* was published in April 2004. The programme, which builds on initiatives such as the Cleaner Greener Production Programme, aims to deliver substantive results on waste prevention and minimisation and will integrate a range of initiatives addressing awareness-raising, technical and financial assistance, training and incentive mechanisms¹⁷. Ireland also has a national waste awareness programme (Race Against Waste) which has a business and household focus, and there are also support systems at municipal level (e.g. Environmental Awareness Officers, and Regional Industrial Waste Minimisation Officers).

¹⁶ The EU's Eco-Management and Audit Scheme, is a voluntary initiative designed as a management tool for companies and other organisations to evaluate, report and improve their environmental performance.

¹⁷ The objective of the Cleaner Greener Production programme is to encourage companies in Ireland, particularly SMEs, to adopt a high standard of environmental performance by adapting or improving business practices in order to minimise negative impact on the environment.

Enterprise Ireland has established the www.envirocentre.ie website, a free environmental information service designed specifically to enhance environmental awareness in Irish industry, with a particular focus on SMEs. The aim is to assist Irish companies to increase profitability, competitiveness and growth through improved environmental performance.

Table 1 below provides an overview of the waste prevention programmes in the benchmark countries. It was not possible to obtain information for the Czech Republic.

Table 1: Overview of Waste Prevention Programmes in the Benchmark Countries

	National Programme	Regional Programme	Municipal Programme	Comments
Austria	Yes	Yes	Yes	Austrian Waste Plan includes policies for prevention, mainly on a sectoral or waste stream basis. A number of cleaner production/business initiatives are also in place, some of which are on a regional level.
Denmark	Yes	Yes	Yes	The Danish Waste Plan includes policies for waste prevention.
Flanders	N/A	Yes	Yes	Flanders' Waste Plan includes sectoral plans for prevention, recycling etc. The Flemish EPA has co-ordinated prevention programmes since 1997.
Ireland	Yes	No	Yes	Prevention programmes are regionally co-ordinated but delivered by local authorities. Exceptions include the Regional Industrial Waste Minimisation Officer in the mid-west region, and the www.dublinwaste.ie website. The EPA runs the Cleaner Greener Production Programme.
Massachusetts	N/A	No	Yes	Prevention programmes are the responsibility of the municipalities.
Netherlands	Yes	No	Yes	Netherlands Waste Plan includes policy for prevention. There are also several programmes for cleaner production in industry.
New Zealand	Yes	Yes	Yes	New Zealand's Waste Strategy includes policies for 'Zero Waste'. Implementation is via local authorities and also a range of special companies or trusts set up to assist business and industry. Some of these are regional in scope.
Scotland	Yes	No	Yes	While there is no separate 'prevention programme', Scotland has two programmes similar to the Race Against Waste.
Singapore	No	No	No	The main emphasis in Singapore's 'Green plan 2012' is to increase public engagement in recycling.
Sweden	No	No	Yes	Successful reuse schemes in place for glass and plastic bottles across Sweden.

Source: RPS

Producer Responsibility Schemes

Producer responsibility schemes stem from European legislation, enacted because of growing concern about particular waste streams and their impact on the environment. They are an extension of the 'polluter pays' principle, and seek to ensure that businesses take

responsibility for the products they have placed on the market once those products reach the end of their life.

The overarching objective of the producer responsibility schemes is to achieve a more sustainable approach to resource use and a reduction in the quantity of waste going to landfill, by diverting end of life products to re-use, recycling or other forms of recovery. These schemes can be either voluntary or regulatory. Producer responsibility is an alternative to taxation or traditional regulation. By placing at least some of the costs of their products on producers, producer responsibility schemes can influence the design of the product, the materials employed and the supply chain.

Producer Responsibility can be achieved through voluntary schemes or through direct regulation. Voluntary schemes can be advantageous in reducing the burden of regulation and increasing the flexibility of the solution. However, the regulatory approach can ensure there are no free-loaders (companies that avoid their responsibilities) and also provide a stimulus to ensure that effective schemes are established. Table 2 provides an overview of producer responsibility schemes in the benchmark countries.

