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An Ghníomhaireacht um Chaomhnú Comhshaoil

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Critical Analysis of the Potential of Mechanical Biological Treatment for Irish waste Management

STRIVE

Environmental Protection Agency Programme

2007-2013

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government

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EPA STRIVE Programme 2007–2013

Critical Analysis of the Potential of Mechanical Biological Treatment for Irish Waste Management

(2005-WRM-MS-35)

Synthesis Report

(End-of-project report available on http://erc.epa.ie/safer/reports)

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The project, entitled 'Critical Analysis of the Potential of Mechanical Biological Treatment for Irish Waste Management', is led by Fehily Timoney and Company with assistance from project partners Rambøll (Denmark) and Veolia Environmental Services UK. The project is based on both desktop and field studies of the existing mechanical and biological treatment situation in Europe and on first-hand information provided by project partners on the operational performance of several mechanical and biological facilities across Europe and in the UK.

This report was prepared under the guidance of the Project Steering Committee: Dr Brian Donlon, Environmental Protection Agency; Mr Kealan Reynolds, Environmental Protection Agency; and Mr Brendan O'Neill, Department of the Environmental, Heritage and Local Government. The authors wish to thank the Steering Committee for their guidance and input throughout the project and also all other contributors who provided opinions and information when contacted.

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Acronyms

AD:	anaerobic digestion
BMW:	biodegradable municipal waste
CEN:	European Committee for Standardisation
CHP:	combined heat and power
EfW:	energy from waste
EIS:	environmental impact statement
IPPC:	integrated pollution prevention control
LCA:	life cycle assessment
MBT:	mechanical biological treament
MRF:	material recovery facility
MSW:	municipal solid waste
RDF:	refuse derived fuel
RTO:	regenerative thermal oxidiser
SRC:	short rotation coppice
SRF:	solid recovered fuel
tpa:	tonnes per annum
WMR:	Waste Management Region
WTE:	waste-to-energy

Executive Summary

Introduction

Mechanical Biological Treatment (MBT) is a waste treatment concept that has grown into a dynamic industry on mainland Europe since the 1980s. It evolved from a need in the face of changing legislative requirements to develop a method for treating residual municipal solid waste (MSW)[1] material, and thereby reduce the need for traditional landfill disposal.

The aims of this project were to:

- Provide information in relation to MBT that may inform future government policy.
- Identify issues that require addressing in order to establish conditions that are suitable to the environmental development of MBT facilities in Ireland.
- Identify issues that require addressing in order to establish conditions that are suitable to the economic development of MBT facilities in Ireland.
- Make recommendations where possible as to the means to address these issues.

In Ireland, landfill disposal has been the historical means of disposing of the residual fraction of MSW. However, in the face of European legislation (particularly the Council Directive 99/31/EC of 26 April 1999 on the Landfill of Waste, [the 'Landfill Directive']), there is a requirement that alternative treatment methods must be employed to pre-treat all waste before landfilling.

The Landfill Directive contains binding obligations for an EU-wide reduction of the use of landfill as an option for the disposal of biodegradable municipal waste[2] (BMW). It contains explicit landfill-use reduction targets that must be applied nationally. These targets are to be viewed against baseline quantities of BMW landfilled in each member state for the year 1995. These are shown in Table 1.

Table 1: Landfill Directive Biodegradable Waste Diversion Targets

Target	Year
75% of 1995 quantities	2010
50% of 1995 quantities	2013
35% of 1995 quantities	2016

The Waste Hierarchy

The 'waste hierarchy' has been fundamental to the development of national policies and Waste Management Plans designed to move away from a dependence on landfill. The waste hierarchy prioritises the prevention and reduction of waste, then its reuse and recycling and lastly its final disposal. The concept is described by the '3Rs' – Reduce, Reuse, Recover – followed by unavoidable disposal (Figure 1).

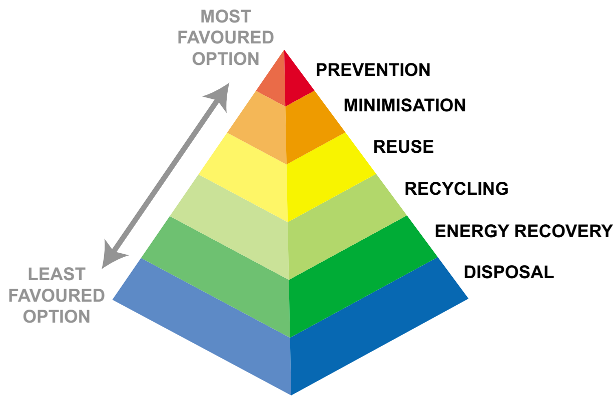

Figure 1: Waste Management Hierarchy

[1] MSW incorporates household and commercial waste and other wastes which, because of their nature and composition, are similar to household waste.

[2] 'Biodegradable municipal waste' means biodegradable materials from the MSW stream, which will break down over time ('biodegrade') by natural processes. BMW includes paper, organics, wood and textiles.

The degree to which MBT can contribute to each step of the hierarchy in relation to recycling, energy recovery and disposal is determined by the configuration of each component of the system, the performance of the MBT facility, the quality of outputs and the economic drivers behind the operation of the facility.

What is Mechanical Biological Treatment?

The wide-ranging term 'mechanical-biological treatment' encompasses a broad range of distinct technologies that can be combined to treat residual municipal solid waste, typically at the same facility.

A recent report[3] on MBT defined it a process that 'partially processes mixed household waste by mechanically removing some parts of the waste and biologically treating others, so that the residual fraction is smaller and more suitable for a number of possible uses'.

This concise definition sums up the process of MBT as comprising both mechanical and biological treatment process elements.

An important point to note in this definition is the use of the word 'partially'. MBT in itself does not result in the final treatment of residual waste. Whatever outputs are generated from an MBT process are typically in a form that may require further treatment to make them suitable for their end use. Alternatively, they are treated to a required standard that makes them suitable for disposal. For this reason, MBT can be considered a 'pre-treatment' process.

MBT comprises two distinct treatment phases: (i) mechanical treatment and (ii) biological treatment.

Mechanical Treatment

Mechanical treatment refers to the use of a range of sorting, separation and size-reduction equipment to recover various recyclable elements from the residual waste stream and to prepare the waste stream for further treatment.

Mechanical treatment can vary from a simple shredding and trommelling process to a complicated system that incorporates shredding, trommelling, magnetic-extraction, eddy current separation, near infra-red separation, optical separation or ballistic separation. The mechanical process generally produces a residue that has a high paper, card and plastics content that is, in many cases, used as a fuel in thermal treatment facilities. This material is known as 'solid recovered fuel' (SRF) or 'refuse derived fuel' (RDF).

Biological Treatment

The biological treatment of waste converts the organic fraction of the waste stream into a more stable material. This is either an aerobic or anaerobic process (using microbes that either perform in the presence or absence of oxygen). The aerobic treatment of the organic fraction is typically a composting process that produces a part-stabilised organic material. The anaerobic treatment is achieved in a process known as 'anaerobic digestion' (AD) which produces both a part-stabilised organic material and methane gas that can be used in electricity generation.

These treatment methods can be applied singly or in combination – for instance, the output from the anaerobic digestion phase can be further treated by the aerobic composting process. The overall biological treatment process produces a 'stabilised' organic material that is either landfilled or used in limited land application as a soil conditioner, depending on the regulations of the particular country.

The ultimate configuration of an MBT facility is determined by the desired performance of the plant. MBT plants can be optimised for:

- producing a stabilised organic fraction;
- producing a recovered fuel for energy generation;
- recovering recyclable material.

This treatment process is generically illustrated in Figure 2.

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3 Juniper Consultancy Services Ltd (2005) *MBT: A Guide for Decision Makers – Processes, Policies and Markets.*

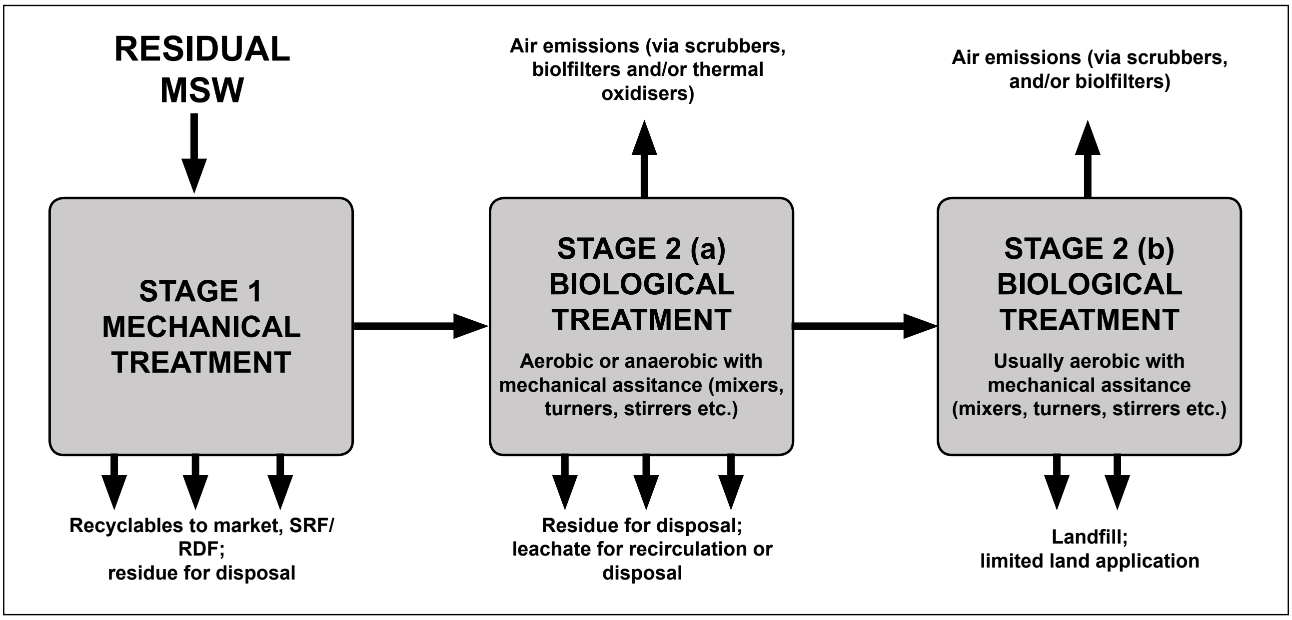

Figure 2: Generic Process Flow Diagram for MBT

Relevant Policy and Legislation

Various legislation must be adhered to in the development of an MBT facility, with the Planning and Development Acts 2000–2006 (and subsequent amendments) governing the facility's planning requirements. When siting a facility, attention must be paid to the requirements of the local Development Plan, the regional Waste Management Plan and the requirements of the Animal By-products Regulation (EC) No. 1774/2002.

An environmental impact statement (EIS) will, in most cases, be required for submission with a planning application; and screening and scoping procedures must be followed in the preparation of the EIS. A facility with a capacity of over 100,000 tonnes per annum for the disposal, treatment or recovery of waste may be considered to be of 'strategic' importance and, in this situation, the planning application is to be made directly to An Bord Pleanála.

An MBT facility will also require an Animal By-product Licence and either a waste or an integrated pollution prevention control (IPPC) licence depending on the scale of operations carried out.

There are currently no firm standards in place in Ireland for the management of outputs produced by the MBT process. In relation to a stabilised organic output, the *Working Document for the Treatment of Biowaste (2nd Draft)* (EC, 2001) suggests quality standards and limited land application uses for a stabilised organic material and also proposes biodegradability levels if landfilling the material. The Working Document has been abandoned yet remains the only guidance text on relevant standards produced at a European level.

The Environmental Protection Agency (EPA) has recently published *Municipal Solid Waste – Pre-treatment and Residuals Management Technical Guidance Document, Consultant Draft* (EPA, 2008). This document proposes a standard that may be adopted by the industry in the near future.

The EPA has used other standards proposed in the Working Document in the granting of Waste Licences for other facilities. It is proposed that the standards in relation to MBT outputs in this document could be taken as reasonable limits for future use in an Irish context. However, a decision is necessary as to whether this material will be suitable for use in limited land applications, as allowed under Austrian legislation or whether it will all be consigned to landfill, as is general practice in Germany.

If a decision was made that the stabilised output could be land applied in certain situations, the requirements of the Nitrates Directive (91/676/EEC) and the Good Agricultural Practice for Protection of Water Quality Regulations 2006 (S.I. No. 378 of 2006) would also need to be taken into account.

A similar situation exists in Ireland in respect of the recovered fuel (SRF/RDF) output from the MBT process. Indeed, regulatory guidance is absent at a European level in relation to this material but it is expected that the work (CEN 343) of the European Committee for Standardisation (Comité Européen de Normalisation) will produce a harmonised European standard by 2009.

The Renewable Energy Feed in Tariff (REFIT) is a financial scheme aimed at encouraging the generation of green electricity. In relation to MBT, the generation of methane from anaerobic digestion of the organic fraction of waste can qualify for this scheme.

In the UK processes that are similar to those in Ireland are used for granting planning permissions and licensing MBT facilities. The UK also employs a landfill allowance scheme whereby the amount of biodegradable waste being sent to landfill is limited for each local authority. For renewable energy generation for an MBT process, a Renewable Obligation Credit (ROC) system is used.

Germany and Austria have developed their own standards for the stability of material being consigned to landfill, which are in excess of the requirements of the EC *Working Document of the Treatment of Biowaste – 2nd Draft* (EC, 2001).

MBT in Relation to National and EU Waste Management and Legislation

The employment of MBT practice and the associated technology is not only governed by traditional waste legislation at a European level but also comes under the regime of renewable energy, thermal treatment, soil protection and integrated environmental protection legislation.

Irish national policy in relation to waste management identifies the role MBT may play in Irish waste management in the *National Strategy on Biodegradable Waste* (DoEHLG, 2006) where MBT is described as a technology which can ‘limit the quantity of biodegradable municipal waste which ultimately needs to be sent to landfill’ (DoEHLG, 2006, p. 90).

The Programme for Government of 12 June 2007 states: ‘We are also committed to meeting the targets to divert biodegradable waste form landfill required under the 1999 EU Landfill Directive. To achieve this, we are committed to the introduction of Mechanical Biological Treatment facilities as one of a range of technologies’ (Department of the Taoiseach, 2007, p. 22).

If MBT is to be considered as a waste treatment technology to reduce Ireland’s dependency on landfill, it is recommended that national standards be developed to:

- govern the operation of MBT facilities in addition to EPA licensing;
- determine the biodegradability or stability of the treated biological fraction of residual waste;
- develop quality standards to categorise the outputs from the ‘mechanical’ treatment phase;
- determine appropriate outlets for the management of stabilised biowaste and the outputs from the mechanical treatment phase;
- establish revised waste acceptance criteria for landfilling.

These standards are necessary in order to ensure that the performance of MBT facilities is standardised nationally and is in keeping with the objectives of the waste hierarchy. They are also needed in order to provide a structured environment to ensure both the economic and environmental viability of a facility.

Before MBT is examined further to determine its role in assisting Ireland comply with the diversion targets set out in the Landfill Directive, a number of ‘gaps’ in current waste-management policy must be highlighted.

To date, limited guidance has been provided to set out the criteria and mechanisms by which the Landfill Directive will be implemented – that is, it has not been fully determined whether the diversion targets will be assessed on a national basis, applied proportionally based on waste arisings in each of the ten Waste Management Regions (WMR) or applied directly to each landfill.

Clarification on this issue is vital as it will determine the size and geographical distribution of the facilities necessary to meet the requirements of the Landfill Directive.

Review of Regional Waste Management Plans to determine the Role Identified for MBT in Meeting the Objectives of the Plans

The current Waste Management Plans for each of the ten WMRs were assessed to fully determine the role that MBT could play in each region, in line with the stated objectives of the Plans.

While seven of the ten WMRs indicate a preference for thermal treatment as the primary residual waste-management solution, eight regions also indicate that MBT can play a role in the treatment of residual waste – particularly in the short term where thermal capacity may not be available. This is partly due to the acknowledgement that the establishment of a thermal treatment facility is a lengthy process and that some form of pre-treatment is required in order to achieve the diversion targets laid down in the Landfill Directive. The Cork region, in particular, has shown a clear preference for MBT of residual waste.

MBT Contribution to Government Policy on Greenhouse Gas Emissions and Renewable Energy

The Irish government has set out clear targets and objectives in relation to renewable energy and greenhouse gas emissions. MBT has a potential role to play in the achievement of these targets and objectives and these two sectors, in particular, tend to be strongly interlinked.

Waste-management activities in the period of 1990–2004 were responsible for 2.6% of overall greenhouse gas emissions in Ireland. Within the sector, landfill is the major source of greenhouse gas emissions through the release of methane. MBT can contribute to the reduction of methane emissions from landfills by the biodegradation of organic material in residual waste to a required stability standard. Again, Ireland currently lacks a regulatory standard of this nature. Such a standard is a necessity in the future if MBT processes are to be demonstrably seen to be an effective contributor to the reduction of greenhouse gas emissions in line with our obligations under the Kyoto Protocol.[4]

Ireland is also committed to the generation of 13.2% of its domestic electricity by renewable sources by 2010 under EU Directive (2001/77/EC). MBT may have the potential to contribute to the achievement of this target in two ways:

1 through the thermal treatment or co-firing of recovered fuel material of which the 'biomass' portion is deemed a renewable energy source;

2 through the generation of electricity and heat through the combustion of AD produced biogas in a gas-fired engine as part of a combined heat and power (CHP) plant.

Assessment of the Impact of Residual Waste Stream Composition on MBT Performance

The contribution that MBT can make to assist Ireland in complying with the diversion targets for biodegradable waste from landfill in the future is dependent on the waste composition of the residual waste stream.

The composition of the residual waste stream is determined by a number of factors, such as:

- collection regime (one-, two- or three-bin collection);
- demographics;
- waste source (urban or rural);
- social and economic factors;
- type of user charge employed.

An accurate analysis of the composition of the residual waste stream will be a prerequisite when determining the performance of an MBT facility in the Irish waste-management arena in future years.

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4 Ireland has agreed to limit its emissions of greenhouse gases to 13% above 1990 levels by 2012.

Therefore, it is essential as the roll-out of the three-bin continues nationally that annual waste composition surveys are undertaken to capture the changing composition of residual waste.

Furthermore, when assessing the performance of the individual MBT facilities operating in other EU member states it is critical that the input waste characteristics to those facilities are compared to those observed in an Irish context. It cannot be assumed that the mass balances and operational performance achieved at the MBT facilities operated in EU member states will be the same if applied to the Irish residual bin.

Identification and Review of Leading Manufacturers and Suppliers of MBT Technology

A number of sources were used in order to investigate the status of the MBT industry, including the comprehensive industry report *MBT; A Guide for Decision Makers – Processes, Policies and Markets* (2005), undertaken by Juniper Consulting. The identification of MBT technology suppliers followed a process of (i) market survey; (ii) classification; (iii) pre-selection; and (iv) technical validation.

Five technologies at case-study plants were chosen to represent a broad range of the types of configurations used in MBT facilities throughout Europe. Each plant treats residual waste streams that vary in composition because of location, demographics and waste-collection service employed. The plants were selected on the basis of the *core biological treatment* applied to the organic fraction, with each facility representing a specific type or configuration of technology:

1 WTT-Horstmann in Osterholz, Germany (MBT aerobic biodegradation using tunnel technology).

2 Kelag-VKW in Istanbul, Turkey (MBT aerobic biodegradation in agitated halls).

3 Vinci Environment in Launay-Lantic, France (MBT aerobic biodegradation using rotary drums).

4 OWS in Pohlsche Heide, Germany (MBT aerobic biodegradation in tunnels combined with anaerobic digestion).

5 Ecodeco in Frog Island, London (MBT biodrying using bunkers to produce SRF).

Information on each particular facility was collated as part of a technical review of these facilities.

The outcome of the comparison of the five flagship facilities suggests that a combination of aerobic and anaerobic biological treatments may be the most effective way of treating the organic fraction of the input waste to achieve a respiration activity indicative of a suitable degree of stabilisation.

However, these technical reviews provided only a snapshot in time in terms of facility operation and performance.

Environmental Impact Appraisal of MBT and Incineration-centric Waste Management System

A comparative environmental assessment was carried out using the UK Environment Agency's WRATE Life Cycle Assessment (LCA) model to quantify and compare the environmental aspects of an MBT-based waste-management system in context with an incineration-centric waste-management system. Five waste-management scenarios were inputted to the model. These scenarios are outlined and described in Table 2.

The results of the analysis show that for the majority of impact categories, the treatment of residual waste with MBT or thermal treatment provides a net environmental benefit over landfilling of untreated MSW, provided that the systems employ efficient energy recovery and a significant rate of recycling is achieved:

- All scenarios show a net benefit, due to the high levels of recycling of source-separated material across all scenarios, i.e. a segregated kerbside collection.
- The disposal of untreated residual MSW from the three-bin system to landfill performs significantly worse than either energy from waste (EfW) or MBT scenarios.
- Results of the environmental performance assessment suggest that incineration in a high-efficiency combined heat and power (CHP) configuration, with the recovery of both useable heat and power, performs best.