Table 2: Producer Responsibility Schemes in the Benchmark Countries

	Packaging	WEEE	EOLV	Batteries	Tyres	Farm Plastic	Waste Oil	Paint	Other
Ireland	L	L				L			C&D waste (V)
Denmark	L	L		L	L		V		
Sweden	L	L							
Scotland	L		L						Newsprint (V)
Flanders	L	L		L					Paper (separately for newsprint & advertising)
Netherlands	L	L	L	L	L	L	L		Minor chemical waste, plastic panels, sheet glass (L), plastic piping (V)
Austria	L	L	L	L					Refrigerants, Lamps (L)
Massachusetts		V		V	V		L	V	Carpets, gas cylinders, pesticides (v) Glass (L)
New Zealand	V	V			V		V	V	Refrigerants (v)

Source: RPS

Note: L - Legally binding; V - Voluntary.

The approach followed in Denmark, Holland and a number of other EU countries is to develop a relatively simple scheme that involves a fee (which can be separate or part of the purchase price) being charged to the consumer at the point of purchase. This fee is used to finance the recovery scheme. The consumer can deposit the material at a designated point free of charge. Any local authority costs in managing the waste are paid from the central fund. A similar model is in use for the WEEE scheme in Ireland.

While the producer responsibility schemes are intended to create a financial incentive for manufacturers to prevent/minimise end-of-life waste by the redesign of their products, in practice the key focus of Ireland's schemes has been to encourage producers to finance the collective recycling of their product waste at the end of its life (e.g. packaging).

It was not possible within the scope of this study to carry out an assessment of the effectiveness of producer responsibility schemes in minimising waste in the benchmark countries. In particular, the impact of producer responsibility schemes on the enterprise base needs to be explored further.

5. Key Conclusions

Lengthy delays in rolling out planned infrastructure, continuing increases in waste generation due to a growing population and economy, and an increasing dependence on exporting have led to concerns over the ability of the Irish waste system to cater for further economic expansion and to provide competitively priced waste management solutions. Analysis of the Irish waste management system has indicated higher waste management costs, shortfalls in waste treatment capacity and limited choice of waste treatment solutions compared to the benchmark countries.

This analysis suggests a number of policy issues that need to be addressed in order to improve Ireland's comparative performance in meeting the waste management needs of industry. These are outlined below:

Waste Prevention and Minimisation

As indicated in the previous section, Ireland has the highest level of municipal waste generation per capita of all the benchmark countries and manufacturing waste generation per employee is also relatively high.

The preferred waste management solutions are prevention and minimisation. These are policy options that are aimed at avoiding the creation of waste, and if this is not possible, at reducing the amount of material that will ultimately become waste.

Investing resources in waste prevention and minimisation offers potential long-term benefits for the competitiveness of enterprises of all types. When a company analyses and identifies wasteful practices it often becomes aware of other inefficiencies in its operations - for example, poor management or storage of raw materials, inefficient machinery or poorly trained staff, or supply chain systems that create a lot of excess packaging waste. When prevention and minimisation is put in place, waste management costs can also be reduced.

Ireland's *National Waste Prevention Programme 2004-2008* was launched in 2004 to drive waste prevention and minimisation. The main objectives of the programme are to reverse current trends in waste production, decouple waste generation from economic growth and minimise the environmental impact of waste. Sustained efforts over many years will be required to achieve these goals. It is imperative for Ireland's future competitiveness and environmental sustainability that the necessary resources and commitment to realise these objectives are provided.

Infrastructure Deficits

While significant progress has been made in recent years in increasing the percentage of waste generated being recycled, efforts to deliver waste infrastructure especially in preferred waste treatment options such as thermal treatment and biological treatment have been much less successful. Ireland's comparatively poor performance on key benchmarking indicators such as costs and capacity can be traced back to the failure to deliver key waste management infrastructure in recent years.

Ireland's infrastructure deficits are also likely to impact on our ability to meet the targets laid down in the EU Landfill Directive. Ireland will be restricted to land-filling 75 percent of the municipal biodegradable waste produced (by weight) in 1995 by 2010. Given that in 2004, the amount of biodegradable municipal waste land-filled in Ireland was 101 percent of the 1995 baseline, Ireland faces significant challenges in meeting the 2010 target¹⁸.