Table 2: Summary of Scenarios Analysed

Baseline	**Landfill Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated to produce compost. The residual bin is sent directly to landfill without further treatment.
Scenario 1	**Aerobic MBT Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated to produce compost. The residual bin is sent for MBT recovering ferrous metal, a recovered fuel and with an aerobic stabilisation step. Stabilised waste is sent to landfill. The high calorific value fraction is separated and sent for use as a fuel (SRF).
Scenario 2	**Anaerobic MBT Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated to produce compost. The residual bin is sent for MBT recovering ferrous metal, a recovered fuel and with an anaerobic stabilisation step yielding a biogas. Stabilised waste is sent to landfill. The high calorific value fraction is separated and sent for use as a fuel (SRF).
Scenario 3	**Thermal (CHP) Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated to produce compost. The residual bin is sent for treatment by incineration with energy recovery; combined heat and power with electricity and commercial heat generated. Incinerator fly ash (APC residue) is sent to landfill, and bottom ash is recycled as aggregate.
Scenario 4	**Thermal- (Power only) Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated compost. The residual bin is sent for treatment by incineration with energy recovery as electricity exported to the national grid. Incinerator fly ash (APC residue) is sent to landfill, and bottom ash is recycled as aggregate.

- However, the difference between the systems is largely dependent on energy recovery. The relative closeness in the results suggest that, rather than being mutually exclusive, from an environmental performance point of view, there is likely a role for both approaches dependent on local circumstances. Important aspects include the composition of the waste being treated and the indigenous fuel mix.

There is a need for further study into the emissions and environmental fate of materials in MBT systems.

Whole Life Costs of MBT Compared to the Whole Life Costs of Incineration-centric Waste

Based on the assumptions outlined in the main report, it appears that MBT over the life of a project is more expensive than EfW as a residual waste treatment technology. However, the investment cost is highest for EfW whereas the cost of operation is highest for MBT, which is why the overall whole-life-cost is higher for MBT than for EfW.

MBT may be described as more flexible in that a facility could, for example, treat a source-separated waste stream (subject to keeping material flow separate), which may increase revenue through sale of a compost product and generation of excess biogas that could be used for sale of power, if anaerobic digestion technology was employed.

These calculations, however, do not include the cost of planning, or account for whether EfW or MBT actually can be delivered at a particular site – for instance, based on local, regional or national political willingness to support such facilities. Furthermore, community anxiety or support for these facilities may have an impact on their deliverability, which may be particularly influenced by the political support, or lack of support, for particular technologies.

In the event that facilities do not charge a gate fee to accept SRF or if the sale of SRF generates revenue, then the difference in cost between MBT and EfW will be reduced.

Indeed, if the management of SRF can generate net revenue, then MBT may be cheaper in whole-life costs than EfW provided that:

- the price obtained for the sale of electricity produced by an EfW is lower than the price obtained from the sale of electricity produced by an MBT facility;
- there is no sale of heat from EfW;
- bottom ash cannot be recycled.

Identification and Assessment of the Long-term Sustainable Outlets for the Management of MBT outputs

There are generally three to four outputs from MBT, namely:

1 Stabilised organic fraction.

2 Solid recovered fuel product.

3 Ferrous/non-ferrous metallic outputs.

4 Anaerobic digestion biogas (if anaerobic digestion is employed as part of the treatment process).

Stabilised Organic Fraction

If stabilised biowaste is to be managed through landfilling, then a stabilisation standard must be determined to ensure that all pre-treatment facilities produce stabilised biowaste to comply with the requirements of the Landfill Directive. In addition to establishing this standard, verifying mechanisms and testing protocols must also be established.

The purpose of establishing a stability standard is to determine the biodegradability of the treated waste stream. Biodegradability refers to the ability of the material to further biodegrade when encapsulated within the landfill. Biodegradation within the landfill will result in the release of landfill gas. The aim of the biological treatment phase is to produce a material that will not generate significant quantities of landfill gas when landfilled.

If the stabilised biowaste fraction of residual waste is to be applied to any land use activity, then the treatment process applied must comply with the requirement of the Animal By-Product Regulations (1774/2002).

S.I. No. 253 of 2008 Diseases of Animals Act 1966 (Transmissible Spongiform Encephalopaties) (Fertilisers & Soil Improvers) Order 2008 governs the application of materials treated at an MBT facility to land.

Certain stipulations have been placed on the application to land of compost derived from catering waste, former foodstuffs and fish by-products particularly to pasture land. Certain time periods have to be maintained in relation to which animal grazes the land, with the current recommendation in Ireland from Department of Agriculture Forestry and Food (DAFF) being that 21 days should be maintained for ruminants and 60 days for pigs. However, the application to land of stabilised biowaste derived from higher risk animal by-products (e.g. other than manure, the contents of the digestive tract, milk or colostrum) is prohibited. Accordingly, if the waste processed at an MBT facility is likely to contain animal by-products which represent a higher risk than catering waste, former foodstuffs or fish by-products, then MBT processed material may not be applied to land.

Solid Recovered Fuel Products

The terms SRF (solid recovered fuel) and RDF (refuse derived fuel) are regularly used when referring to a recovered fuel product from the MBT process. The main difference between the two terms is that SRF implies that the recovered fuel product is further treated to specific requirements for its use. RDF tends not to be treated further and, as a consequence, can be deemed a lower-quality product.

A CEN Technical Committee (CEN 343) was established to develop the relevant standards for the marketing of SRF throughout Europe where SRF can be used as a substitution of fossil fuels in the production of heat and/or power and in different industrial furnaces. A preliminary standard is expected for 2009.

In the absence of any other national standard, Ireland should consider adopting this proposed standard once finalised.

Ferrous and Non-Ferrous Outputs

The markets for ferrous and non-ferrous metals are well established and it can be assumed that they will continue to trade. Increased recovery rates for metals will lead to increased revenue for recyclers, collectors and merchants with a reduction in the volume of material going to landfill contributing to landfill-diversion targets. Nonetheless, the quality of materials recovered at an MBT facility may be an issue and could lead to a lower price received for the material.

Anaerobic Digestion Biogas

The use of biogas generated from an AD process within an MBT facility can be used to generate electricity in a combined heat and power (CHP) engine at the facility. This electricity can be used to power plant and machinery used in both the mechanical and biostabilisation phases of the MBT operation. Various configurations will be used in different MBT facilities so the power consumption on-site will vary. Heat generated from the CHP engine can be used to heat AD tanks, sterilise digestate liquor or to heat staff buildings, etc.

Excess electricity generated can be sold into the national grid under the REFIT scheme which is open until 2010. AD-generated biogas currently receives 7.2 cents/kWh under REFIT, and a new feed-in-tariff was announced offering a guaranteed price for the production of electricity from biomass CHP and anaerobic digestion. These new bands under the REFIT programme will receive a guaranteed price of 12 cents/kWh from 2008 onwards.

Review of Common Perceptions of MBT and Incineration-centric Waste Management

When considering whether MBT or EfW is the most appropriate solution for the management of residual waste, a well-organised waste-management sector should be characterised by:

- the ability to make capital-intensive investments based on certainty of a significant minimum waste supply;
- environmental- and performance-based regulatory requirements for the operation of residual waste-treatment facilities to include the management of all process outputs and by-products;
- fiscal tools that provide a well-defined long-term economic basis for investing and operating particular waste-management facilities;
- a transparent and manageable planning and permitting regime for waste-management facilities that allows for the construction and operation of compliant and desirable infrastructure at technically suitable locations.

What is clear when considering residual waste treatment technologies is:

- the best quality of recyclables and the least expense for generating such recyclables are achieved by source separation – that is, the operation of a three-bin collection system rather than the sorting of mixed waste (considerable advances have been achieved however in terms of mechanical sorting of waste compared to only 10 years ago);

- any integrated waste-management system would consist of several mutually complementary waste-treatment technologies;
- both MBT and EfW facilities have strengths and weaknesses.

Successful implementation of any multi-faceted waste-management system that focuses on a high degree of waste recovery and minimum landfilling requires a highly well-organised and regulated waste-management sector.

1 Introduction

Mechanical Biological Treatment (MBT) of waste is a waste-treatment concept that has grown into a dynamic industry on mainland Europe since the 1980s. MBT evolved from a need to develop a method of treating municipal solid waste (MSW), other than using traditional landfill disposal, in the face of changing legislative requirements. Municipal solid waste (MSW) is household waste and commercial and other waste which, because of its nature and composition, is similar to household waste.

The aims of this project are to:

- Provide information in relation to MBT that may inform future government policy.
- Identify issues that require addressing in order to establish conditions that are suitable to the environmental development of MBT facilities in Ireland.
- Identify issues that require addressing in order to establish conditions that are suitable to the economic development of MBT facilities in Ireland.
- Make recommendations where possible as to the means to address these issues.

Prior to the commencement of this research, the project team in association with the steering committee compiled a number of subject topics under which the viability of MBT in the Irish waste-management sector would be assessed. These subject topics are outlined in Table 1.1.

Table 1.1: MBT Research Topics

TASK	ACTIVITY
1	Assess MBT in relation to national and EU waste-management policies.
2	Review county and regional waste-management plans with respect to the use of MBT.
3	Identify all regulatory requirements associated with the establishment and operation of an MBT facility.
4	Identify processes, leading manufacturers and suppliers of MBT technology.
5	Identify case study MBT facilities to bench operational performance and cost.
6	Assess input characteristics of the waste streams.
7	Identify diversion and recycling rates achieved at the flagship facilities and compare to the diversion and recycling rates set out in the national waste-management policy and county and regional waste-management plans.
8	Conduct operational mass balances to determine the fate of each component of the input waste stream and to identify all output components to include an energy mass balance.
9	Identify the characteristics of the MBT outputs.
10	Identify and assess long-term sustainable outlets for the management of MBT outputs.
11	Determine the whole life-cycle costs associated with MBT and compare to those associated with thermal treatment.
12	Assess the environmental impacts of MBT versus thermal treatment using the life-cycle assessment techniques.
13	Evaluation of how the outputs from the MBT process can contribute towards achievement of environmental policies in renewable energy, greenhouse gas emissions and landfill diversion targets for biodegradable waste.
14	Strength, weakness, opportunities and threats (SWOT) analysis of MBT versus thermal treatment.

In Ireland, landfill disposal has been the historical means of disposing of the residual fraction of MSW, but in the face of European legislation, particularly the Landfill Directiv, alternative treatment methods must be employed to pre-treat all waste prior to landfilling. MBT has been contributing to the fulfilment of this role in Europe and this report investigates the role MBT can play in the management of Irish residual waste.

MBT can be defined as a process that ‘partially processes mixed household waste by mechanically removing some parts of the waste and biologically treating others, so that the residual fraction is smaller and more suitable for a number of possible uses’ (Juniper, 2005).

An important point to note in this definition is the use of the word ‘partially’. MBT in itself does not result in the final treatment of residual waste. Whatever outputs are generated from an MBT process are typically in a form that may require further treatment to make them suitable for their end use or they are treated to a required standard that makes them suitable for disposal. For this reason, MBT can be considered a ‘pre-treatment’ process.

MBT comprises of two distinct treatment phases:

1 Mechanical treatment.

2 Biological treatment.

Mechanical Treatment

The mechanical treatment method refers to the use of a range of sorting, separation and size-reduction equipment to recover various recyclable elements from the residual waste stream and to prepare the waste stream for further treatment.

This can vary from a simple shredding and trommelling process to a complicated system incorporating shredding, trommelling, magnetic extraction, eddy current separation, near infra-red separation, optical separation or ballistic separation. The mechanical process generally produces a material that has a high paper, card and plastics content that is, in most cases, used as a fuel in thermal-treatment facilities.

Biological Treatment

The biological treatment of waste, which converts the organic fraction of the waste stream into a more stable material, is either an aerobic or anaerobic process i.e. it utilises microbes that perform in the presence or absence of oxygen. The aerobic treatment of the organic fraction is typically a composting process that produces a part stabilised organic material. The anaerobic treatment is achieved in a process known as anaerobic digestion which produces both a part-stabilised organic material and methane gas that can be utilised in electricity generation.

These treatment methods can be applied singly or in combination where the output from the anaerobic digestion phase can be further treated by the aerobic composting process. The overall biological treatment process produces a stabilised organic material that is either landfilled or used in limited land application as a soil conditioner, depending on the regulations of the particular country.

The ultimate configuration of an MBT facility is determined by the desired performance of the plant. MBT plants can be optimised for:

- producing a stabilised organic fraction;
- producing a recovered fuel for energy generation;
- recovery of recyclable material.

2 MBT in Relation to EU and National Waste Policies

2.1 Relevant European Legislation and Policy

MBT of waste can encompass a number of steps in the waste hierarchy, namely recycling, energy recovery and disposal.

The waste hierarchy prioritises the prevention and reduction of waste, then its reuse and recycling and lastly, its final disposal. The concept is described by the '3Rs' – Reduce, Reuse, Recycle – followed by unavoidable disposal. Prevention was first given a priority within European waste policy in the Waste Framework Directive of 1975 and the formal Waste Hierarchy was established in 1989 through the European Commission's Strategy for Waste Management (EC, 2006).

The degree to which MBT can contribute to each step of the hierarchy is determined by the configuration of each component of the system, performance of the MBT facility, the quality of outputs and the economic drivers behind the operation of the facility.

A number of legislative instruments which have relevance to MBT are in place at European level which are transposed into Irish law. These are summarised below.

2.1.1 Council Directive 99/31/EC of 26 April 1999 on the Landfill of Waste

This is the main legislative driver behind the requirement for treatment of waste and contains binding obligations for an EU-wide reduction of the use of landfill as an option for the disposal of biodegradable municipal waste (BMW).

2.1.2 Directive 94/62/EC of the European Parliament and Council of 20 December 1994 on Packaging and Packaging Waste (as amended on 11 February 2004 by Directive 2004/12/EC)

This Directive aims to minimise the amount of packaging waste generated and to promote the reduction, the reuse and the recycling of packaging. The thermal treatment of a Solid Recovered Fuel (SRF) material can contribute to the recovery targets laid down in the amended Directive 2004/12/EC as it provides that the incineration of packaging waste at waste incineration plants with energy recovery contributes to the attainment of the recovery targets as set out.

2.1.3 Regulation (EC) 1774/2002 of the European Parliament and the Council of 3 October 2002 Laying down Health Rules concerning Animal By-products Not Intended for Human Consumption

The treatment of waste containing an organic fraction which may contain material of animal origin (including household 'catering' waste) is governed by the EU Animal By-product Regulations which lay down certain parameters for the siting of facilities, the design, performance and control of treatment processes, as well as the use of treated animal by-products.

2.1.4 The Working Document on the Biological Treatment of Waste – 2nd Draft

Although withdrawn, this document (EC, 2001) provides an indication as to the previous thinking at a European level concerning the treatment of biowaste. The document outlines standards in relation to compost quality, 'stabilised biowaste' quality parameters and a respiratory standard for the biodegradability of the stabilised material if landfilling this material. Some of these standards have been adopted by the Environmental Protection Agency to date.

2.1.5 Waste Incineration Directive 2000/76/EC and the Large Combustion Plant Directive 2001/80/EC

Depending on the thermal treatment option employed for the treatment of SRF produced at an MBT facility, the treatment process will be governed by either of these Directives.

2.1.6 Directive 96/61/EC Concerning Integrated Pollution Prevention and Control (IPPC Directive)

This Directive will apply to a facility that is mechanically and/or biologically processing waste at more than 50 tonnes per day, that thermally treats SRF material from an MBT process at a rate of 3 tonnes per hour or more or if the gaseous emissions from this process are being thermally treated.

2.1.7 Directive 2001/77/EC of 27 September 2001 on the Promotion of Electricity Produced from Renewable Energy Sources in the Internal Electricity Market

This legislation is intended to promote the generation of renewable energy in each member state within a certain timeframe. Ireland has set a target of 15% renewable energy generation by 2010 and 30% by 2020.

2.1.8 Thematic Strategy for the Protection of Soil (CEC, 2006)

This Strategy (CEC, 2006) requires the keeping of a list of processes, or outputs from processes, which have the ability to pollute the soil. It lists the IPPC Annex 1 processes as potential soil-polluting process, into which some MBT processes fall.

2.1.9 Thematic Strategy on the Prevention and Recycling of Waste

The 2006 *Taking Sustainable use of Resources Forward: A Thematic Strategy on the Prevention and Recycling of Waste* (European Commission, 2006) document examines the possibility of a complete review of the waste sector in Europe, in order to bring together the waste policies of member states. It aims to provide clarification regarding common understanding of agreed definitions, clarity on the issue of waste or by-product, end-of-waste status and minimum waste-treatment standards.

2.1.10 Other Relevant Policies

CEN is currently developing a standard which can be applied to categorise the quality of SRF produced during the MBT process (this will be known as CEN 343).

The incineration or co-incineration of SRF in thermal-treatment or power-generating plants can reduce our dependence on fossil fuels and contribute to the meeting of our targets for the reduction of greenhouse gases under the Kyoto Protocol.

2.2 Relevant Irish Waste Policy

Irish waste-management policy has been outlined in a number of document publications that were produced from the mid-1990s onwards. These are summarised below.

2.2.1 Waste Management: Changing Our Ways

The policy document *Waste Management: Changing Our Ways* (DoE, 1998) published in 1998 highlighted the need to progress waste-management practice in Ireland from a very high level of landfill dependence. This document outlines some of the target requirements outlined in the Directives previously mentioned in relation to waste consigned to landfill, packaging recycling targets etc.

2.2.2 Preventing and Recycling Waste – Delivering Change

Published in 2002 (DoEHLG, 2002), this document addressed in more detail the means by which the landfill diversion targets would be achieved. This identified that a national strategy for biodegradable waste was needed in addition to the provision of infrastructure for the biological treatment of organic waste.

2.2.3 Waste Management – Taking Stock and Moving Forward (DoEHLG, 2004)

Waste Management – Taking Stock and Moving Forward (DoEHLG, 2004), reviewed the progress made in working towards the achievement of the targets set out in *Waste Management: Changing our Ways* (DoE, 1998). It identified that the targets would become more difficult to achieve in the face of an ever-increasing population but that the targets were to be maintained; it also set out a series of action points to ensure that the necessary progress in waste management was achieved.

2.2.4 National Biodegradable Waste Strategy

The National Strategy on Biodegradable Waste (DoEHLG, 2006), published in 2006, is the first policy document that makes direct reference to the role that MBT could play in achieving Irish landfill-diversion targets. The Strategy identifies MBT as a technology that can 'limit the quantity of biodegradable municipal waste which ultimately needs to be sent to landfill' (DoEHLG, 2006, p. 90) and also identifies that almost half a million tonnes of residual municipal waste will need treatment in 2016 – either by thermal treatment and/or with Mechanical Biological Treatment.

To date, limited guidance has been provided to set out the criteria and mechanisms by which the Landfill Directive will be implemented i.e. it has not been fully determined whether the diversion targets will be assessed on a national basis, applied proportionally based on waste arising in each of the ten Waste Managment Regions (WMR) or applied directly to each landfill.

However, the National Biodegradable Waste Strategy has indicated that each WMR or county should assess its individual needs for biodegradable municipal waste management (BMW) by obtaining indicative diversion target capacity and providing the capacity to address these requirements.

2.2.5 Renewable Energy Development 2006 (DCMNR, 2006)

Produced in 2006, this document (DCMNR, 2006) identified co-firing of biomass at peat-power stations from conventional forestry and short rotation sources as a proven technology that is both carbon neutral and indigenous. The report does state importantly that 'biomass' can be broadened to include municipal solid waste, thereby allowing for the co-firing of SRF material at the peat-power station.

2.3 Summary

MBT technology is not only governed by traditional waste legislation at a European level but also comes under the regime of renewable energy, thermal treatment, soil protection and integrated environmental protection legislation. Irish national policy in relation to waste management identifies the role MBT may play in Irish waste management in the 2006 National Biodegradable Waste Strategy where MBT is described as a technology that can 'limit the quantity of biodegradable municipal waste which ultimately needs to be sent to landfill'.

3 Review of County and Regional Waste Management Plans

The Waste Management Act 1996 requires each local authority to prepare a Waste Management Plan[5] for its functional area. The Plan must cover:

- policies, objectives and priorities for waste management for the area;
- data and forecasts of wastes arising in the locality;
- information on waste disposal and recovery facilities;
- infrastructure required in the planning period;
- steps local authorities must take to enforce the Waste Management Act;
- an identification and risk assessment of closed waste facilities;
- information on the implementation of the National Hazardous Waste Plan.

A number of local authorities have joined forces to form WMRs, while Kildare, Wicklow, Donegal and Cork have remained as stand-alone counties. There are ten WMRs:

- Connacht.
- Cork.
- Donegal.
- Dublin.
- Kildare.
- Limerick/Clare/Kerry.
- Midlands.
- North-Eastern.
- South East.
- Wicklow.