Ireland currently exports 30 percent of municipal waste and 70 percent of hazardous waste. Specific infrastructure deficits include:

- no operational thermal treatment capacity to recover energy from municipal and industrial waste;
- no operational thermal treatment or landfill capacity for hazardous waste;
- inadequate biological treatment (composting, anaerobic digestion) throughout Ireland; and
- limited reprocessing capacity for recovered materials (e.g. paper, glass, plastic, metal recycling).

That said, new waste treatment facilities have to be economically viable. Accordingly, in certain cases, the export option will remain the most practical and cost effective solution, as long as export of waste is permitted and other countries are willing to accept it. For example, in 2004, a quantity of municipal waste from Ireland underwent energy recovery operations in Germany but this ceased in 2005 as a result of Germany's implementation of the EU Landfill

¹⁸ EPA, *National Waste Report 2004*, January 2006.

Directive - German incineration capacity was reduced as waste was diverted from landfill. It also led to an increase in incineration gate fees¹⁹.

Effectiveness of Existing Implementation Mechanisms

The lack of national coordination on waste management issues in Ireland was identified in discussions with stakeholders as one of the major challenges in the waste management area from an enterprise perspective. Decisions on the roll-out of infrastructure are primarily made within county boundaries rather than being based on national criteria such as industry economies of scale, the development of critical mass and the existence of transport corridors. There also appears to be a lack of urgency at a local level in the implementation of the waste plans.

The absence of a central focus for the co-ordinated and consistent implementation of essential infrastructure on a national basis was highlighted by Forfás in its 2001 report, *Key Waste Management Issues in Ireland*, as a major barrier to Ireland's competitiveness in meeting the waste management needs of enterprise. That report recommended the establishment of a National Waste Management Agency to develop an integrated national waste management plan and to address such issues. However, the Minister for Environment, Heritage and Local Government has stated in the Dáil that he does not favour the establishment of such an agency.

Specific infrastructure requirements have been identified in the *National Hazardous Waste Management Plan* and the *National Strategy on Biodegradable Waste* as well as in the regional waste management plans but have not been implemented. This is mainly due to lengthy delays in the planning process. The publication of the Strategic Infrastructure Bill, which includes waste disposal infrastructure such as incineration, chemical treatment and landfill, is therefore a welcome development. The fast tracking of major projects will accelerate the delivery of important infrastructure and improve cost effectiveness. However, as noted by the Minister for the Environment, Heritage and Local Government when announcing the publication of the Strategic Infrastructure Bill in February 2006, a lot of the most protracted delays to decisions on infrastructure in recent years have been due to legal challenges to planning decisions. This issue needs to be addressed also.

¹⁹ EPA, *National Waste Report 2004*, January 2006.

APPENDIX I: DATA SOURCES

Figure 2: Municipal Waste Per Capita	
Ireland	EPA, National Waste Report 2004, January 2006
Denmark	Danish Ministry for the Environment EPA, Waste Statistics, 2003
Sweden	The Swedish Association of Waste Management, Waste Management in Sweden, 2005
Scotland	Scottish Environment Protection Agency (SEPA), Waste Data Digest 5, 2003 and 2003/2004 data
Flanders	OVAM, Municipal Waste Management in Flanders - Experiences and Challenges, 2004
Netherlands	CBS, Statistical Yearbook of The Netherlands, 2005
Austria	Austrian Federal Ministry of Agricultural Environment and Water Management, Federal Waste Management Plan, 2001
Czech Republic	Ministry of the Environment of the Czech Republic, Waste Management Plan of the Czech Republic, 2003
Singapore	National Environment Agency, Environmental Protection Division: 2004 Annual Report, 2004
Massachusetts	Department of Environmental Protection, Solid Waste Master Plan: 2005 Revision, Public Hearing Draft, September 2005,
New Zealand	Ministry for the Environment, National Waste Data Report, May 1997

Figure 3: Manufacturing Waste Generation	
Ireland	EPA, National Waste Report 2004, January 2006
Denmark	Danish Ministry for the Environment EPA, Waste Statistics, 2003
Sweden	The Swedish Association of Waste Management, Waste Management in Sweden, 2005
Scotland	SEPA, Waste Data Digest 5, 2003 and 2003/2004 data
Netherlands	Waste Management Council, National Waste Management Plan 2002 - 2012, 2002
Austria	Austrian Federal Ministry of Agricultural Environment and Water Management, Federal Waste Management Plan, 2001
Czech Republic	Ministry of the Environment of the Czech Republic, Waste Management Plan of the Czech Republic, 2003
New Zealand	Ministry for the Environment, National Waste Data Report, May 1997

Figure 4: Hazardous Waste Per Capita	
Ireland	EPA, National Waste Report 2004, January 2006
Denmark	Danish Ministry for the Environment EPA, Waste Statistics, 2003,
Sweden	The Swedish Association of Waste Management, Waste Management in Sweden, 2005
Scotland	SEPA, Waste Data Digest 5, 2003 and 2003/2004 data.
Flanders	Indaver data
Netherlands	Waste Management Council, The Future of Incineration of Specific Hazardous Waste, 2004
Austria	Austrian Federal Ministry of Agricultural Environment and Water Management, Federal Waste Management Plan, 2001
Czech Republic	Ministry of the Environment of the Czech Republic, Waste Management Plan of the Czech Republic, 2003
New Zealand	Ministry for the Environment, National Waste Data Report, May 1997,

Figure 5: Municipal Waste Treatment Options	
Ireland	EPA, National Waste Report 2004, January 2006
Denmark	Danish Ministry for the Environment EPA, Waste Statistics, 2003
Sweden	The Swedish Association of Waste Management, Waste Management in Sweden, 2005
Scotland	SEPA, Waste Data Digest 5, 2003 and 2003/2004 data
Flanders	OVAM, Municipal Waste Management in Flanders - Experiences and Challenges, 2004
Netherlands	Waste Management Council, National Waste Management Plan 2002 - 2012, 2002
Austria	Austrian Federal Ministry of Agricultural Environment and Water Management, Federal Waste Management Plan, 2001
Czech Republic	Ministry of the Environment of the Czech Republic, Waste Management Plan of the Czech Republic, 2003
Singapore	National Environment Agency, Environmental Protection Division: 2004 Annual Report, 2004
Massachusetts	Department of Environmental Protection, Solid Waste Master Plan: 2005 Revision, Public Hearing Draft, September 2005
New Zealand	Ministry for the Environment, National Waste Data Report, May 1997

Figure 6: Industrial Waste Treatment Options	
Ireland	EPA, National Waste Report 2004, January 2006
Denmark	Danish Ministry for the Environment EPA, Waste Statistics, 2003
Sweden	The Swedish Association of Waste Management, Waste Management in Sweden, 2005
Scotland	SEPA, Waste Data Digest 5, 2003 and 2003/2004 data
Netherlands	Waste Management Council, National Waste Management Plan 2002 - 2012, 2002
Austria	Austrian Federal Ministry of Agricultural Environment and Water Management, Federal Waste Management Plan, 2001
Czech Republic	Ministry of the Environment of the Czech Republic, Waste Management Plan of the Czech Republic, 2003
New Zealand	Ministry for the Environment, National Waste Data Report, May 1997

Figure 7: Non-Hazardous Landfill Gate Fee	
Ireland	RPS (Ireland) Data
Denmark	COWI (Denmark) Data
Sweden	COWI (Sweden) Data
Scotland	RPS Scotland Data
Flanders	Indaver Contact
Netherlands	CEWEP Congress Amsterdam September 2004, Country Report: Netherlands
Austria	CEWEP Congress Amsterdam September 2004, Country Report: Austria
Czech Republic	CEWEP Congress Amsterdam September 2004, Country Report: Czech Republic
Singapore	National Environment Agency, Environmental Protection Division: 2004 Annual Report, 2004
Massachusetts	Massachusetts Department of Environmental Protection
New Zealand	Ministry for the Environment