[5] Waste management plans can be viewed on: http://www.environ.ie/en/Environment/Waste/WasteManagementPlans/

The policy document *Waste Management – Taking Stock and Moving Forward* (DoEHLG, 2004), reviewed the implementation of the waste-management plans and highlighted new issues that required addressing when updating the respective plans.

3.1 Connacht Waste Management Plan 2006–2011

The Connacht WMR is made up of Galway city and county, Leitrim, Mayo, Roscommon and Sligo counties. The replacement Waste Management Plan, which covers the period 2006–2011, sets out a recycling target of 48%, energy recovery of 33% and residual waste disposal target of 19%. These target objectives have been set for 2013.

The Plan has set out a strategy of integrated waste management with the aim of establishing a centralised thermal treatment facility with a capacity of 175,000 tonnes per year within the region by 2016.

However, while the Plan has set out the preferred strategy of thermal treatment with energy recovery, it also acknowledges that some form of pre-treatment will be required within the region prior to the establishment of the thermal facility.

3.2 Cork Waste Management Plan

The Cork Waste Management Plan covers both the county and city areas with the revised Plan being published in 2004 to cover the period 2004–2009. At present a two-bin system is in operation throughout the county for the collection of dry recyclables and residual waste. The residual waste is largely landfilled within the region at the council's Youghal and Kinsale Road Landfills.

However, the preferred strategy for the Region is for the council to establish a 150,000 tonnes per year mechanical separation plant to treat mixed MSW in addition to a composting facility with a capacity of 65,000 tonnes per year to treat the separated organic fraction. This strategy can be loosely described as MBT based, albeit with the mechanical and biological treatments occurring at separate facilities.

3.3 Donegal Waste Management Plan 2006–2010

Donegal's Replacement Waste Management Plan estimated that approximately 52% of households within the region are without a collection service. This is supplemented by a network of bring banks throughout the county. At present the region is largely dependent on landfill but the replacement Plan has set out a number of strategies with the aim of changing this including:

- the implementation of a three-bin collection system to all households already availing of a collection service;
- the establishment of biological treatment facilities by the private sector.

With respect to the establishment of an MBT facility within the Region, the Plan states that 'Donegal County Council will investigate the requirement for the development within the County of MBT treatment facilities' (2006, pp. 12–15).

3.4 Dublin Waste Management Plan 2005–2010

The review of the Dublin Waste Management Plan began in 2004 and considered the current capacity available for the treatment of waste and what future capacity would be required to meet the Plan targets. A review of MBT was carried out to ascertain its suitability for the treatment of residual waste.

The assessment of MBT concluded that the continued preferred policy of the Dublin Region is thermal treatment (with energy recovery) of residual waste after recycling and composting of source-separated organic waste. This policy decision was based on the following:

- the implementation of a source-separated organic waste collection within the Dublin Region;
- the recognition that compost produced from source-separated organic waste can achieve a much higher quality;
- an acknowledgement that if an MBT process was to produce SRF, the sourcing of a long-term sustainable market to take the SRF might be difficult;
- an awareness that the energy yield from waste-to-energy (WTE) facilities is better than from MBT systems;
- an understanding that waste-to-energy (WtE) is a robust treatment technology proven to work well on a variety of waste streams on a scale required for the Dublin Region.

3.5 Kildare Waste Management Plan 2005–2010

The Kildare Waste Management Plan sets out an integrated waste-management system comprising of:

- home composting;
- three-bin collection system (dry recyclables, biowaste, and residual waste);
- network of bring banks and recycling centres (civic amenity sites);
- transfer station/stations;
- biological treatment facility/facilities;
- dry material recovery facility/facilities;
- Mechanical Biological Treatment facility/facilities;
- residual landfill/landfills.

With reference to biological treatment facilities, the Plan states that Kildare will have 'due regard to developments in adjoining waste management regions' and that the provision of facilities of a scale of economic viability may require 'inter-regional movement of waste to ensure viability' (2005, p. 91).

3.6 Limerick/Clare/Kerry Waste Management Plan 2006–2011

The replacement Plan of 2006–2011 sets out a strategy for integrated waste management to include a form of thermal treatment with a capacity of 150,000 tonnes per annum. It is envisaged that this will be provided by the private sector. The Plan also refers to the development of the following infrastructure:

- a three-bin collection system for households as well as commercial and industrial premises. A minimum target of 40% and 60% coverage has been set for households and commerce respectively;
- a minimum coverage of 35% for home composting;
- biological treatment technologies including Mechanical Biological Treatment;
- material recovery facilities/waste transfer stations.

3.7 Midland Waste Management Plan 2005–2010

The Midland Waste Management Plan 2005–2010 outlined a preferred policy for the collection of municipal and industrial waste using a three-bin system being rolled out from 2006 with a target date for completion of 2009.

The Plan outlines thermal treatment as the preferred treatment option for the region but acknowledges that the establishment of a thermal treatment facility could take five to seven years and that the region must find a solution to divert residual waste away from landfill in order to meet the Landfill Directive targets.

The Plan requires that 'it shall be a policy that the pre-treatment of mixed municipal and industrial waste shall be required prior to landfilling in the Region in the short term to comply with the EU Landfill Directive pending the development of a Waste-to-Energy facility' (p. 93).

The Plan also states that 'MBT processes can significantly reduce the biodegradable content of the municipal waste stream prior to landfilling' (p. 92). However, the Plan questions the securing of long-term markets for the outputs of the process while identifying that the establishment of a Waste to Energy facility and the three-bin roll out will jeopardise the viability of any MBT facility.

3.8 North East Region Waste Management Plan 2005–2010

The preferred policy of the North East Region for the treatment of residual waste is thermal treatment. This will most likely be served by a 200,000-tonnes per year facility that has been granted planning permission at Carranstown, Co. Meath. Construction of this facility commenced in July 2008.

3.9 South East Plan 2006–2011

The Plan sets out thermal treatment as the preferred strategy for the South East Region, and a target date of 2011 has been set for the establishment of a thermal treatment plant in the region. This facility will be for combustible waste and will be part of an overall integrated waste-management system that will comprise of:

- three-bin collection system;
- home composting (in rural areas not provided with a three-bin collection system);
- network of bring banks and civic amenity sites;
- transfer station(s);
- biological treatment facility(s);
- dry material recovery facility(s;)
- thermal treatment facility(s);
- residual landfill(s).

The Plan promotes the support of the existing composting facility and proposes the provision of increased biological treatment capacity by the private sector.

3.10 Wicklow Waste Management Plan

The Plan sets out a preferred policy of a three-bin collection system which will be enforced through the waste-collection regime (see Table 3.1). The implementation of a three-bin collection system will be completed to meet the National Strategy on Biodegradable Waste targets (first target is in 2010).

The Plan has set out a preferred strategy for the region of an integrated waste-management system with the processing of residual waste using MBT with the output going to landfill. The region however will have regard to thermal treatment developments in neighbouring regions.

3.11 Summary

While seven of the ten WMRs indicate a preference for thermal treatment as the primary residual waste-management solution, eight regions also indicate that MBT can play a role in the treatment of residual waste, particularly in the short term where thermal capacity may not be available. This arises from the acknowledgement that the establishment of a thermal-treatment facility is a lengthy process and that some form of pre-treatment is required in order to achieve the diversion targets laid down in the Landfill Directive. The Cork region, in particular, has shown a clear preference for MBT of residual waste.

Table 3.1: Preferred Residual Waste Treatment Techniques for the Waste Management Regions

Region	Thermal Treatment Recommended	MBT Recommended	Two- or three-bin Collection System Recommended
Connacht	Y	Y	3 -bin
Cork	Y	Y	3 -bin
Donegal	N*	Y	3 -bin
Dublin	Y	N	3 -bin
Kildare	N*	Y	3 -bin
Limerick/Clare/Kerry	Y	Y	3 -bin
Midlands	Y	Y	3 -bin
North-East	Y	Y	3 -bin
South East	Y	N	3 -bin
Wicklow	N*	Y	3 -bin

* Will look at developments in neighbouring region

4 Regulatory Requirements Associated with the Establishment and Operation of an MBT Facility

The establishment of an MBT facility will be governed by the Planning and Development Act 2000, which is amended by the Planning and Development (Strategic Infrastructure) Act 2006.

The regulatory process for establishing an MBT facility from the pre-development stage through to the utilisation of end products, with reference to all relevant legislation, can be outlined under the following headings:

- Pre-development.
- Planning requirements (including environmental impact statement).
- Licence applications (Animal By-products, EPA).
- By-product management.

4.1 Pre-development

The siting of a proposed facility must take the Development Plan of the functional area in which the facility is proposed into consideration. The Planning and Development Act 2000 requires each local authority to prepare a Development Plan that outlines the objectives of zoning land for a particular purpose.

The siting of a proposed MBT development must consider the zoning objective of the location of the intended facility and whether or not it fits in with the Development Plan for the area.

A proposed development must also pay consideration to the requirements of the European Communities (Transmissible Spongiform Encephalopathies and Animal By-product Regulations) 2008 (S.I. 252) which lays down health rules for the disposal of animal by-products not intended for human consumption, as required under Regulation 1774/2002.

It must also be noted that the objectives of a local authority Development Plan can be superseded by the objectives of a Regional Waste Management Plan under the Protection of the Environment Act 2003.

4.2 Planning Requirements

The relevant legislation governing the submission and processing of planning applications are the Planning and Development Acts 2000–2006. Subsidiary to the primary legislation are the Planning and Development Regulations 2001–2007. This legislation has been amended a number of times, most importantly by the Planning and Development (Strategic Infrastructure Act) 2006 and the Planning and Development Regulations 2006.

This legislation sets out the various routes by which development consent can be obtained. It also determines whether an Environmental Impact Assessment (EIA) is required and sets down the content for such a document.

4.2.1 Environmental Impact Assessment (EIA)

Any MBT facility with a capacity in excess of 25,000 tonnes per annum will automatically require an Environmental Impact Statement (EIS)[6]. In respect of smaller-scale proposals, an EIS will be necessary where significant effects on the environment are envisaged to occur from a development.

Accordingly, most MBT plants of any sigificant size will require an EIS. Whether an EIS is required, as well as its contents, is governed by the Planning and Development Act and its subsidiary regulations.

Therefore, in a situation where significant effects on the environment are envisaged from MBT facilities below the 25,000 tonnes per annum threshold, an EIS will almost certainly be required. Moreover, extensions to existing facilities may themselves warrant the preparation of an

[6] The result of an EIA is assembled in a document known as an Environmental Impact Statement (EIS) which looks at all the positive and negative effects of a particular project on the environment

EIS. The result is that, as a general rule of thumb, a planning application for an MBT plant of any size will need to be accompanied by an EIS.

Mandatory information required in an EIS is:

- a description of the proposed development with information on the site, design and size of said development;
- a description of the measures envisaged in order to avoid, reduce and remedy significant adverse effects;
- the data required to assess the main effects which the proposed development is likely to have on the environment;
- an outline of the alternatives investigated by the developer and the reasons for their choice, taking into account effects on the environment;
- a non-technical summary.

Further information that is required is deemed relevant by the specific characteristics of the development and the environmental features likely to be affected.

Two procedures to be carried out during the initial stages of the EIS procedure are the 'screening' and 'scoping' measures. The screening process will identify the actual need for an EIS while the scoping process will identify the major issues to be addressed in the EIS.

The 'Planning and Development Regulations 2001' allow prospective applicants to request the planning authority to provide an opinion as to what should be addressed in the EIS, as part of the scoping process.

4.2.2 Categories of Developer and Decision-making Body

The Planning and Development Acts 2000–2006 contains three different means to attain development consent for an MBT facility. This is partly dependent on whether the developer is:

- a local authority, with the facility being proposed to be located within its functional area (this includes a local authority-led project involving a private sector partner);
- a private sector developer or a local authority wishing to establish an MBT plant outside its functional area.

The essential difference between the two options set down above is that an independent system exists for determining development consent of major local authority projects. Where an EIS is required in respect of a local authority project which is to be sited within its functional area, planning permission is awarded via a direct application to An Bord Pleanála.

In the case of a private-sector-led project, two alternative systems for development consent apply. Where an MBT project is to process 100,000 tonnes of waste per annum or less, an application for planning permission is made to the local planning authority. In the event that development consent is refused, or the applicant is unhappy with one or more conditions of the consent, or if third parties object to the proposal, an appeal can be made to An Bord Pleanála.

If an MBT facility is proposed that exceeds the 100,000-tonne threshold, then pending a final decision from the relevant planning authority to which the application is to be made, a compulsory pre-application consultation must be held with the Strategic Infrastructure Division of An Bord Pleanála.

In the event that the project satsifies one of three criteria that is used to determine if a proposed development is considered strategic, an application for development consent has to be lodged directly with An Bord Pleanála. The three relevant properties concern whether the proposed MBT plant is:

- of strategic economic or social importance nationally or regionally; or
- contributes substantially to the fulfilment of the National Spatial Strategy (2002) or any regional planning guidelines relevant to its proposed location; or
- has a significant effect on the area of more than one planning authority.

Usually, the first and third criteria will have the most relevance for a large MBT facility.

As noted, the pre-application consultation with An Bord Pleanála is compulsory for any MBT plant which exceeds the 100,000-tonne threshold. In this case, the legislation also prohibits an application for planning permission being lodged until An Bord Pleanála has provided a written response to the applicant on the outcome of this process.

If an MBT facility is under the 100,000 tonne per year threshold described above, a pre-application consultation with An Bord Pleanála is not required. Instead, an applicant can choose to have a pre-application consultation with officers of the local authority (or in the case of a local authority development an An Bord Pleanála Non Strategic Division) with the planning application being lodged with the relevant authority following this.

Finally, even if the 100,000 tonne per year threshold is exceeded by an MBT proposal, An Bord Pleanála retains the option of deciding that the project does not satisfy any of the three properties mentioned above. In such instances, the application is lodged with the local authority once the pre-application consultation process has been completed and the applicant has been formally notified of the outcome.

With projects that are close to the 100,000 tonne per annum threshold, an applicant must consider carefully the correct route for the application; i.e. whether the application should be submitted directly to An Bord Pleanála or to the local authority.

4.3 Licence Applications

An MBT plant of any significant scale will fall within the waste-licensing system as set down by the Waste Management Acts 1996–2007 in almost all cases. Subsidiary to these provisions are the Waste Management (Licensing) Regulations 2004, which govern the main steps of the Waste Licence application process. Waste Licences are granted by the Environmental Protection Agency.

Under the Third Schedule (Part 1) Activity Class 10 of the Waste Management (Facility Permit & Registration) (Amendment) Regulations (S.I. 86 of 2008), a non-hazardous waste recovery activity below 50,000 tonnes per annum (other than a scheduled IPPC activity) where no more than 15% of annual intake is consigned from the facility as residual waste for onward disposal, can be authorised by a Waste Permit.

An Animal By-product Licence will also be required if a composting or anaerobic digestion phase is employed for the treatment of animal by-product material in addition to a Waste Licence.

Animal By-product Licences are governed by the Department of Agriculture, Fisheries and Food.

4.3.1 Waste Licence

The Waste Management Act 1996 defines ‘recovery’ and ‘disposal’ activities in its Third and Fourth Schedules. Because it is likely that a significant portion of the output of an MBT plant will be disposed of by activities listed in Paragraphs 1–5, 7–10 and 13 of the Third Schedule, MBT plants are to be regarded as ‘waste disposal activities’.

As it is likely that economies of scale will dictate that a facility will exceed 25,000 tonnes per year throughput, an EIS will be required to accompany the Waste Licence application.

4.3.2 Veterinary Approval Application Procedure

As mentioned previously, a proposed development must undergo a two-stage application process under the European Communities S.I. No. 253 of 2008 Diseases of Animals Act 1966 (Transmissible Spongiform Encephalopaties) (Fertilisers & Soil Improvers) Order 2008. The first stage of the process is the Notification Stage where the applicant must inform the Department Agriculture and Food of their intention to build a facility.

Once a ‘Favourable Notification’, agreeing in principle to the development, is received from the Department, the applicant is free to continue with their development as planned. Once construction is completed on-site and the facility is in a position to begin operation and receive material on-site, the applicant should undergo the second part of the process by submitting an application.

The application is acknowledged by the Department and a validation visit is arranged. The purpose of this visit is to:

1 check the specifications contained in the notification have been adhered to; and

2 examine the procedures in place at the facility and to ensure that all material passing through the facility is processed in accordance with the standards laid down in Regulation 1774/2002.

4.4 By-product Management

When determining the regulatory control in respect of the outputs produced by the MBT process, we consider two general outputs are considered:

1 stabilised organic fraction;

2 outputs used in electricity generation.

4.4.1 Stabilised Organic Fraction

The stabilised organic fraction produced during the MBT process is limited in use. The National Biodegradable Waste Strategy states that the organic outputs from the MBT process 'typically emerges as a low quality material – stabilised biowaste – that has limited applications' (DoEHLG, 2006, p. 90). It lists some possible applications as daily landfill cover and use as acoustic barriers.

The options for the 'ultimate fate' of this material are realistically limited to two applications:

1 limited land application;

2 disposal in landfill after reaching a certain stability level.

The feasibility of these options in an Irish context are explored in more detail in subsequent sections of this report but from the point of view of regulatory control on MBT outputs, it can be said that Ireland is lacking when compared to other European countries. While this is understandable when one considers that the MBT industry is not yet established in this country, there is an urgent need for guidance in relation to the options for the stabilised organic fraction in particular should it be decide in principle by the Irish authorities to allow the spreading of stabilised biowaste on agricultural pasture land.

To date, most guidance has been provided by the *Working Document on the Treatment of Biowaste – 2nd Draft* (EC, 2001) which has been withdrawn at a European level. The EPA has adopted the standards for compost produced from source-separated organics outlined in this document in a number of Waste Licences.

The EPA's recent *Municipal Solid Waste – Pre-treatment & Residuals Management Technical Guidance* document (Consultation Draft) (EPA, 2008) proposes a respiration standard that might well be adopted in the near future.

CRÉ – the Irish Composting Association – is currently developing a standard for compost produced from source-separated material only (EPA ERTDI Research Project 2006–WRM–DS–26). The proposed standards are similar to those outlined in the *Working Document* (EC, 2001). However, there are no immediate plans to develop a standard for the stabilised organic fraction from an MBT process. In the absence of a standard, that suggested by the *Working Document* (EC, 2001) may provide the best guidance.

Indeed, prior to developing a standard for the stabilised fraction, a decision is needed as to whether land application of this material is to be supported. It is interesting to note that in Germany and Austria, the two countries with possibly the most developed MBT infrastructure, the stabilised fraction is almost always landfilled. Austria has produced standards that allow the use of the stabilised fraction in limited applications, such as biofilter construction, but, even with this allowance, in 2006 only 0.3% of the stabilised fraction was used in these applications.

Even if limited land application is to be allowed, there will still be a considerable amount of material that will be landfilled and a stability standard will be required against which the biodegradability of the stabilised fraction can be measured.

In the event of land application being allowed, attention must also be paid to the requirements of The Diseases of Animals Act 1966 (Transmissible Spongiform Encephalopathies) (Fertilisers and Soil Improvers) Order 2008 which gives effect to Regulation 1774/2002.

The 2008 Order places certain stipulations on the application to land of compost derived from *catering waste, former foodstuffs and fish by-products*, particularly to pasture land. Certain time periods must be maintained in relation to which animal grazes the land, with the current recommendation in Ireland from the Department of Agriculture, Fisheries & Food (DAFF) being that 21 days should be maintained for ruminants and 60 days for pigs.

However, the application to land of stabilised biowaste derived from higher risk animal by-products (e.g. other than manure, the contents of the digestive tract, milk or colostrum) is prohibited. Accordingly, if the waste processed at an MBT facility is likely to contain animal by-products which represent a higher risk than catering waste, former foodstuffs or fish by-products, then MBT processed material may not be applied to land.

Council Directive (91/676/EC) of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (the Nitrates Directive), requires member states to establish a Good Code of Agricultural Practice to Protect Waters from such pollution. An outcome from the production of this code (DoE and DAFF, 1996) in Ireland is the requirement for a Nutrient Management Plan in relation to lands where fertiliser is applied.

This will require a landowner to take account of the fertilizing qualities of the stabilised fraction prior to land application.

It must also be noted that the Landfill Directive requires that all waste, with the exception of inert waste, be treated before going to landfill. This is required under Irish law by the Waste Management Licensing Regulations (S.I. 395) of 2004. For an existing landfill facility, the requirement for pre-treatment of waste comes into force on the 16 July 2009.

4.4.2 Outputs Used in the Generation of Electricity

CEN is currently working on the preparation of relevant standards for the marketing of solid recovered fuels (SRF). SRF is defined within CEN's Working Group 1 as: 'solid fuel prepared from non-hazardous waste to be utilised for energy recovery in incineration or co-incineration plants and meeting the classifications and specification requirements laid down in CEN/TC 343' (CEN 343 Working Group 1, 2007).

While this definition may seem broad ranging by referring to all non-hazardous waste to be utilised in energy recovery as SRF, the inclusion of the word 'prepared' places the requirement for some extra treatment on the producer.

'Prepared', in the CEN specification, means that the material must be processed, homogenised and up-graded to a quality that can be traded amongst producers and users. This may require the by-product of the MBT process to be further treated to meet the specification that will be laid down in CEN 343.

A timetable for the completion of CEN TC 343 is unavailable but it is hoped that provisional standards will be available in 2008/2009.

As SRF is a non-fossil fuel and its biodegradable fraction deemed as a renewable biomass under the Renewable Energy Directive, renewable energy produced from this material is eligible for the government REFIT (Renewable Energy Feed in Tariff) scheme. Energy produced from the combustion of biogas produced by the anaerobic digestion of the organic fraction of residual waste, as part of the MBT process, will also be eligible for this scheme, assuming it is not all consumed by the mechanical processes on site.

4.5 UK Regulatory Approach

The UK regulatory approach can be used to act as a comparator with the similar regulatory framework that exists in Ireland. Similar to Ireland, the UK is facing similar landfill diversion targets for biodegradable waste. The UK consists of three regulatory divisions: (i) England and Wales (Environmental Agency/Department for Environment, Food and Rural Affairs); (ii) Scotland (Scottish Environment Protection Agency/Local Authority); and (iii) Northern Ireland (Department of Environment/ Department of Agriculture and Rural Development Northern Ireland).

The planning application procedure for the UK countries is quite similar to that followed in Ireland – applications are made to the local authorities. However, in England and Wales, once a decision is made in relation to the granting of planning permission by the local authority, this decision cannot be appealed by a third party. However, a third party may appeal to a Local Authority Ombudsman if they feel the authority has acted incorrectly in the handling of a particular application.

Licence-application procedures are also akin to those in Ireland. Waste Licence applications in England and Wales are either fixed or bespoke licences where there are 14 fixed prepared licences for activities with perceived risks and conditions imposed on them for a range of sizes of development. Bespoke licences will be variations of fixed licences but are more costly.

In Northern Ireland, animal by-product requirements are governed by the Department of Agriculture and Rural Developments (DARDNI) while the State Veterinary Service governs these activities in England and Wales. In Scotland, local authorities are responsible for animal by-product monitoring.

In relation to the management of MBT process outputs, the Landfill Allowance Trading Scheme (LATS) and Landfill Allowance Scheme (LAS) restrict the amount of biodegradable waste going to landfill. LATS operates in England, Scotland and Northern Ireland while LAS operates in Wales. These schemes assign yearly allowances to each local authority for the amount of biodegradable waste going to landfill. LATS allows trading of these allowances between authorities and for future years while LAS does not allow trading of allowances. A specially determined mass balance equation is then assigned to determine the quantity of biodegradable waste sent to landfill.

The UK also operates a financial support scheme – known as the Renewable Obligation Certificate (ROC) – for electricity generated from renewable sources. For each megawatt of renewable energy supply, a Renewable Energy Certificate is allocated by the Office of Gas and Electricity Markets. With respect to MBT, the technologies eligible for ROCs are anaerobic digestion, pyrolysis and gasification.

4.6 Other European Regulatory Approaches to MBT

MBT forms a considerable part of their integrated waste-management infrastructure of a number of other European countries, including Germany, Austria, Italy and Spain.

4.6.1 Germany

In Germany, the first Waste Management Act (*Die Abfallgesetz*) was created in 1986 to establish a legal framework for the treatment of waste. This Act laid down the option to establish technical standards for the treatment of waste.

The technical standards were updated and enforced in 1993 with the publication of the Technical Instructions on Waste from Human Settlements (*Technische Anordnung Siedlungsabfall*, 'TASI') (Hempsen, 2005).

TASI laid down the requirements on the location, design and operation of landfills and on the composition of waste to be accepted for landfilling. In order to comply with the landfill classification criteria, waste with an organic fraction must be made inert and stabilised by treatment prior to landfill. Limits were also set for residual quantities of organic material and heavy metals as well as biodegradable stability.

In March 2001, TASI was updated when the Ordinance on Environmentally Compatible Storage of Waste from Human Settlements (*Abfallablagerungsverordnung*) (Hempsen, 2005) was entered into legislation. This regulation also revised the standard for biological treatment required by pre-treatment by allowing respirometry as a method to test the residual fermentability of the material. The standards allow the AT4 Index as a measure for respiration activity – measured over four days and set at <5 mgO_2/g DM.

Following on from this updated TASI, the 30th Federal Emission Control Ordinance laid down emission standards for MBT corresponding to those set down for incinerators. This Ordinance requires that MBT facilities are to be housed and must meet emission standards that are generally achieved using regenerative thermal oxidation technology (RTO). Existing plants were to be refitted or taken out of service by 1 March 2006. Section 16 of this Ordinance allows for a relaxation of the requirement for housing if the material intended for biological post-processing has a respiration activity of less than 20 mgO_2/g DM and where it can be guaranteed through operational measures that enough provisions are made against harmful influences to the environment.

4.6.2 Austria

In the 1997 Landfill Ordinance (*Deponieverordnung*) (Bundesgesetzblatt für die Republik Österreich, 1996), restrictions on the landfilling of wastes were introduced which amounted to a ban on the landfilling of untreated material and a maximum limit value for organic carbon content. A further restriction on the landfill of waste that may have a potential resource (i.e. as a fuel) means that a limit is set for the gross calorific value of material sent to landfill by 2008.

Limits for the biodegradability of material going to landfill were set out in the Draft Guidelines on the Mechanical-Biological Treatment of Waste 2001 and were adopted into the Landfill Ordinance under an amendment in 2004.

The maximum organic content limit is set at 5% – however, this does not apply to MBT facilities where only the biodegradability standard for the treated material applies. This standard has been set as <7 mgO_2/g DM for an AT4 index test which is a slight increase on the German standard of <5 mgO_2/g DM.

Stabilised organic outputs from MBT however do not have to be sent to landfill as the only option. The 1992 Ordinance on the Separate Collection of Biogenous Waste, mentioned above, allows a third set of quality standards for MBT outputs so that they can be used in landfill remediation projects or biofilters.

4.6.3 Italy

The main legislative document (known as the Ronchi Decree [*Decreto* Ronchi]) in Italy relating to waste management was introduced in 1997 (Faviono, 2005). This decree aims to minimise waste generation through reuse and recycling; to promote alternative methods to derive a raw material from waste; to promote reused/recycled product development and SRF.

The Ronchi Decree establishes a standard for RDF for incineration or co-incineration. However, there are very few plants in Italy capable of burning SRF, so much so that there are an estimated 3 million tonnes of SRF stockpiled in the Naples region that have no destination.

Decree 36/03 enforces the Landfill Directive in Italian legislation (Faviono, 2005). As regards the standards for stabilisation criteria for material going to landfill post-MBT treatment, Italy does not have any fixed legislative control but has, on an unofficial basis, conformed with the AT4 value of <10 mgO_2/g DM that was the proposed respiration activity level in the 2nd Draft of the EC *Working Document on the Biological Treatment of Biowaste* in 2001.

Given the climate of Italy and the other Mediterranean countries, there is a large need for organic material in soils and the option of using stabilised biowaste in restricted application is one that is highly favoured in Italy.

4.6.4 Spain

The National Waste Strategy, published in 2000, is the driving force behind the national waste policy in Spain. The main aims of the Plan are to close non-compliant landfills, to construct waste transfer stations, to modify current landfills to comply with the Landfill Directive, to reduce and recycle cardboard and paper and to recycle organics through recycling (http://www.compostnetwork.info/index.php?id=44).

A National Plan on Composting promotes the development of an agricultural standard for compost, aims to create a National Centre for Compost, promotes compost generally and creates incentives for producers.

The Ordinance on Fertilisers and Related Products 1998 outlines basic standards in relation to compost quality that refer to heavy metals content, type of raw material and degree of maturity (http://www.compostnetwork.info/index.php?id=44).

A definitive standard that covers composting and compost standards is currently being drafted. It will contain a definition for an MBT-type stabilised biowaste material and will define areas and applications to which this material can be applied.

Spain currently loses 23 tonnes of soil per hectare per year to desertification and it is thought that this material, and material from source-separated composting, can have a role to play in combating this phenomenon.

4.7 Summary

Various legislation must be adhered to in the development of an MBT facility with the Planning and Development Act 2000 (and subsequent amendments) being the main document governing the planning requirements of a facility. When siting a facility, attention must be given to the requirements of the local development plan, the regional Waste Management Plan and the requirements of Regulation 1774/2002.

An EIS will, in most cases, be required for submission with a planning application and screening and scoping procedures must be followed in preparation of the EIS. A facility with a capacity of over 100,000 tonnes per annum for the disposal, treatment or recovery of waste may be considered of 'strategic' importance and, in this situation, the planning application is made directly to An Bord Pleanála.

An MBT facility will require an animal by-product licence and either a waste or IPPC licence depending on the scale of operations carried out.

There are no firm regulatory controls in place in Ireland presently for the management of outputs that would be produced by the MBT process. In relation to a stabilised organic output, the abandoned *Working Document for the Treatment of Biowaste – 2nd Draft* (EC, 2001) does suggest quality standards and limited land application uses for a stabilised organic material while also proposing biodegradability levels if landfilling the material.

The EPA has used other standards proposed in this document in the granting of Waste Licences for other facilities. It is proposed that the standards in relation to MBT outputs in this document could be taken as reasonable limits for future use in an Irish context. However, a decision is necessary as to whether this material will be suitable for use in limited applications as in Austria or whether it will all be consigned to landfill as in Germany.

If a decision was made that the stabilised output could be land applied in certain situations, then cognisance must be paid to the requirements of the Nitrates Directive (91/676/EEC) and the Good Agricultural Practice for Protection of Water Quality Regulations 2006.

A similar situation exists in Ireland in respect of a SRF output from the MBT process. Indeed, regulatory guidance is absent at a European level in relation to this material but it is expected that the work of CEN 343 will produce a standard for this material in 2008/09.

The Renewable Energy Feed In Tariff (REFIT) is a financial scheme aimed at encouraging the generation of green electricity. In relation to MBT, the generation of methane from anaerobic digestion of the organic fraction of waste can qualify for this scheme.

In the UK, similar processes are used for granting planning permissions and licensing MBT facilities. The UK also employs a landfill allowance scheme whereby the amount of biodegradable waste being sent to landfill is limited for each local authority. For renewable energy generation for an MBT process, a Renewable Obligation Credit (ROC) system is used.

Germany and Austria have developed their own standards for the stability of material being consigned to landfill which are in excess of the requirements of the *Working Document of the Treatment of Biowaste – 2nd Draft* (EC, 2001).

If MBT is to be considered as a waste treatment technology to reduce Ireland's dependency on landfill, it is recommended that national standards be developed to:

- govern the operation of MBT facilities in addition to EPA licensing;
- determine the biodegradability or stability of the treated biological fraction of residual waste;
- develop quality standards to categorise the outputs from the 'mechanical' treatment phase;
- determine appropriate outlets for the management of stabilised biowaste and the outputs from the mechanical treatment phase;

- establish revised waste acceptance criteria for landfilling.

These standards are necessary to ensure that the performance of MBT facilities is standardised nationally and is in keeping with the objectives of the waste hierarchy and to provide a structured environment where both the economic and environmental viability of a facility can be ensured.

5 Identification of Leading Manufacturers and Suppliers of MBT Technology

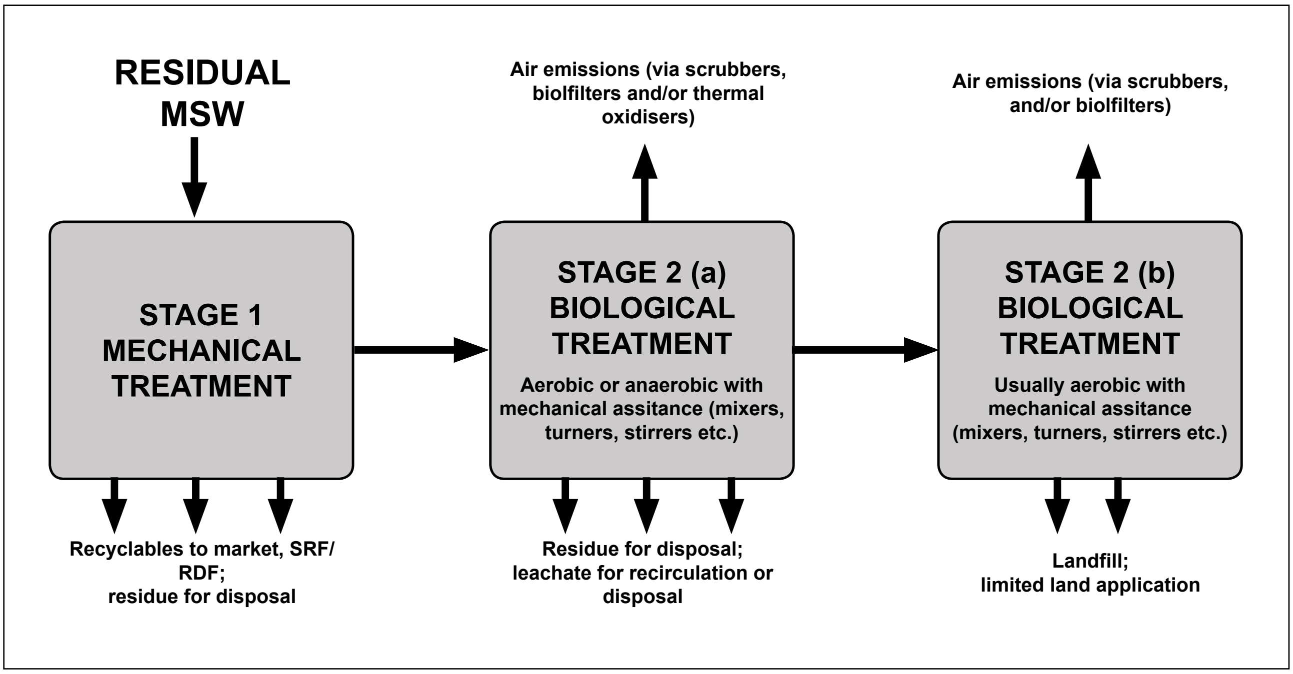

Figure 5.1: Generic Process Flow Diagram for MBT

5.1 MBT Description

The nature and extent of both the mechanical and biological aspect of the MBT process will vary, depending both on the type/quantity of waste to be treated and on the output specification. The latter will depend primarily on whether all or part of the output is being recovered, recycled or disposed.

The concept of MBT evolved on continental Europe, particularly in Germany, as a response to a strong desire to reduce the quantity of biodegradable waste sent to landfill and to increase the potential recovery of resources from the waste stream. The waste-management industry developed technologies and combinations of technologies in response to this need. A generic flow diagram showing waste material movement through a typical MBT process is given in Figure 5.1.

The mechanical plant usually installed in advance of biological stabilisation can include:

- bag splitters;
- shredders;
- grinders;
- magnetic separators;
- eddy-current separators;
- air classifiers;
- screens;
- optical separators;
- ballistic separators;
- conveyors.

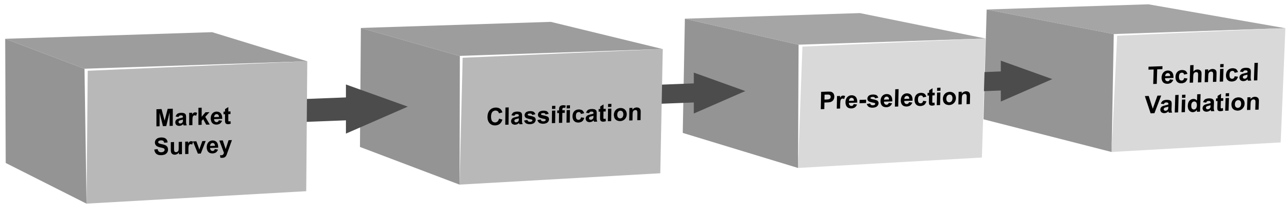

Figure 5.2: Identification process for MBT technology suppliers

There is a large number of processes and combinations of technologies being marketed, proposed and used to stabilise the organic fraction of residual waste, including:

- anaerobic digestion:
  - wet;
  - dry;
  - multi-stage.
- aerobic composting:
  - windrow;
  - in-vessel;
  - aerated static piles;
  - tunnel.

5.2 Sources of Information Consulted

5.2.1 The Juniper Report

This report was undertaken by Juniper Consultancy Services (Juniper, 2005) in the UK and was published in March 2005. The report focuses on the options available for the residual waste created by the MBT process. The report presents options to allow organisations to focus on an MBT plant that best suits their particular set of circumstances. Annex D of the report reviews 27 processes developed in 17 countries.

5.2.2 STRAW Position Paper

The Sustainable Transport Resources and Waste (STRAW) (2005) project was commissioned by Biffaward, the Department of Environment, Food, Rural Affairs (DEFRA-UK) the Highways Agency, British Waterways Trust and the Institution of Civil Engineers in the UK. The outcome of the project, *Position Paper 7: Technologies for Waste Management and Reprocessing*, describes the suite of physical, biological, combined (e.g. MBT), chemical (e.g. energy from waste) and landfilling. This paper provided a useful reference for general capital costings.

5.2.3 Other Sources

Other sources of information used by the project team included vendor literature and internet research while a number of project team members also attended international conferences on MBT that were held during the timeframe of this project. These conferences provided the project team with information on the latest technological advances within the MBT industry as well as other information in relation to market values for outputs etc.

5.3 Review Process

At the beginning of the project, the project team carried out an independent review of the marketplace to determine what manufacturers serviced the Irish/UK/Northern European markets as well as categorising what technologies could be classified as ‘proven’ or ‘under development’.

Figure 5.2 above outlines the path of the review process.

5.3.1 Market Survey

The market survey was undertaken by conducting a literature review and compiling information from international exhibitions and conferences. The objective was to identify the main MBT suppliers that are *active* in the Irish/British/North European market.

5.3.2 Classification

With the results of the market review, the suppliers have been grouped into five different MBT 'configurations' based on the *core biological treament* applied to the organic fraction:

1 aerobic biodegradation;

2 anaerobic biodegradation;

3 biodrying;

4 alcoholic fermentation;

5 heat and pressure treatment (autoclave).

5.3.3 Pre-selection

An exemplary supplier from each of the *proven* MBT configurations was retained for a detailed technical evaluation for the technology.

5.3.4 Technical Validation

The technical validation of each chosen technology was carried out and is detailed in the following sections of this report.

5.4 Process Descriptions

This section outlines the technologies offered by the suppliers identified from the review process.

Research shows that even though two or more specific plants may be have the same supplier, the choice of equipment, particularly upstream and downstream of the 'core' technology will invariably differ. Some providers have developed their own core technology; others combine what they see as their best-choice combination of technologies and equipment.

The following is the list of suppliers examined as part of the review process:

- ArroBio
- Bedminster
- Biodegma
- Civic
- Ecodeco
- Estech
- Genesyst
- GICOM
- Global Renewables
- HAASE
- Herhoff
- HESE
- Kelag
- Kompogas
- Linde
- New Earth Solutions
- OWS
- Purac – BTA
- ROS ROCA
- SRS
- Sterecycle
- Sutco
- TEG
- Thermosave
- Valorga
- Vinci Environnement
- WESER
- WTT

5.5 Mechanical Separation/Handling Equipment

The typical mechanical treatments employed are:

Bag splitters – a rotating drum with splitting 'blades' that tears and rips open bags to provide an even flow of waste into the next treatment step.

Shredders – shredding is undertaken to reduce particle size and to produce a more homogenous waste stream. Shredders generally consist of a series of rotating toothed drums that rip the material to a specific particle size but can also be of the ball-mill variety that pulverises material to the required particle size.

Magnetic separators – separate out ferrous metals by passing the waste on a conveyor by a magnetised drum that will attract out the ferrous portion from the moving waste stream.

Eddy current separators – induce temporary magnetism in non-magnetic (non-ferrous) metals in order to remove them from the waste.

Air classifiers – separate out material by its density relative to air streams through which the waste passes; lighter materials travel further in the air stream and can be captured.

Screens – screens separate by size, weight or shape or a combination of all three. Trommel screens are the most commonly used: waste is passed through a cylindrical drum with specific-sized openings and the waste stream is then separated into two fractions of differing sizes.

Optical separators – also known as near infra-red (NIR), these use infra red light to determine the structure of specific materials (usually plastics, paper and plastic coated papers) and the direction of the material rapidly and then use air jets to shoot the material in a specific direction where it is collected.

Ballistic separators – generally used to separate out inert materials like stones and glass by passing the material over a rotor that flings the material through the air, with the smaller, lighter materials such as the inerts travelling further and then being collected. A vibrating conveyor also achieves the same results.

Other equipment used in the mechanical treatment include conveyors and loading shovels, which are generic pieces of equipment, the strengths of which are well known.