Figure 8: Non-Hazardous Thermal Treatment Gate Fee	
Denmark	COWI (Denmark) Data
Sweden	COWI (Sweden) Data
Scotland	RPS Scotland
Flanders	Indaver
Netherlands	CEWEP Congress Amsterdam September 2004, Country Report: Netherlands
Austria	CEWEP Congress Amsterdam September 2004, Country Report: Austria
Czech Republic	CEWEP Congress Amsterdam September 2004, Country Report: Czech Republic
Singapore	National Environment Agency, Environmental Protection Division: 2004 Annual Report, 2004
Massachusetts	Massachusetts Department of Environmental Protection

Figure 9: Biological Treatment Gate Fee	
Ireland	RPS Ireland
Denmark	COWI (Denmark) Data
Sweden	COWI (Sweden) Data
Scotland	RPS Scotland
Flanders	VLACO Flanders Composting Association
Netherlands	Brance Verenigen Organische Reststoffen (Dutch Composting Association for Green Waste)
Austria	Kompost - Entwicklung & Beratung Composting Consultancy
Czech Republic	Czech Association for Biomass
Massachusetts	Department of Environmental Protection

Figure 10: Municipal Waste Capacity	
Ireland	RPS Data and Regional Waste Management Plans
Denmark	Danish Ministry for the Environment, EPA, Waste Statistics, 2003, The Danish Government, Waste Strategy 2005 - 2008, 2004
Sweden	The Swedish Association of Waste Management, Waste Management in Sweden, 2005
Scotland	SEPA, National Waste Strategy, 2003
Flanders	OVAM, Municipal waste management in Flanders - Experiences and Challenges, 2004,
Netherlands	Waste Management Council, National Waste Management Plan 2002 - 2012, 2002
Austria	Austrian Federal Ministry of Agricultural Environment and Water Management, Federal Waste Management Plan, 2001
Czech Republic	Ministry of the Environment of the Czech Republic, Waste Management Plan of the Czech Republic, 2003
Singapore	Ministry of the Environment and Water Resources, The Singapore Green Plan 2012, 2002
Massachusetts	Department of Environmental Protection, Solid Waste Master Plan: 2005 Revision, Public Hearing Draft, September 2005,
New Zealand	Ministry for the Environment, National Waste Data Report, May 1997

Figure 11: No. of Waste Treatment Facilities	
Ireland	EPA
Denmark	Danish Ministry for the Environment, EPA, Waste Statistics, 2003, The Danish Government, Waste Strategy 2005 - 2008, 2004
Sweden	COWI Data The Swedish Association of Waste Management, Waste Management in Sweden, 2005
Scotland	SEPA, National Waste Strategy, 2003
Flanders	European Compost Network: Country Report Indaver
Netherlands	Waste Management Council, National Waste Management Plan 2002 - 2012, 2002
Austria	Austrian Federal Ministry of Agricultural Environment and Water Management, Federal Waste Management Plan, 2001
Czech Republic	Ministry of the Environment of the Czech Republic, Waste Management Plan of the Czech Republic, 2003
Singapore	Ministry of the Environment and Water Resources, The Singapore Green Plan 2012, 2002
Massachusetts	Department of Environmental Protection (DEP) , Active MSW Combustion Facilities in Massachusetts, 2004 DEP, Active Solid Waste Landfills in Massachusetts, 2005 DEP, Active Composting Sites, 2005
New Zealand	Ministry for the Environment

Figure 12: No of Recycling/Reprocessing Facilities	
Ireland	RPS Ireland Data
Denmark	COWI Data
Sweden	COWI Data
Scotland	RPS Scotland Data
Flanders	Indaver/OVAM Data
Austria	Austrian Federal Ministry of Agricultural Environment and Water Management, Federal Waste Management Plan, 2001
Singapore	National Environment Agency, Environmental Protection Division: 2004 Annual Report, 2004
New Zealand	Ministry for the Environment

Figure 13: Municipal Collection Ownership	
Ireland	RPS Ireland Data
Denmark	COWI (Denmark) Data
Sweden	COWI (Sweden) Data
Scotland	RPS Scotland Dats
Netherlands	The Waste Market: The Netherlands and Neighbouring Countries
Singapore	Ministry of the Environment and Water Resources, The Singapore Green Plan 2012, 2002
New Zealand	Ministry for the Environment

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