5.6 Biological Processes

Technologies are typically described as 'aerobic' or 'anaerobic'. Aerobic technologies use the microbial action of oxygen-dependent organisms to break down the organic material into its constituent parts. Anaerobic technologies use the action of microbes that survive in an environment deprived of oxygen.

The typical aerobic processes employed at MBT facilities are:

- tunnel composting;
- aerobic static piles;
- rotating drum;
- vertical tower;
- biodrying.

5.6.1 Tunnel Composting

Here, waste is placed in a tunnel (concrete, steel and/ or fabric composites), which is kept virtually airtight to prevent fugitive emissions escaping. The tunnel may have doors at one (or both) ends to facilitate filling and emptying and the roof may be fixed in place or may be removable/ openable. The waste is placed in the tunnel either using a loading shovel or automated filling conveyors and usually removed using a loading shovel. Tunnel composting typically works on a batch basis ('all in/all out').

Perforated pipes or troughs in the floor facilitate both aeration and leachate drainage while overhead sprinklers are used to irrigate the waste mass if necessary. Sensors, which are inserted in the body of the waste, facilitate temperature monitoring and temperature control and can be affected by adjustment of the aeration rate through a computer-controlled system.

5.6.2 Aerated Static Piles

Usually indoor, and similar to tunnel composting, air is forced up or down through piles of waste with similar monitoring to control the conditions within the pile. Numerous piles of different ages might be arranged within the same building (composting hall). Waste is moved from pile to pile either using a loading shovel or wind-row turner. Exhaust air is removed from the composting hall and treated either using a biofilter or regenerative thermal oxidiser (RTO).

A variation on the above is often used in the maturation phase where air is drawn down through the pile using negative pressure in the under-floor ventilation system.

5.6.3 Rotating Drum

Waste is inserted into a slowly-rotating, insulated metal drum and is subjected to continuous turning as the waste progresses along the drum. The environment within the drum can be controlled by adjusting the speed of rotation or increasing/decreasing the rate of ventilation. Rotating drums are normally used for short-duration composting and would be accompanied by subsequent steps using other technology.

5.6.4 Vertical Tower

Shredded waste is introduced into the top of a multi-floored tower. Air convects up through the waste (low energy user). At intervals, the floors open allowing the waste to drop to the next level. Ultimately, the waste reaches the floor where it is extracted using an augur system.

5.6.5 Biodrying

This can occur either in the aerated static pile configuration or in the in-tunnel configuration. The principles are the same as for the composting systems but clearly the objective is different – thus, water addition is not carried out and the primary aim is to reduce the moisture content with a consequent increase in calorific value coupled with weight reduction.

5.6.6 Anaerobic Digestion (AD)

Anaerobic digestion (AD) utilise certain bacteria in the absence of oxygen to convert organic matter into a gas containing carbon dioxide and methane at an approximate ratio of 45:55. In biological terms, the process consists of four distinct stages:

1 *Hydrolysis* – the organic matter is broken down into smaller molecular units that other bacteria can absorb.

2 *Acidogenesis* – the smaller molecules are converted to fatty acids.

3 *Acetogenesis* – the fatty acids are broken down to acetic acid.

4 *Methanogenesis* – the acetic acid is broken down to carbon dioxide and methane.

AD can be either a dry or wet process – the dry process operates with a moisture content of 70–80% while the wet process operates with a moisture content of 90% or more. The AD process can be either mesophilic or thermophilic – mesophilic processes operate in the temperature range of 35–45°C while thermophilic processes operate in the range of 50–65°C.

AD may also be described as a batch or mass flow process – a batch process treats waste material in single batches while with a continuous flow process material moves through the system by mass flow – material added into the beginning of the system displaces material expelled at the back end.

The gas produced from AD can be burnt in a spark ignition engine driving a generator. Steam can be raised in a waste heat boiler using the hot exhaust gas from the engine. Surplus steam can be supplied for heating or other process uses.

5.7 Air and Off-Gas Treatment

The management of MSW inevitably gives rise to off-gasses potentially causing odour nuisance and also to the generation and emission of 'greenhouse gasses'.

Off-gasses are usually treated using negative pressure, air-recycling, scrubbers, biofilters, carbon adsorption, gas utilisation flaring and regenerative thermal oxidation or a combination of the above.

5.7.1 Negative Pressure

This term refers to buildings being subjected to sufficient forced ventilation such that air does not escape to the atmosphere either through leaks and other orifices or indeed when doors are opened.

5.7.2 Air Recycling

There is no need for absolutely clean air in the aerobic composting process. It is good practice to use the (probably most odiferous) air from the reception hall to ventilate the aerobic tunnels or aerated static piles with odour concentrations within the recirculated air stream being reduced in the process.

5.7.3 Scrubbers

Ammonia generation is an inevitable consequence of aerobic digestion (composting) of organic material. Ammonia can be removed using a sulphuric acid or water scrubber. Within a scrubber, air is normally blown upwards through a medium (usually plastic) that is saturated with the re-circulating scrubbing liquor. The ammonia is absorbed as ammonium sulphate.

5.7.4 Biofilters

Biofilters comprise a bed of supporting medium such as wood-chip, bark, heather, sea-shells or other suitable biological growing medium. Discharged air is blown slowly up through the medium. Depending on the range of pollutants in the air-flow, appropriate bacteria will become established that digest the compounds and discharge CO_2.

5.7.5 Carbon Adsorption

Carbon-adsorption systems are similar to biofilters – however, the process entails *physical adsorption* rather than biological respiration. Depending on the degree of saturation, the carbon medium must be replaced regularly and treated by a specialist service provider. It is possible that the spent carbon will be considered hazardous during transport and as a result require special precautions.

5.7.8 Regenerative Thermal Oxidation (RTO)

RTO is effectively an exhaust gas incinerator. The heat contained in the exhaust gas heats up the intake gas stream. RTO is best suited to autothermic (will burn) range gasses. Sub-autothermic gasses will need an auxiliary gas supply to augment the process.

5.7.9 Gas Flaring

A gas flare comprises a device that is used to burn combustible gas in a controlled environment. In the context of established MBT plants, flares are generally used only as a stand-by contingency, with RTO favoured as the main method for gaseous emissions treatment.

5.8 Summary

An examination of the processes, manufacturers and suppliers of MBT technology showed that typically mechanical treatment occurs before the biological treatment step. Nonetheless, this is not always the case as will be shown in the technology review in the next section.

The mechanical treatment process is usually carried out using technology such as shredders, grinders, screens, metallic separators and conveyors while the biological treatment phase is typically aerobic or anaerobic with many variations on these processes. The results of the pre-selection and technical validation processes are outlined in the following sections.

A number of sources were used to investigate the status of the MBT industry. The identification of the MBT technology supplier for each of the predominant MBT technological configurations followed a process of market survey, classification, pre-selection and technical validation.

6 Case Study Facilities

6.1 Residual Bin Composition

Five technologies at 'flagship' plants were chosen to represent a broad range of the types of configurations used in MBT facilities throughout Europe. Each of these flagships treat residual waste streams that vary in composition because of location, demographics and waste collection service employed.

The performance of the individual facilities will vary in locations where the input waste characteristics differ – as a result, it cannot be assumed that the mass balances observed at the flagship facilities will be the same if applied to the Irish residual bin.

Irish residual bin characteristics were identified in order to determine approximately the potential performance of each flagship facility in an Irish context. The Irish residual bin composition is identified in the EPA *National Waste Report 2005* and is based on the results of a study entitled 'Programme for Municipal Waste Characterisation Surveys' (EPA, 2005) .

This survey considered the collection system and demographic situation of an area and their influence on the composition of MSW. Data was available on the composition of a residual bin in city, urban and rural areas with one-, two- and three-bin collection systems.

Figure 6.1 shows how the National Waste Report 2005 determined the composition of the mixed residual bin.

For the purposes of comparing the flagship facilities, some categories have been combined for ease of comparison with flagship facilities as shown in Table 6.1.

However, given the intentions of each of the ten WMRs to roll out a three-bin collection system in their functional areas, it is likely that future residual bin composition will change. A three-bin collection regime will typically consist of a bin for dry recyclables, a second for biodegradable

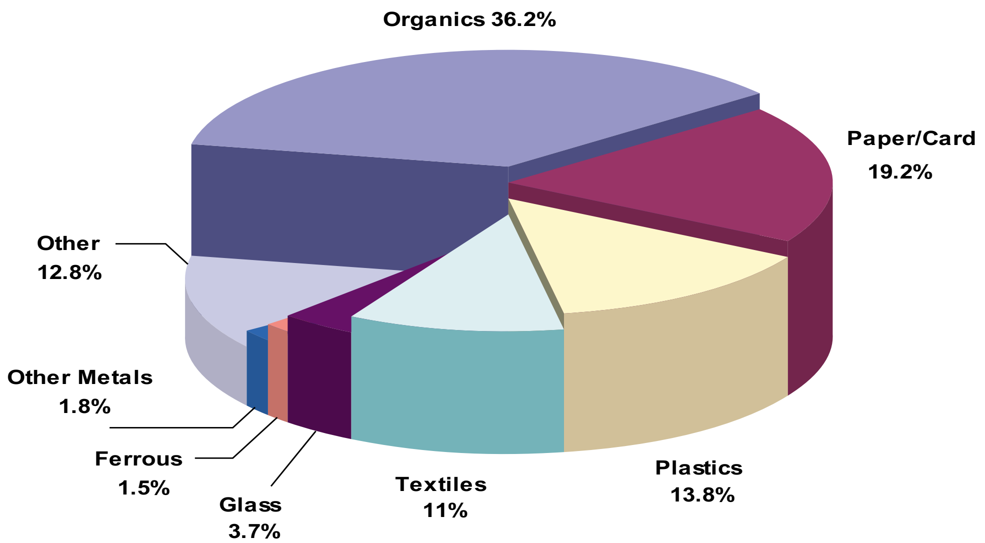

Figure 6.1: National Mixed Residual Waste Characterisation

Table 6.1: Combination of Categories

National Waste Report 2005	%	Combined Categories	%
Organics	36.2	Organics	36.2
Paper/Cardboard	19.2	Paper/Cardboard	19.2
Plastics	13.8	Plastics	13.8
Textiles	11.0	Textiles	11.0
Glass	3.7	Glass	3.7
Ferrous	1.5	Ferrous	1.5
Aluminium	1.4	-	-
Wood	0.9	-	-
WEEE*	0.8	-	-
Other Metals	0.4	Other Metals (inc aluminium)	1.8
Other	11.1	Other (inc WEEE, wood)	12.8
Total	100	**Total**	100

*Waste Electrical and Electronic Equipment

waste and a third for residual waste. Residual bin composition presented in the EPA *National Waste Report 2005* indicates that the two-bin collection system is the predominant system in Ireland at present. With the future roll-out of the three-bin system in each region, the expected change in waste composition will affect the performance of any MBT facility constructed. An accurate analysis of the composition of the residual waste stream will be a prerequisite when determining the performance of an MBT facility in the Irish waste-management arena in future years.

A predicted composition of the residual bin post three-bin roll out is indicated in Table 6.2.

Table 6.2: Possible Future Residual Bin Composition Post-Three Bin Roll-out

Waste Category	Future Residual Bin Composition
Organics	19.3
Paper/Cardboard	15.3
Textiles	14.7
Plastics	12.3
Glass	3.7
Aluminium	0.3
Other Metals	4.3
Wood	0.7
Others *	29.3

* Other fraction – typically consists of unclassified combustible and incombustible material and fine elements (<20 mm)

6.2 Case Study Technologies

Five facilities were identified in the review process for case study with each one representing a specific type or configuration of technology:

1. MBT aerobic biodegradation using tunnel technology.
2. MBT aerobic biodegradation in agitated halls.
3. MBT aerobic biodegradation using rotary drums.
4. MBT aerobic biodegradation in tunnels combined with anaerobic digestion.
5. MBT biodrying using bunkers to produce SRF.

Detailed information was sought for each facility. There are a number of important points to bear in mind in relation to the information presented:

- The information provided presents a snapshot of the facility operation and is only intended to give an overview of a number of MBT technology configurations that are offered by companies on a commercial scale.
- The information presented, particularly the mass balances, will differ in an Irish context due to differences in the input waste stream from the representative location and an Irish waste stream.
- Information presented in relation to sampled waste material and referenced against available standards

is representative only of the sample taken and may not be an accurate representation of the performance of the system as a whole.

- The information presented is not intended to show preference for any particular technology over another.

6.3 Summary of Case Study Technologies

The performances of the individual case study facilities are outlined below.

6.3.1 Location and Technology Provider

The range of technologies listed in Table 6.3 provides a good representation of the MBT industry as determined by the technology review in previous sections of this report. The suppliers are well-established companies with considerable experience. Throughputs in the studied facilities vary: the largest facility has a throughput per annum (tpa) of 300,000 tonnes. In an Irish context, it is not envisaged that MBT facilities of this size will be constructed with 100,000–200,000 tpa being more likely.

6.3.2 Input Waste Stream Comparison

The composition of the Irish residual bin is given in Section 6.1. The input waste stream of each facility was characterised and is compared to the Irish residual bin composition in Table 6.4. Some categories had to be combined with others due to variations in the information provided. The other fraction is taken to typically consist of unclassified combustible and incombustible material and fine elements (<20 mm).

Table 6.3: Overview of Case Study Facility Locations and Technology Provider

Facility Information	Aerobic Tunnel Technology	Aerobic Agitated Halls	Aerobic Rotary Drums	Aerobic tunnels / anaerobic digestion	Biodrying
Site	Osterholz, Germany	Istanbul, Turkey	Launay Lantic, France	Pohlsche Heide, Germany	Frog Island, United Kingdom
Equipment Supplier	WTT Horstmann	VKW Kelag	VINCI Environnement	OWS/ Launay Lantic	Ecodeco
Operator	Abfall – Service Osterholz GmbH	Metropolitan Municipality of Istanbul	SNITOM de Launay Lantic	Kompostwerk Pohlsche Heide	Shanks East London
Throughput per annum (tpa)	45,000 tonnes	300,000 tonnes	40,000 tonnes	80,000 tonnes	180,000 tonnes

Table 6.4: Comparison of Case Study Facility Input Waste Streams with Irish Residual Bin Composition

Primary Waste Category	Irish Residual Bin %	Aerobic Tunnel Technology %	Aerobic Agitated Halls %	Aerobic Rotary Drums %	Aerobic tunnels / anaerobic digestion %	Biodrying %
Organics	36.2	27	34.9	63.2	10.4	23
Paper/ Cardboard	19.2	25	11.4	↑	9.7	39
Plastics	13.8	14	12.1	24.8	13.4	9
Textiles	11	2	9.8	0	24.3	4
Glass	3.7	7	12.7	2	10.7	7
Ferrous	1.5	↓	↓	↓	↓	↓
Other Metals	1.8	4	1.9	3.4	5.7	6
Others	12.8	21	17.3	6.7	25.8	12
Total	**100**	**100**	**100**	**100**	**100**	**100**

↑↓ indicates that a waste category is combined with the waste category above or below it

Table 6.5: Comparison of Mass Balances Observed at Case Study Facilities

Mass Balance Component	Aerobic Tunnel Technology %	Aerobic Agitated Halls %	Aerobic Rotary Drums %	Aerobic tunnels / anaerobic digestion %	Biodrying %
Input Waste	**100**	**100**	**100**	**100**	**100**
SRF material	50	46	33.1 (2 SRF fractions)	44	40
Metallic recyclates	2	unknown	1.1	2	3.5
Process Loss	23	29 (assumed)	35	19	29
Others/rejects	not available	unknown	3	6	27.5
Stabilised Organic Fraction	25	25	27.8	29	not available

6.3.3 Mass Balances

As previously outlined, the input waste stream composition will greatly affect the performance and mass balances observed at the facilities (Table 6.5).

6.3.4 SRF Fraction

Table 6.6 indicates that the SRF fraction consists of a large proportion of the input waste stream in all facilities. In the case of the Istanbul facility, this material is not sent for thermal treatment as there is no suitable facility to treat this material but the composition of the material can be used to ascertain its suitability as an SRF.

6.3.5 Stabilised Organic Fraction

Table 6.7 also indicates that the stabilised organic fraction output from an MBT facility tends to comprise approximately a quarter of the input waste stream. Even if certain land applications of this material were allowed, it would still require a considerable amount to be landfilled. The 'biodegradability' or 'respiration activity' of the material is then of importance.

The comparable standard for these values is indicated in the EC *Working Document on the Biological Treatment of Biowaste – 2nd Draft* (EC, 2001). Even though withdrawn, this document has provided the only guidance at a European level in relation to respiration activity of biowaste material post-biological treatment. For the DR4 respiration test, the EC *Working Document on the Biological Treatment of Biowaste – 2nd Draft* (EC, 2001) uses the figure of 1,000 mgO_2/kg as an indication of a sufficient degree of stability for stabilised organic material being landfilled.

The case study facilities appear, in general, to perform quite poorly in achieving this pro-forma 'standard' for respiration activity.

However, this table does indicate that an MBT process employing both anaerobic and aerobic treatment seems to perform best, albeit while not achieving the requisite respiration standard. This may be explained by the fact that the biodegradable fraction is exposed to two differing microbial populations which may prove to be more efficient in reducing the degradation potential of a material.

It should be borne in mind that the results presented in Table 6.7 in relation to the respiration activity of the stabilised organic material produced at the case study facilities represent only a single sampling event in the overall operation at each facility and should not be taken as representative of the performance of the facilities as a whole.

6.4 MBT Contribution to Irish Residual Waste Treatment

The contribution that MBT can make in the treatment of Irish residual waste in the coming years is dependent on waste composition, the treatment processes employed and the availability of markets for the outputs of the process. Given the requirement for pre-treatment of waste prior to landfilling, as per Landfill Directive 99/31/EC, MBT may be in a position to fulfil this need.

Table 6.6: Comparison of SRF Compositions at Case Study Facilities

Parameter	Aerobic Tunnel Technology	Aerobic Agitated Halls	Aerobic Rotary Drums	Aerobic tunnels / anaerobic digestion	Biodrying
Moisture Content	35%	60%	49.2% (avg)	40%	not available
Calorific Value	14 MJ/kg	13.2 MJ/kg	21.75 MJ/kg (avg)	13.8 MJ/kg	not available
Organic Content	73%	86%	81% (avg)	83%	not available

Table 6.7: Comparison of Stabilised Organic fractions at Case Study Facilities

Parameter	Aerobic Tunnel Technology	Aerobic Agitated Halls	Aerobic Rotary Drums	Aerobic tunnels / anaerobic digestion	Biodrying
Moisture Content	40%	38%	39.9%	33%	not available
Organic Content	83%	49%	60.1%	33%	not available
DR4*	86,000 mgO_2/kg	21,481 mgO_2/kg	195,000 mgO_2/kg (3 months)	8,889 mgO_2/kg	not available
BM100 (litres/kg Loss On Ignition)**	158	58	354	24	not available

* DR4 = Dynamic Respiration over 4 days
** BM100 = Biochemical Methane production over 100 days

6.4.1 Determination of Future Residual Waste Generation

The *National Waste Report 2005* (NWR) (EPA, 2005) has indicated that 3,050,052 tonnes of municipal waste was generated in Ireland. Of this figure, 964,367 tonnes of MSW was recycled giving a MSW recycling rate of approximately 32%.

The NWR 2005 also gives a figure of 2,007,859 tonnes as the quantity of biodegradable waste generated, corresponding to approximately 66% of the MSW generated.

The *National Strategy on Biodegradable Waste* (DoEHLG, 2006), projects the generation of BMW produced in Ireland in the coming years (Table 6.8). Assuming that the BMW portion of MSW remains constant at 66%, future MSW generation figures can also be predicted.

Given the MSW recycling rate of 32% seen in 2005, and the national municipal waste recycling target of 35% in 2013 which is likely to be achieved and exceeded, it is not unreasonable to assume future MSW recycling rates as follows:

- 2010 – 40%.
- 2013 – 45%.
- 2016 – 50%.

Taking these MSW recycling rates into consideration, Table 6.9 shows how future quantities of residual MSW can be determined.

Table 6.8: Projected BMW and MSW Generation in Target Years[7]

Landfill Directive Target Year	2010 (tonnes)	2013 (tonnes)	2016 (tonnes)
Total BMW projected	**2,379,516**	**2,374,541**	**2,268,731**
Total MSW projected	3,605,327	3,597,789	3,437,471

Table 6.9: Projected Residual MSW in Target Years

Landfill Directive Target Year	2010 (tonnes)	2013 (tonnes)	2016 (tonnes)
MSW Projected	3,605,327	3,597,789	3,437,471
Recycling Rate (assumed)	40%	45%	50%
Residual MSW	2,163,196	1,978,783	1,718,735

[7] More recent data and alternative projections on MSW and BMW generation have been published by the EPA in Ireland's Environment 2008. ISBN 1-84095-274-1

6.4.2 Mechanical Biological Treatment of Projected Residual Waste

When considering the four flagships reviewed in previous sections that produce a conventional SRF and stabilised organic fraction, the average SRF fraction comprises 43.3% of the input waste while the average biodegraded fraction comprises 26.7% of input waste stream.

Using these average fractions to determine the treatment effect MBT may have on the projected residual MSW generation in the future, the following can be predicted (Table 6.10):

- SRF production in the Landfill Directive target years will range in the order of 950,000 tonnes in 2010, reducing to 750,000 tonnes in 2016 as all waste minimisation, recycling and recovery schemes have taken effect. To this end, thermal capacity of this magnitude is required for the treatment of this material, either in dedicated waste thermal treatment facilities or through co-incineration in existing facilities.
- Stabilised organic material will be generated in the range of 570,000 tonnes in 2010, again reducing to 460,000 tonnes in 2016.

6.5 Summary

The Irish residual bin composition used in the comparison of the case-study facilities is that identified in the EPA *National Waste Report 2005*. The case study facilities identified represent a specific type or configuration of technology and is only intended to present a snapshot of the facilities operation. This information should not be taken as a validation or otherwise of any specific technology. A summary of the data presented in the main report is presented in tabular form under the headings of location and technology provider, input waste stream comparison, mass balances, SRF fraction and stabilised organic fraction.

The outcome of the comparison of flagship facilities suggests that a combination of aerobic and anaerobic biological treatments may be the most effective way of treating the organic fraction of the input waste to achieve a respiration activity indicative of a suitable degree of stabilisation.

Table 6.10: SRF and Stabilised Organic Fraction Generated in Target Years

Landfill Directive Target Year		2010 (tonnes)	2013 (tonnes)	2016 (tonnes)
Residual MSW projected		2,163,196	1,978,783	1,718,735
MBT	SRF	936,663	856,813	744,212
	Stabilised organic fraction	577,573	528,335	458,902

7 Identifying and Assessing Long-term Sustainable Outlets for Managing MBT Outputs

7.1 Introduction

There are generally three to four outputs from MBT, namely:

1 Stabilised organic fraction.

2 Solid recovered fuel product.

3 Ferrous/non-ferrous metallic outputs.

4 Anaerobic digestion biogas.

The presence of an AD biogas output assumes the use of AD as a biological treatment technology. Other outputs may include inert or reject material, usually generated by a ballistic separation process, but as these materials have no monetary value it is assumed they are landfilled.

A market development group (MGD) was set up in 2004 under the Governmental policy statement 'Delivering Change'. The aim of this group was to realise the full resource value of all reclaimed recyclable material and to develop innovative outlets to use and obtain optimum value for what is recycled.

The Market Development Programme for Waste Resources 2007–2011 (DoEHLG, 2007b), launched under the MDG, laid down the timetable and tasks for the investigation into and development of markets for the three main waste streams (organics, paper and plastics). However, no reference is made to an SRF output from the MBT process while only passing reference is made to the stabilised output from MBT.

7.2 Stabilised Organic Fraction

As outlined previously, stabilised biowaste is the result of a biological treatment phase (typically composting) through which the degradability of the organic fraction is greatly reduced. The resulting material may be used in limited land applications or can be landfilled.

Article 6 of the Landfill Directive (99/31/EC) requires that all waste going to landfill, with the exception of inert wastes, must be pre-treated. MBT may fulfil this requirement but with the lack of legislative guidance at an EU level the degree of stabilisation required (in Europe) varies from country to country.

The EC *Working Document for the Treatment of Biowaste – 2nd Draft* (EC, 2001), which is now withdrawn, proposed three categories for biologically treated compost material with stabilised biowaste material 'produced from unsorted waste and restricted to use in artificial soil or land use where food or fodder crops are not grown' (European Commission, 2001, p. 8)

This document also proposed a standard for the respiration activity of stabilised organic material prior to landfilling.

At a European level, 'Project Horizontal' aims to harmonise European standards in the fields of sludge, soil and treated biowaste. It is anticipated that the outcomes of this project will provide clear guidance on standards for stabilised biowaste material. Ireland is participating to this project by providing funding and by active participation on the steering committee.

The *National Strategy on Biodegradable Waste* (DoEHLG, 2006) indicates that the stabilised outputs from an MBT process may be used in applications like landfill cover or screening embankments at quarries and landfills.

The *Assessments and Evaluations of Outlets of Compost produced from Municipal Waste* report (EPA, 2002) contains a series of recommendations as to the support for sustainable markets for compost. It introduced the idea of a compost hierarchy with the highest quality product being used in horticultural applications and the lower quality material used under the heading 'other uses'.

These 'other uses' are listed as use in biofilters, acoustic barriers and landfill cover/capping and while no specific reference is made to MBT, it is assumed that the stabilised organic fraction is covered as a lower quality material.

The Irish Composting Association (CRÉ) is currently working on the production of a quality standard which will only apply to source-separated material and will not have any reference to material produced from MBT processes.

Guidance is required to determine the policy Ireland wishes to adopt in relation to the use of a stabilised biowaste material. In simple terms, there are two options that may be followed:

- the stabilisation of organic material to a defined biodegradability prior to landfilling only as adopted in Germany; or
- the achievement of set standards for certain parameters prior to limited land use applications, as well as landfilling, as is the case in Austria.

7.2.1 Austrian Standard

Three classes of compost material of which Class B is produced from non-hazardous mixed waste and which is limited to land reclamation, biofiltration and landfill cover.

In 2006, only 0.3% of total residual waste treated at MBT facilities was used in these applications indicating that even with legislative allowances these outlets may not prove to be viable.

7.2.2 German Standard

Regulatory standard in relation to land application of stabilised organic material is deemed unnecessary as all material is landfilled.

A quality assurance scheme exists for compost produced from green waste and source-separated organics.

7.2.3 UK Standard

The UK operated to the BSI PAS 100 compost standard but this does not include material produced from mixed waste.

British Standard 3882 which covers blended topsoils may provide an outlet for this material as an economy grade topsoil.

A report for the Scottish Executive entitled 'The Use of Stabilised Biowaste in the Restoration of Former Landfill Sites' found that the use of stabilised biowaste for landfill restoration has 'moderate acceptability and is capable of providing useful amounts of organic matter and some plant nutrients' (Scottish Executive, 2005, p. 41)

This report also suggests forestry, restoration or mines and poor quality applications as other uses.

7.2.4 Phytoremediation using SRC

There has been some investigations into combining the requirement for fast-growing biomass plants with organic waste recycling. However, stabilised biowaste material can be high in heavy metals and this is seen as a barrier for the use of material in wider land applications.

However, some biomass plants display a capability known as 'phytoremediation' whereby the levels of heavy metals that may be in a soil can be significantly reduced by the relationship of the plants to the soil in which it grows.

This phytoremediation effect has led to investigations with the use of biomass crops in the remediation of contaminated land sites whereby the biomass crop can have a beneficial effect on the contaminated soil over the duration of the biomass lifetime, where a contaminated land site is found to be suitable for the production of a biomass crop.

The use of stabilised biowaste in the growth of biomass plants on non-contaminated land could also see some development in the future. The nutrients available in the stabilised material would benefit the growth of the plant while the biomass plant itself may reduce heavy metal concentrations to a level that would leave the land in a condition that would be acceptable for alternative land uses after the biomass crop is harvested.

However, the rate of application of a material must be carefully controlled as heavy metals may be applied at a rate greater than they can be removed by a biomass crop, which will lead to accumulation in the soil. Typical short rotation coppice (SRC) plants such as willow have an economic life of 20–25 years.

7.2.5 Land Application in Ireland

In the event of stabilised biowaste/organic material being applied in a land use application, a number of legislative instruments must be adhered to. These are listed below.

Animal By-product Regulations

The European Communities (Transmissible Spongiform Encephalopathies and Animal By Products) Regulation 2008 (S.I. 252) implements Regulation 1774/2002 concerning the health rules for the disposal of animal by products not intended for human consumption.

The veterinary requirements concerning the application of organic fertiliser to land is governed by the Diseases of Animals Act 1966 (Transmissible Spongiform Encephalopathies) (Fertilisers and Soil Improvers) Order 2008 (S.I. No. 253 of 2008).

S.I. No. 253 places certain stipulations on the land application of compost derived from catering waste, former foodstuffs and fish by-products, particularly to pasture land. However, the application to land of stabilised biowaste derived from other animal by-products is prohibited. Accordingly, if the waste processed at an MBT facility is likely to contain animal by-products other than catering waste, former foodstuffs or fish by-products, this material may not be applied to land.

Nitrates Directive (91/676/EEC)

This Directive relates to the protection of waters against pollution by nitrates from agricultural sources and requires the landowner to prepare a Nutrient Management Plan for land to which fertilizers are applied.

If stabilised biowaste is to be applied to agricultural land, directly or in the form of a blended soil, the concentration of nitrates and phosphorous must be determined to establish the nutrient load that it will apply to the land. Composted materials generally release nitrogen more slowly than typical fertilizers which should have a positive effect in relation to the formation of a Nutrient Management Plan. Under S.I. No. 378 of 2006, compost such as material is assumed to have a nutrient availability equal to that of cattle manure, unless an alternative availability level can be agreed with the EPA.

The EPA *Brownfield Site Redevelopment* viewpoint document (2006) identified that there are between 1,900 and 2,300 sites where historical or current industrial activities may pose a risk to soil and groundwater. Assuming the current trend for land development and hence development of brownfield sites continues, this option could provide a short to medium term use for a stabilised biowaste output from MBT as a material to replace contaminated soil or reinstate land banks, subject to clear identification of toxicant and heavy metals concentrations in the biowaste or adherence with any standards that may be adopted. In the longer term, this option is likely to become limited as the number of available sites decrease.

7.2.6 Landfilling of MBT Stabilised Output

The landfilling of MBT stabilised residues poses some technical issues for landfill operators who have, in the past, been used to landfilling only untreated MSW.

The mechanical treatment of the material results in a reduction in the range of particle sizes within the material and a more homogenous structure of fine particles is typically observed. This affects the density and settlement of the material.

Settlement is caused by overburden pressure and microbial degradation of the organic material and given that the majority of organic material has been consumed in a stabilised organic material prior to landfilling, it is likely that settlement in landfills solely consisting of MBT treated material will be considerably reduced and appears more evenly settled compared to settlements of MSW.

The stability of the material with respect to formation of slopes is also affected by the reduced particle size. The angle of traction and angle of friction are important engineering concepts when designing slopes on landfills and these are greatly affected by particle size.

MBT treated material requires different placement techniques than those used for untreated MSW.

7.3 Solid Recovered Fuel (SRF)

The output of the mechanical separation phase of MBT is typically used as a fuel in an incineration plant or co-incinerated, for example, in a cement kiln or power generating plant. At some facilities in Europe, unsuccessful attempts have been made to send this material for recycling but contamination levels are generally too high and materials are deemed unsuitable.

As a general rule, refuse derived fuel (RDF) refers to a high calorific value material that is produced by the mechanical sorting of an MBT process. Over the years, RDF has received bad press due to technical difficulties associated with its incineration and poor combustion performance. The MBT industry then introduced the term SRF in order to market a product that has been produced to tighter quality specifications.

7.3.1 Definition of a Recovered Fuel

The work currently being carried out by the European Committee for Standardisation (CEN) on the formation of a standard for SRF (CEN/TC 343) aims to standardise, across Europe, the classification of solid recovered fuels to establish their acceptability in the fuel market.

CEN/TC 343 proposes the definition of SRF as 'fuel prepared from non-hazardous waste to be used for energy recovery in waste incineration and co-incineration' (CEN 343 Working Group 1 Report, 2007).

While the definition may seem broad-ranging by referring to all non-hazardous waste to be utilised in energy recovery as SRF, the inclusion of the word 'prepared' places the requirement for some extra treatment on the producer.

'Prepared', in the CEN specification, means that the material must be processed, homogenised and up-graded to a quality that can be traded amongst producers and users. This may require the by-product of the MBT process to be further treated to meet the specification that will be laid down in CEN 343.

7.3.2 Thermal Treatment Options in Ireland

As highlighted in previous sections of this report, it can be seen that SRF production in the Landfill Directive target years may range in the order of 950,000 tonnes in 2010, reducing to 750,000 tonnes in 2016 as all waste minimisation, recycling and recovery schemes have taken effect. As its stands, Ireland has no thermal treatment facilities for waste in operation at present, although a number of facilities are in various stages of the planning process:

- A 200,000 tonnes/year facility at Carranstown, Co. Meath which has been granted planning permission. Construction of this facility commenced in July 2008.
- A 200,000 tonnes/year facility in Ringaskiddy, Co. Cork that will process both hazardous and non-hazardous waste.
- A 600,000 tonnes/year facility in Poolbeg, Co. Dublin which has been granted planning permission.
- The South East Region has commenced the preparation of Contract Documents for the procurement of a thermal treatment facility through a Public Private Partnership.
- The 350,000 tonnes/year N7 Resource Recovery Project in Rathcoole, Co. Dublin has lodged a planning application.

The recent government White Paper, published in March 2007 (*Delivering a Sustainable Energy Future for Ireland*) (DCMNR, 2007) sets a target of 30% co-firing in the Midland peat power generation stations to be achieved progressively by 2015. Given that the three peat-power stations consume approximately 3 million tonnes of peat per year, replacement of 30% of this capacity (900,000 tonnes) could be achieved by using SRF material but the quantity that could be used would be dependent on the calorific value, the moisture content and the other physical parameters of the material. In addition, the technical design of the facilities would have to be suitable to effectively facilitate co-firing.

The cement industry may present an option for the co-firing of SRF material but issues such as public perception and uneconomic start-up costs, when compared to other biomass options, may present difficulties for this industry.

7.3.3 Technical Constraints for SRF Incineration/Co-incineration

It is not the case that all SRF materials can be used in all thermal treatment situations – consideration must be given to the chemical and physical qualities of the material such as calorific value, moisture content, particle size and metals and chloride content of the material.

The differing technologies used in cement plants, dedicated waste to energy plants and peat-fired power-generating plants all have differing requirements as to the calorific value, particle size, ash etc. of the SRF material.

It must be borne in mind that all facilities used for the incineration or co-incineration of waste must be fitted with flue-gas cleaning systems in order to comply with the criteria of the Waste Incineration Directive (2000/76/EC).

The long-term quality requirements of any SRF user must be considered in the design phase of an MBT facility so that the various treatment processes can be designed into the facility in order to produce a material that meets the required specification of the thermal treatment process.

7.4 Ferrous and Non-Ferrous Metallic Outputs

The metallic outputs from an MBT process typically amount to between 2% and 4% of input material, depending on the level of metal reclamation employed at a facility.

Ferrous metals are defined as those containing iron and in a typical waste stream would consist of various steels and iron products. They are typically magnetic and are usually separated using magnetic separation whereby conveyors use magnetic belts, rollers or overhead magnets to separate the ferrous component from the waste stream.

Non-ferrous metals in a typical MBT waste stream are aluminium, tin, copper, zinc and alloys such as brass. Precious metals are also non-ferrous. The non-ferrous component is typically separated via eddy current separation where repulsive forces are exerted on the waste stream to remove electrically conductive materials.

The recovery of metallic components can provide a revenue stream to a facility although this is highly dependent on the quality of material recovered.

7.4.1 Current Ferrous Outlets

Since the closure of Irish Ispat in 2001, most ferrous metals recovered in this country are sent for export to continental steel mills. Continental mills are preferred over UK mills due to price and currency stability and the presence of a well-established foreign market.

7.4.2 Current Non-Ferrous Outlets

Most copper metal recovered in Ireland is sent to Belgium while lead and nickel cadmium batteries are exported to the UK. There are a number of merchants and agents dealing in non-ferrous metals in Ireland with access to these well-established markets. E-commerce trading is also popular for the trading of non-ferrous metals.

7.4.3 Future for Metallic Outputs

It is assumed that these well-developed markets will continue to trade. The ability to trade metals recovered through the MBT process will be highly dependent of the quality of the materials recovered.

7.5 Anaerobic Digestion Biogas Production

Anaerobic digestion is normally used in conjunction with an aerobic composting treatment where material is firstly exposed to an anaerobic phase for the production of biogas and the achievement of a certain level of stability and is then followed by the aerobic stabilisation of the solid digestate produced during the anaerobic phase.

Anaerobic digestion is a naturally occurring process whereby organic matter is broken down into its simpler chemical components in the absence of oxygen. It can be broken down into four stages: (i) hydrolysis; (ii) acidogenesis; (iii) acetogenesis; and (iv) methanogenesis which were described in the earlier sections of this report.

Anaerobic digestion may occur in a batch or continuous process, in a single or multi-stage digester and is either a wet or dry process.

A number of process parameters are of importance and must be carefully managed during the AD process such as temperature, pH, carbon-nitrogen ratio, retention time and organic loading rate.

7.5.1 AD Outputs

The AD process produces two outputs – (i) biogas and (ii) a solid digestate material.

Biogas has a methane content of typically between 50 and 75% and a carbon dioxide content of between 25 and 50%. The calorific value of biogas is typically between 17 and 25 MJ/m^3, dependent on methane content, as opposed to approximately 36 MJ/m^3 for natural gas.

Biogas produced through an AD process is generally fed to a combined heat and power (CHP) unit with the heat generated being used to heat the digesters, to sterilize the digestate or to heat facility buildings while the electricity produced can be consumed on-site or sold into the national grid under the REFIT scheme.

Depending on whether a wet or dry process is used, the digestate is produced in two forms – a relatively dry fibre material and a liquor. The dry-fibre material is typically aerobically composted to ensure the required stability prior to whatever disposal or application option is utilised.

7.5.2 REFIT Scheme

The Renewable Energy Feed in Tariff programme supports the construction of 400 MW of new electricity plant by 2010. This scheme offers a reference price of 12 cents per kWh produced for biomass projects under which AD is included.

On the assumption that the mechanical treatment element of the MBT facility removes approximately 50% of the input waste as a SRF, a 100,000 tonnes/year facility will treat 50,000 tonnes of material anaerobically. Dependent on biogas yields and efficiencies of electrical plant, this material has the potential to generate over 15,000,000 kWh of electricity.

7.6 Summary

The stabilised organic fraction produced through the MBT process is generally landfilled or used in some limited land applications. A decision is required as to whether landfilling is to be the only option for this material or whether limited land application is to be allowed in Ireland. Both options require the creation of national standards and criteria which the material must meet prior to either landfilling or land application. Similar standards are in existence in other countries or have been suggested at European level and need to be adopted in Ireland.

CEN TC 343 is developing a European-wide standard for solid recovered fuels that will require SRF produced at an MBT facility to meet certain criteria. Ireland currently has a number of waste-to-energy facilities in the planning process and these facilities will provide an option for the treatment of this material. Co-firing in the peat-powered electricity generation plant in the Midlands is stated government policy and also provides another option for the treatment of SRF material. Certain technical constraints must be considered when SRF is used in the differing thermal treatment processes.

Both ferrous and non-ferrous metals can be recovered during the MBT process. Stable, well developed markets currently exist but the price received will be highly dependent on the quality and cleanliness of the metals produced.

AD biogas can be utilised in a CHP engine to generate heat and electricity. The heat can be used to heat buildings, sterilise waste material or heat digesters while the electricity produced can be consumed on-site with the excess being sold to the national grid under the REFIT scheme.

8 Environmental Impact Appraisal

8.1 Introduction

A comparative environmental assessment was carried out using the UK Environment Agency's WRATE Life Cycle Assessment (LCA) model to quantify and compare the environmental aspects of an MBT-based waste-management system in context with an incineration-centric waste-management system.

The assessment focused on two generic configurations for the MBT plant: (i) aerobic system and (ii) anaerobic-based stabilisation system, both MBT plants produce an SRF fraction, recovered materials for recycling and a stabilised material which is sent to landfill. Emissions from energy from waste (EfW) based configurations were used as a comparator, and to set the emissions from the MBT-centric systems in context.

Two thermal treatment systems were included in the assessment; both were mass-burn, moving-grate plants with one configured for electrical power-only recovery and the other configured for combined heat and power recovery (CHP). In each case a full waste-management scenario was constructed based on the treatment of 100,000 tonnes of household waste collected at the kerbside i.e. three waste streams consisting of dry recyclables, biodegradable material and residual material.

8.2 Methodology

Life cycle assessment (LCA) is a technique for assessing the potential environmental burdens associated with a product or service. The concept of a LCA is as a 'system' assessment of the burdens, with material and energy exchanges to and from the system being counted. WRATE (Waste and Resource Assessment Tool for the Environment) developed by the Environment Agency (UK) has been used as a tool for evaluating the environmental aspects of waste-management activities within predefined system boundaries. It enables a comparison of alternative integrated waste-management systems. LCA is a useful approach to the assessment of waste systems as it addresses a wide range of environmental criteria. In the context of this report, LCA provides a means of comparing the environmental performance of MBT vis-à-vis EfW which is considered as the other viable, alternative residual waste treatment method.

There are limitations to the WRATE model in that it is restricted to existing scientific knowledge, the Environment Agency's research programme and has a limited number of user-entered processes. The major environmental impact categories have been categorised into the following environmental impact categories:

- Human health.
- Ecological toxicity potential.
- Abiotic resource depletion.
- Acidification.
- Eutrophication.
- Global climate change (carbon footprint).

Emissions to air are considered in all the environmental impact categories. Water emissions are considered in the human toxicity and ecological toxicity categories and in eutrophication.

The impact of emissions to each of the categories is defined in terms of a reference compound, for example 'kg CO_2-equivalent' emissions for global warming. A reference conversion factor to the reference compound has been defined for each actual emission compound playing a role in the impact category. This equivalency factor allows each of the emissions to be related back to the reference compound, and to be expressed in terms of the reference compound.

The results of this analysis must not be considered in isolation. The findings are presented to assist in decision making, but it must be considered in parallel to other criteria to be taken into account when a decision on the type of system to be put in place is necessary.

This would include, but not be limited to:

- waste composition;
- land use;
- odour;
- noise;
- employment;
- cost;
- marketability;
- bankability;
- reliability;
- adaptability.

Site- and region-specific factors will also play a part in the decision, including the transport systems, types of collection systems and, in particular, markets and uses available for outputs and products recovered from the systems. The results of LCA studies are normally combined with the factors listed above in project-specific cases, to inform the decision-making process of the project (Table 8.1).

8.3 Scenarios Modelled

Five waste-management systems or scenarios for the treatment of residual waste have been used in this study. Four scenarios have been chosen to reflect the broad choice posed by waste plans in Ireland, the fifth is a baseline scenario entered for comparative purposes. There are many other systems and set-ups for all scenarios, and particularly for the MBT scenarios; however, a full assessment of all of the set-ups is beyond the scope of this study.

Table 8.1: Scenarios Modelled

Baseline	**Landfill Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated to produce compost. The residual bin is sent directly to landfill without further treatment.
Scenario 1	**Aerobic MBT Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated to produce compost. The residual bin is sent for MBT recovering ferrous metal, a recovered fuel and with an aerobic stabilisation step. Stabilised waste is sent to landfill. The high calorific value fraction is separated and sent for use as a fuel (SRF).
Scenario 2	**Anaerobic MBT Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated to produce compost. The residual bin is sent for MBT recovering ferrous metal, a recovered fuel and with an anaerobic stabilisation step yielding a biogas. Stabilised waste is sent to landfill. The high calorific value fraction is separated and sent for use as a fuel (SRF).
Scenario 3	**Thermal (CHP) Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated to produce compost. The residual bin is sent for treatment by incineration with energy recovery; combined heat and power with electricity and commercial heat generated. Incinerator fly ash (APC residue) is sent to landfill, and bottom ash is recycled as aggregate.
Scenario 4	**Thermal- (Power only) Centric**	Three-bin system where dry recyclables (paper, card, dense plastics, metals) and organic waste are collected at the kerbside. Remaining waste is collected in a residual bin. The dry recyclables are sent to a MRF for sorting and sent for recycling, the organic waste is aerobically treated compost. The residual bin is sent for treatment by incineration with energy recovery as electricity exported to the national grid. Incinerator fly ash (APC residue) is sent to landfill, and bottom ash is recycled as aggregate.

8.4 Goal and Scope of Assessment

8.4.1 Goal of Assessment

The purpose of this study is to set in context the likely environmental performance of MBT-based residual waste-management systems. This study is included in the MBT research project so as to inform decision makers as to the likely environmental performance of MBT in comparison to other established residual waste-management systems, such as thermal treatment which has been well established internationally.

8.4.2 Scope of Assessment

This section looks at the impact under human toxicity potential, aquatic toxicity potential, acidification potential, eutrophication potential, abiotic resource depletion and climate change potential.

Human Toxicity Potential (HTP)

The protection of public health is one of the main drivers for a modern waste-management system. While an improvement over the traditional disposal of untreated waste to landfill, the integrated management of waste materials using any process, including recycling, energy recovery or deposit to land, has the potential to generate emissions and consume materials and energy. The emission of certain chemical compounds has the potential to impact on the health of human beings. This section of the appraisal compares the relative human health impacts of each of the scenarios in terms of the volumes of materials released to the environment. The materials considered in the human health category include emission of toxic chemicals to air and water. The toxic materials considered in this assessment include dust, inorganic compounds, volatile organic compounds, heavy metals and dioxin-like compounds.

Freshwater Aquatic Ecotoxicity Potential (FAETP)

This separately considers the emission of toxic chemicals to water ecosystems. The equivalency factors take account of the toxicity, the degradability and the dispersion of the chemical in the environment across water and deposition from air. Account is taken of the fact that emissions to one media can impact on another – for example, an emission to atmosphere may impact on freshwater through precipitation.

Acidification Potential (AP)

The acidification potential is related to the acidifying effect of a chemical on a particular ecosystem as compared to sulphur dioxide (SO_2). The equivalency factors calculated take account of the dispersion of the acid gases and the sensitivities of the receiving ecosystem. The EU National Emissions Ceilings (NEC) Directive (2001/81/EC) now sets down legally binding total emission limits for the release of acidifying gases within each EU member state.

Eutrophication Potential (EP)

Eutrophication results from an excess of key growth-limiting nutrients such as phosphate and nitrate entering rivers, lakes, estuaries or marine waters. This results in an overproduction of biomass such as planktonic floating algae. The eutrophication potential is calculated using an equivalency factor which relates the emission of nutrient compounds to phosphate. This compares the potential contribution of the emission to water as compared to phosphate ($-PO_4$) emissions.

Abiotic Resource Depletion

Abiotic resources are those natural resources (including energy resources) such as metals and fossil fuels, which are of finite nature and are non-living.

The impact of global warming potential (GWP) is examined in greater detail in the following section of this report.

8.5 Unit Processes

8.5.1 Transport and Collection Systems

Each of the scenarios analysed assumes that a source-separated collection system, in the form of a ‘three-bin system’ is in place. Consequently, the collection systems make no significant impact on the differential between the scenarios and as such can be excluded from the study.

The transport of waste between unit processes within the waste-management system is also excluded from the study. Rather than estimate distances or enter arbitrary distances that may skew results, it was decided to exclude the transportation impacts from the study. Experience from similar analysis has shown the transportation emission impacts to be of minor importance in the overall context.

8.5.2 MBT Processes

The MBT facilities recover materials including SRF for use as fuels and metals, and the remaining waste is stabilised to reduce the volume of the organic fraction of the residual waste sent to landfill (or alternatively to produce a compost/soil conditioner). For the purpose of this study it is assumed that the plants have a nominal capacity of 60,000 tpa.

The mixed unsorted waste enters the MBT plant (dry recyclables and some organic material has been collected separately at the kerbside). The process involves shredding, separation of metals by magnetic and eddy current separators for ferrous and non-ferrous metals respectively, air separation for segregation of materials suitable for further material recovery, sieving and homogenisation of organic materials for biological treatment which is either aerobic or anaerobic.

Air emissions are calculated for an air purification system efficiency varying between 23 and 90% by individual species.

8.5.3 Thermal Treatment

The thermal treatment of residual waste outputs from the MBT process was treated similarly to other wastes, with the fractions of waste composition used to calculate emission levels from the thermal treatment plant. It is assumed that the energy recovery from the waste stream will be limited to electricity only for SRF.

Incoming municipal waste vehicles discharge their loads into the municipal waste storage bunker which is kept under negative pressure to avoid the release of dust and odour. Combustion conditions are continuously monitored and controlled to avoid the release of dioxins and furans. Dry urea is injected into the furnace for NOx abatement.

The plant has an inclined reverse-acting grate capable of burning a broad range of waste calorific values without the need for any auxiliary fuel. The bottom ash is quenched and ferrous metals recovered by an overband magnet. After this the residues can be recycled for construction with the non-ferrous metals recovered for recycling.

Flue gas from the combustion process passes to a boiler which converts the energy from the hot gases into steam at 45 bar, 400°C. The steam from the boiler feeds a steam turbine which generates electricity and supplies heat to the (assumed) district heating system.

8.5.4 Electricity Generation

During the processing of the waste, electrical energy is used and is also recovered from the waste stream (e.g. thermal treatment, biogas and landfill gas combustion). The emissions associated with the burning of fossil fuels, such as coal and oil as well as peat and gas are taken into account in the model. The emission per kilowatt-hour is based on the current mix of fuels used in Ireland.

8.5.5 Recycling of Materials

The system boundary used includes the reprocessing and recovery of materials from the waste stream. The material processing occurs within the system up to the point of recycled raw material replacements – that is, metal ingots, granules of plastic resin, granules of glass, etc. The environmental burdens that are associated with the reprocessing of recovered material into raw material are used in the model. This includes significant credits for avoided emissions and also emissions associated with the reprocessing activities.

8.5.6 Waste Composition

For this analysis, the waste composition used was that presented in Section 6.1 of this report. This table indicates the composition of household MSW prior to the application of a three-bin collections system. The WRATE model applies its own separation and collection efficiencies for the different treatment options to the waste stream.

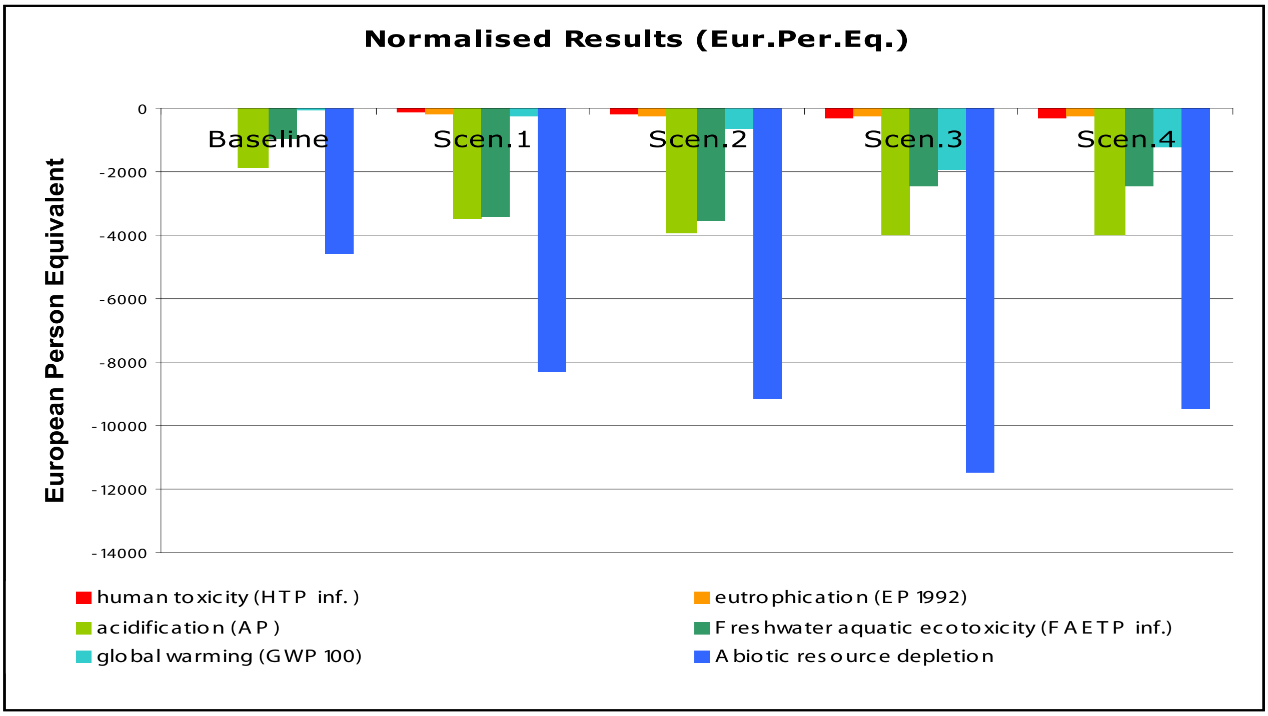

Figure 8.1: Summary of Environmental Aspects for Each Scenario

8.6 Summary of Results

The results in each of the categories have been normalised in comparison to a 'European Person Equivalent'. This allows each environmental aspect to be considered in the terms of the number of average European people equivalent to the emission or impact in that category. While somewhat arbitrary in nature, this allows a comparative assessment of the relative importance of the various categories, and is useful for conceptualising the context of the emissions. The normalised results are given in Figure 8.1. More detail can be found in the end-of-project report.

8.7 Conclusions

The results of the analysis show that, for the majority of impact categories, the treatment of residual waste with MBT or thermal treatment with energy recovery provides a net environmental benefit, provided that the systems employ efficient energy recovery and a significant rate of recycling.

All scenarios show a net benefit, due to the high levels of recycling of source-separated material across all scenarios. This pattern is repeated across all environmental criteria.

The disposal of untreated residual waste from the three-bin system to landfill performs significantly worse than either EfW or MBT scenarios.

Results of the environmental performance assessment suggest that incineration in a high-efficiency CHP configuration, with the recovery of both useable heat and power is the best option across the majority of the impact categories examined.

However, the difference between the systems is largely dependent on energy recovery and the relative closeness in the results suggest that rather than being mutually exclusive – that from an environmental performance point of view, there is likely a role for both approaches within the 'tool-kit' of waste-management options.

There is a need for further study into the emissions and environmental fate of materials in MBT systems.

9 Assessing the Contribution MBT can make to Government Policy on Greenhouse Gas Emissions and Renewable Energy

9.1 Introduction

The Irish government has set out clear targets and objectives in relation to renewable energy and greenhouse gas emissions. MBT may have a potential role to play in the achievement of these targets and objectives and these two sectors, in particular, tend to be strongly interlinked (Figure 9.1).

9.2 Greenhouse Gas Emissions

Human activities since the industrial revolution have increased the levels of naturally occurring gases in the earth's atmosphere to levels where these gases have the ability to increase atmospheric temperatures. These gases allow solar radiation in but trap outgoing radiation, thereby increasing temperatures.

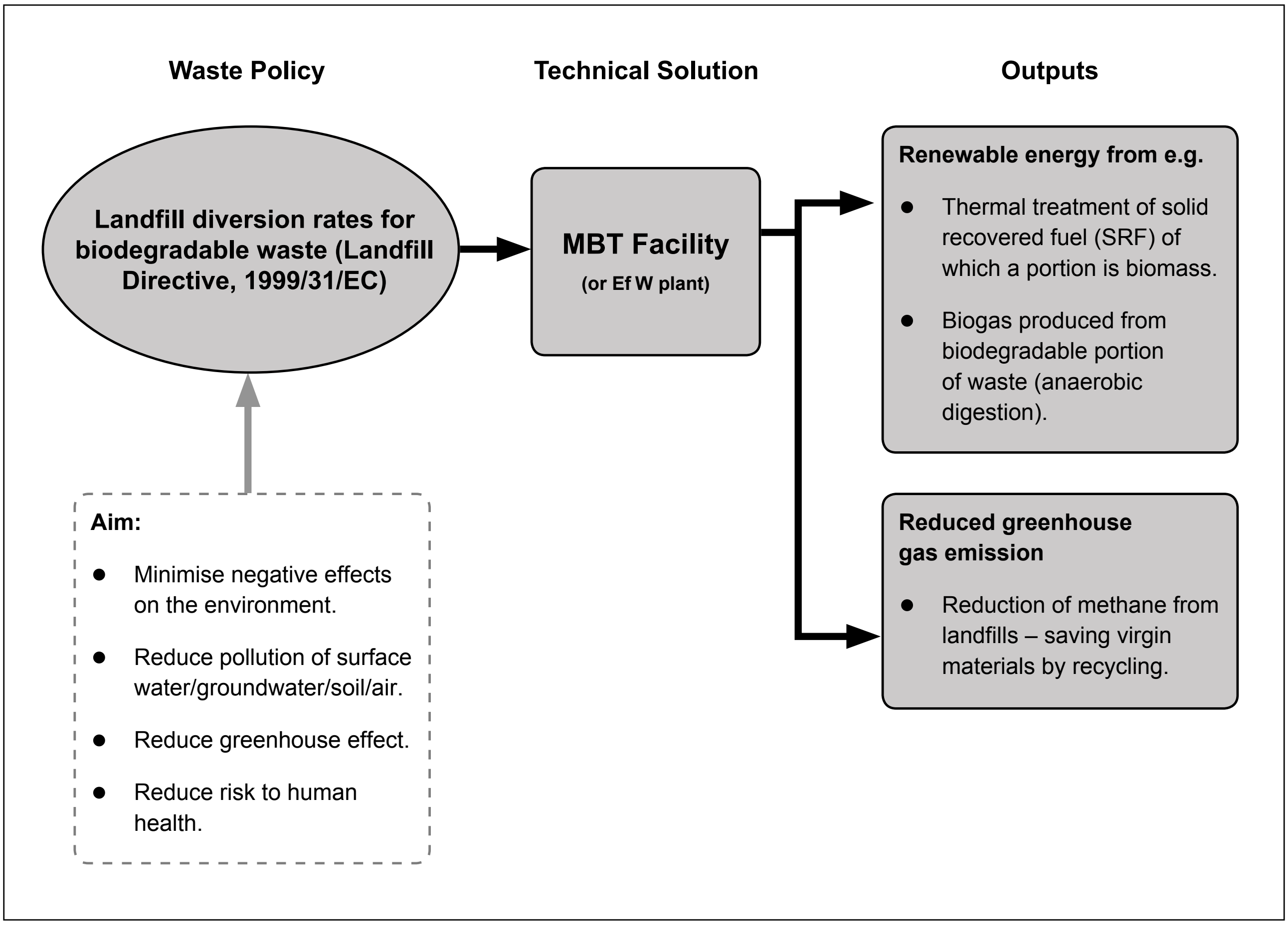

Figure 9.1: Inter-relationship between Legislation, Policy and MBT Outputs

In order to assess the effect of these numerous greenhouse gasses and to allow comparison between them, a baseline has been developed. This is known as CO_2 equivalence (CO_2e) and ensures that all gases can be calculated relative to carbon dioxide.

In relation to waste management, landfill is the biggest contributor to greenhouse gas emissions at present with methane (21 CO_2e) generation from the biodegradation of waste in poorly managed landfills being the main cause within the waste-management sector. However, the Landfill Directive has been a key driver in the modernisation of landfills whereby most landfills now incorporate landfill gas management systems.

Under the Kyoto Protocol, Ireland is obligated to reduce its CO_2 emissions to 13% above 1990 levels by 2010. For the period from 1990–2004, greenhouse gas emissions in Ireland were 23.1% above 1990 levels with waste contributing 2.6% of overall generation.

9.2.1 MBT's Role in Reducing Greenhouse Gas Emissions

The landfilling of the stabilised organic fraction output from the MBT process has the potential to generate methane if this material is not stabilised to a certain degree. The EC *Working Document on the Biological Treatment of Biowaste – 2nd Draft* (EC, 2001) proposed an AT4 level of 10 mgO_2/g as sufficient to ensure that the material has minimal landfill gas generation potential. It also proposed an equivalent DR4 value of 1,000 mgO_2/kg.

Austrian legislation proposes an AT4 limit of 7 mgO_2/g while Germany works with a 5 mgO_2/g limit. Ireland, as yet, has no statutory standard for this material and it is recommended that a standard for the same be adopted.

It should be considered that an AT4 limit of 10 mgO_2/g as proposed in the Working Document is a reasonable limit value given that the MBT industry is not yet established in Ireland and that the industry may not be best well served by the imposition of the higher standards as seen in Austria and Germany where the industry is well developed.

Table 9.1: Required Treatment Time for MSW in MBT Facilities

Process	Respiration activity <5 mgO_2/g DM (German/Austrian Limits) AT4	Respiration activity <10 mgO_2/g DM AT4
Composting (aerobic)	8–16 weeks	5–8 weeks
Anaerobic digestion & composting	2–3 weeks AD 4–10 weeks composting	2–3 weeks AD 2–5 weeks composting

Source: Muller & Bulson, 2005

Table 9.2: Comparison of Treatment Times

Process	Duration	Observed respiration activity (DR4 – mgO_2/kg)
Aerobic Tunnel Technology	6 weeks	86,000 mgO_2/kg
Aerobic Agitated Halls	8 weeks	21,481 mgO_2/kg
Aerobic Rotary Drums	12 weeks	195,000 mgO_2/kg NOTE 1
Aerobic tunnels / anaerobic digestion	3 weeks (AD) + 8 weeks (aerobic) = 11 weeks	8,889 mgO_2/kg
Biodrying	2 weeks	n/a

Note 1 – Material remaining after mechanical separation is mixed with greenwaste at differing times and aerobically composted. This does not allow for accurate comparison with the times quoted in Table 9.1.

Table 9.1 indicates the typical timeframe required for the attainment of the required stability limits as suggested by Muller and Bulson (2005). Table 9.2 indicates the observed respiration levels at the case study facilities referenced in this report. The results presented in Table 9.2 suggest that close consideration should be given to the determination of process residence times when designing any MBT facility.

These treatment times can be compared to those observed in the case study facilities examined in the earlier sections of this report. While Muller and Bulson (2005) refers to respiration activity as measured using the AT4 method and the case study facilities report respiration activity in DR4, the figure of 1,000 mgO_2/kg for DR4 as suggested in the EC *Working Document for the Treatment of Biowaste – 2nd Draft* (EC, 2001) should be borne in mind as an approximate comparison.

In the preceding sections of this report, the environmental impact of a number of waste-management scenarios were modelled in order to determine the impact of MBT processes in comparison to EfW processes. The impact of the landfilling of stabilised waste from the MBT processes were not included in the environmental impact assessments as there is a limited amount of data available on the behaviour of this material when landfilled in terms of gas production.

9.2.2 Comparison of Greenhouse Gas Emissions from MBT, Landfill and EfW Facilities

Four scenarios were outlined in the life-cycle assessment carried out earlier in this report:

- Scenario 1 – Plastic-rich SRF, aerobic composting with biostabilised output to landfill.
- Scenario 2 – Plastic-rich SRF, anaerobic biogas production with digestate.
- Scenario 3 – Thermal treatment of residual waste with combined electricity and heat production.
- Scenario 4 – Thermal treatment of residual waste with electricity production only.

The greenhouse gas emissions from each scenario are outlined in Table 9.3.

This table indicates that, compared to a baseline landfill situation, thermal treatment with combined heat and power generation (Scenario 3), seems to perform the best from the point of view of emissions of greenhouse gases, although both MBT scenarios perform considerably better in comparison to the baseline landfill scenario.

9.3 Renewable Energy Production

Ireland is committed to providing 13.2% of its electricity from renewable sources by 2010 under Directive (2001/77/EC). Under this Directive, a renewable energy source includes the biodegradable fraction of industrial and municipal waste. MBT can contribute to the achievement of these renewable targets through the generation of biogas using anaerobic digestion and by the production of SRF material during the mechanical separation process.

Biogas produced through AD is combusted in a gas-fired engine to produce electricity which can be consumed on-site, with excess electricity sold to the national grid. The gas engines can be part of a co-generation arrangement where the heat produced during the combustion of the biogas can be used to heat buildings or for the reheat of the digesters. This arrangement is known as combined heat and power (CHP).

CHP is recognised as an efficient way of reducing CO_2 emissions while producing the same amount of useful energy (electricity and heat) as achieved by traditional fossil fuel burning. Since biogas produced through the AD process comes from a source with a short carbon cycle and, given that it is not released to the atmosphere, AD biogas does not contribute to the increase in atmospheric greenhouse gas emissions.

The combustion of biogas also comes under the remit of the REFIT (Renewable Energy Feed in Tariff) scheme in that excess electricity sold into the grid can command a price of 12 cent per kW produced and therefore has the potential to provide an income source for a facility.

Table 9.3: Estimation of Greenhouse Gas Emissions in Scenarios 1–4

	SCENARIO 1	SCENARIO 2	SCENARIO 3	SCENARIO 4	Baseline - Landfilling of residual waste without pre-treatment
Emission energy use	**All units in kg CO_2-eq**				
Energy use of facility	32	45	45	45	0
Diesel consumption	3	3	0	0	0
Offset energy production					
Electricity (incineration)	-240	-240	-283	-368	
Electricity (biogas)		-53			-87
Heat (Incineration)			-359		
Offset from recyclables					
Ferrous metal	-5	-5	-5	-5	
Non-ferrous metal	-126	-126	-126	-126	
Glass	-23	-23			
Compost					
Direct emission of greenhouse gases					
Emission of CO_2 from combusted fossil carbon	377	377	397	397	0
Emission of methane from facility	0	7	0	0	0
Emission of methane from landfill	105	105	0	0	638
Emission of N_2O from facility	31	31	3	3	0
	SCENARIO 1	**SCENARIO 2**	**SCENARIO 3**	**SCENARIO 4**	**Baseline - Landfilling of residual waste without pre-treatment**
Emission energy use	**All units in kg CO_2-eq**				
Offset from sequestration					
Sequestrated carbon in landfills - fossil C	-20	-20	0	0	-37
Sequestrated carbon in landfills - biogenic C	-92	-92	0	0	-397
Total emission					
Total emission (excl. sequestrated carbon)	154	121	-327	-53	550
Total emission (incl. sequestrated carbon)	42	10	-327	-53	116

The biodegradable fraction of the SRF material produced during the mechanical separation process (i.e. paper and cardboard) is considered biomass under Directive (2001/77/EC) and as such the thermal treatment of this material, through co-firing or dedicated incineration, will contribute to achieving the target of (2001/77/EC). To be more exact, it is the biodegradable portion of the SRF material (between 60 and 80%) that will be considered as a renewable biomass material. The contribution of this portion to the renewable energy targets of 2001/77/EC is likely to be calculated based on the calorific value of this portion in comparison with the overall calorific value of the SRF.

The thermal treatment of this material in a co-firing arrangement, as recommended in the 2006 Bioenergy Action Plan for the national peat-fired electricity-generating stations, does not come under the remit of the REFIT scheme. However, REFIT is being expanded to include new waste to energy projects.

Waste-management activities in the period of 1990–2004 were responsible for 2.6% of overall greenhouse gas emissions in Ireland. Within the sector, landfill is the major source of greenhouse gas emissions through the release of methane from landfilling activities. MBT can contribute to the reduction of methane emissions from landfills by the biodegradation of organic material in residual waste to a required stability standard. Ireland currently lacks a regulatory standard of this nature and a standard such as this is a necessity in the future if MBT processes are to be demonstrably seen to be an effective contributor to the reduction of greenhouse gas emissions in line with our obligations under the Kyoto Protocol.

Ireland is also committed to the generation of 13.2% of its domestic electricity by renewable sources by 2010 under EU Directive 2001/77/EC. MBT may have the potential to contribute to the achievement of this target in two ways:

- through the thermal treatment or co-firing of SRF material of which the biomass portion is deemed a renewable energy source;
- through the generation of electricity and heat through the combustion of AD produced biogas in a gas-fired engine as part of a CHP plant.

10 Whole Life-cycle Costs of MBT Compared to Whole Life-cycle Costs of Thermal Treatment

10.1 Introduction

When assessing waste treatment technologies and scenarios, especially those for which there may be strong opposing views, assessment must be based on evidence which is unbiased and inclusive of all relevant information and parameters to be evaluated.

Cost analysis is required to determine the economic scenario in which a facility may be developed and to secure financial backing for the development. Where another viable option exists, a comparison is useful to compare the financial performance of each and in the case of the Mechanical Biological Treatment of residual waste, thermal treatment is the only viable alternative at present.

10.2 Baseline Assumptions for the Whole Life Cycle Cost Model

For the purposes of whole life cost comparison, the following assumptions are made:

- Price level – 2007, Ireland.
- Capital costs – Purchase of site, site preparation, planning, tendering and client's representatives, civil works, mechanical and electrical works, commissioning, mobilisation.
- Operation costs – Cost of financing, all-inclusive cost of staff, cost of typical planned and incidental maintenance and repair, up-keep of facility and grounds, typical external services, consumables, disposal of residues etc.
- Revenues include – Gate fees, net sale of energy, net sale of recyclables.
- EfW plant – 150,000 tpa, 8,000 hours/annum, single line unit, Waste Incineration Directive compliant, semi-dry APC with activated carbon and SNCR de-NOx process, producing power only.
- MBT plant – 150,000 tpa, 5,000 h/a, fully enclosed mechanical sorting focused on optimised SRF production based on anaerobic digestion followed by aerobic tunnel composting and open windrow composting and final landfilling of stabilised organic residue (Output: biogas, recyclables, SRF and stabilised organic residue).
- Environmental incentives – The possible use of carbon emission reduction trading schemes and similar, whilst being important, are omitted from the operational costs, as these are not well-defined at the moment and as such fiscal initiatives or trading schemes are relatively new or may change in concept and value of impact.
- Economic life – 15 years.
- Procurement – Traditional procurement and operation.

10.3 Estimation of Whole-life Costs

In order to estimate whole-life costs, two types of facilities were examined. The MBT facility chosen is the facility located at Pohlsche Heide in Germany, as highlighted in the previous sections of this report. This utilises mechanical treatment followed by both anaerobic and aerobic treatment of the organic waste fraction.

The thermal treatment facility utilises a moving grate, dry flue gas cleaning system with SCR De Nox system and is located in Malmo in Sweden.

Costs are very sensitive to:

- The cost of landfill disposal of residues (i.e. air pollution control (APC) residue and biostabilised MBT residue).

Table 10.1: Comparison of MBT vs EfW

		MBT	EfW
Capital costs €		**72,840,000**	**117,550,000**
	€/tpa	486	784
O&M*	€/year	**11,030,000**	**6,880,000**
Revenue	€/year	**-620,000**	**-6,630,000**
Net O&M	**€/year**	**10,410,000**	**250,000**
	€/tonne	**69**	**2**
Gate fee	**€/t**	**118**	**80**

*Operation & Maintenance

- Whether it is assumed that most or some of the bottom ash from EfW can be recycled for e.g. road construction, after sorting and maturation.
- Whether it is assumed that sale of SRF will generate net revenue, or as the case is in Germany today will require €60–90 per tonne in payment to cement works or similar for utilisation of the SRF.
- The quantity and quality of the recovered material (in particular aluminium) and the price per tonne of recovered material that can be achieved.
- Policy and legislative changes that may, e.g. require additional biostabilisation of the MBT residue, additional treatment of EfW bottom ash, capturing of all off-gasses at the MBT plant and retrofitting of regenerative thermal-oxidation (RTO), etc.
- The value of power and, if relevant, heat, that can be produced and sold.

Each of these items can have a significant impact on the overall life-cycle costs and are likely to be influenced by changes in political priorities and development in market prices over the lifetime of a facility.

The outcome of the whole life cost comparison is tabulated in the Table 10.1. The suggested gate fee represents a break-even scenario.

The capital investment is significantly lower for an MBT plant than for an EfW plant. However, the corresponding break even gate fee is significantly higher for an MBT plant than for an EfW plant due to the relatively high operation and maintenance (O&M) costs and reduced revenue due to the assumed absence of income from sale of power (assuming all electricity is consumed on-site).

10.4 Sensitivity Analysis

As identified, the whole life-cycle costs are sensitive to a number of factors.

Of the sensitivity analyses carried out, perhaps the one that shows the greatest potential for effect on gate fee (for MBT) is that in relation to the cost of utilising the SRF. The whole life-cycle cost for MBT is based on there being a cost associated with the utilisation of SRF at a thermal treatment/cement production facility (taken as €60/tonne in the cost analysis).

This is the current situation in Germany where thermal treatment capacity has not grown in line with SRF generation and, as a result, the operators of the thermal treatment facilities are in a position to charge a reasonably high gate fee for the acceptance of SRF at their facilities. However, the situation in Ireland is less clear at the moment given that there are no thermal treatment facilities in existence and that the gate fee that may be charged at these facilities, if operational, is unknown.

If a situation exists in Ireland that the cost of utilising the SRF material is lower than the €60/tonne used in the whole life-cycle costing, or indeed if the cost is neutral, then the break-even gate fee for MBT would compare more favourably to that for EfW (Figure 10.1).

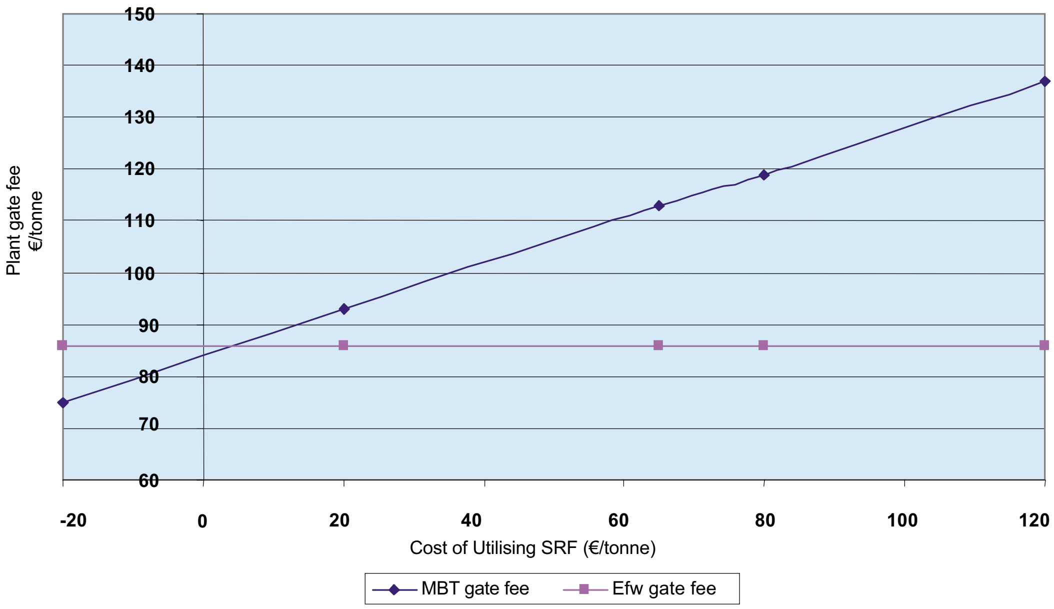

Figure 10.1: Gate Fee of MBT vs EfW depending on cost of SRF Disposal

10.5 Summary

Based on the assumptions outlined in this project (Chapter 11 of the end-of-project report), it appears that MBT over the life of a project is more expensive than EfW as a residual waste treatment technology. However, the investment cost is highest for EfW whereas the cost of operation is highest for MBT, which is why the overall whole-life-cost is higher for MBT than for EfW.

MBT may also be described as more flexible in that a facility could, for example, treat a source-separated waste stream (subject to keeping material flow separate) which may increase revenue through sale of a compost product and generation of excess biogas that could be used for sale of power.

These calculations, however, do not include the cost of planning, or whether EfW or MBT actually can be delivered at a particular site.

In the event of SRF utilisation cost being lower than the €60/tonne used in the cost models, or indeed if SRF generated net revenue, then MBT may be cheaper in whole life costs than EfW provided that:

- the price obtained for the sale of electricity produced by an EfW is lower than the price obtained from the sale of electricity produced by an MBT facility;
- there is no sale of heat from EfW; and
- bottom ash cannot be recycled.

11 Review of Common Perceptions of MBT and EfW

11.1 Common Perceptions Related to MBT and EfW

Table 11.1 presents some of the common positive and negative perceptions of MBT and energy from waste (EfW). It is beneficial to consider these perceptions when deciding on the relative merits of each technology as a method for the treatment of residual waste. As has been seen, the Dublin WMR has indicated a clear preference for energy from waste as the treatment method for residual waste treatment while the Cork Region favours an MBT-based approach.

When deciding on the preferred approach, each Region will have analysed the relative strengths and weaknesses of each technology and the fact that different technologies were chosen is an indication that what may be seen as strengths of one technology in one location may not be perceived the same way in another and vice versa.

Table 11.1: Positive and Negative Perceptions of MBT and EfW

	Mechanical Biological Treatment	Energy from Waste
Positive perceptions	• The return of organic matter to earth is best practice, assuming suitability. • Little environmental nuisance. • The release of CO_2 generated by the landfilled stabilised organic MBT residue is attenuated over many years which delays the impact on the climate. • Production of energy from SRF results in reduced CO_2 emissions due to replacement of fossil fuels. • MBT technologies can be configured to maximise recycling. • If anaerobic digestion is employed, the biogas produced can be used for a range of applications e.g. CHP, vehicle fuel. • Biodegradable content of SRF is deemed 'biomass' under Renewable Energy legislation. • Pre-treatment of residual waste aids in the achievement of Landfill Directive 99/31/EC on the landfill of waste.	• Production of energy from waste is the right thing to do and results in saved CO_2 emissions minimising the use of fossil fuels and reducing the greenhouse gas effect. • It is the only technology that can minimise the need for landfill space and associated pollution from landfills in the form of greenhouse gases and leachate. • Large net energy production of which a fraction can be deemed renewable (dependent on input waste stream). • Bottom ash can be recycled in road construction etc. reducing the need for landfill space to 1–2% of the input to the process. • Pre-treatment of residual waste aids in the achievement of Directive 99/31/EC on the landfill of waste.
Negative perceptions	• The stabilised waste is contaminated and must be landfilled. • The SRF, if produced, is difficult to market and disposal costs can be high despite high calorific value. • Plants using SRF as fuel must invest in retrofitted flue gas cleaning equipment. • A large part of the input still needs to be landfilled and requires landfill capacity. • The stabilised organic fraction is not fully stabilised and continues to generate landfill gas generation for decades in landfills. • High energy consumption due to highly mechanised plant. • Frequent stops due to wear and mechanical failure of key plant components. • Quality of mechanically recovered recyclables is poor and yields no or little income. • No or limited net energy production. • Odour problems.	• All waste is converted into CO_2 which contributes to climate change. • Neighbouring communities and NGOs are opposed to EfW. • Dioxin and other pollutants are emitted into the air affecting public health and environment. • Incineration reduces the need and incentive for recycling. • If heat cannot be utilised EfW is very costly. • Visual impact of plant is negative, especially stack and visible vapour emissions. • Odour problems.

11.2 Summary of Common Perceptions

While it is difficult to make a sound decision for or against MBT and EfW without a full understanding of the positives and negatives of each, it is clear that:

- The best quality of recyclables and the least expense for generating such recyclables is achieved by source-separation rather than sorting of mixed waste. However, considerable advances have been achieved in terms of mechanical sorting of waste compared to only 10 years ago.
- Any integrated waste-management system should consist of several mutually complementary waste treatment technologies.
- Both MBT and EfW facilities have strengths and weaknesses.
- Successful implementation of any multi-faceted waste-management system that focuses on a high degree of waste recovery and minimum landfilling requires a highly well-organised and regulated waste-management sector.

Such a well-organised waste-management sector should be characterised by:

- the ability to make capital-intensive investments based on certainty of a significant minimum waste supply;
- environmental and performance based regulatory requirements as well as fiscal tools that provide a well defined long-term business background for investing and operating particular waste-management facilities; and
- a transparent and manageable planning and permitting regime for waste-management facilities that allows for the construction and operation of compliant and desirable infrastructure at technically suitable locations.

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An Ghníomhaireacht um Chaomhnú Comhshaoil

Is í an Gníomhaireacht um Chaomhnú Comhshaoil (EPA) comhlachta reachtúil a chosnaíonn an comhshaol do mhuintir na tíre go léir. Rialaímid agus déanaimid maoirsiú ar ghníomhaíochtaí a d'fhéadfadh truailliú a chruthú murach sin. Cinntímid go bhfuil eolas cruinn ann ar threochtaí comhshaoil ionas go nglactar aon chéim is gá. Is iad na príomh-nithe a bhfuilimid gníomhach leo ná comhshaol na hÉireann a chosaint agus cinntiú go bhfuil forbairt inbhuanaithe.

Is comhlacht poiblí neamhspleách í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) a bunaíodh i mí Iúil 1993 faoin Acht fán nGníomhaireacht um Chaomhnú Comhshaoil 1992. Ó thaobh an Rialtais, is í an Roinn Comhshaoil agus Rialtais Áitiúil a dhéanann urraíocht uirthi.

ÁR bhFREAGRACHTAÍ

CEADÚNÚ

Bíonn ceadúnais á n-eisiúint againn i gcomhair na nithe seo a leanas chun a chinntiú nach mbíonn astuithe uathu ag cur sláinte an phobail ná an comhshaol i mbaol:

- áiseanna dramhaíola (m.sh., líonadh talún, loisceoirí, stáisiúin aistrithe dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh., déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- diantalmhaíocht;
- úsáid faoi shrian agus scaoileadh smachtaithe Orgánach Géinathraithe (GMO);
- mór-áiseanna stórais peitreail.

FEIDHMIÚ COMHSHAOIL NÁISIÚNTA

- Stiúradh os cionn 2,000 iniúchadh agus cigireacht de áiseanna a fuair ceadúnas ón nGníomhaireacht gach bliain.
- Maoirsiú freagrachtaí cosanta comhshaoil údarás áitiúla thar sé earnáil - aer, fuaim, dramhaíl, dramhuisce agus caighdeán uisce.
- Obair le húdaráis áitiúla agus leis na Gardaí chun stop a chur le gníomhaíocht mhídhleathach dramhaíola trí comhordú a dhéanamh ar líonra forfheidhmithe náisiúnta, díriú isteach ar chiontóirí, stiúradh fiosrúcháin agus maoirsiú leigheas na bhfadhbanna.
- An dlí a chur orthu siúd a bhriseann dlí comhshaoil agus a dhéanann dochar don chomhshaol mar thoradh ar a ngníomhaíochtaí.

MONATÓIREACHT, ANAILÍS AGUS TUAIRISCIÚ AR AN GCOMHSHAOL

- Monatóireacht ar chaighdeán aeir agus caighdeáin aibhneacha, locha, uiscí taoide agus uiscí talaimh; leibhéil agus sruth aibhneacha a thomhas.
- Tuairisciú neamhspleách chun cabhrú le rialtais náisiúnta agus áitiúla cinntí a dhéanamh.

RIALÚ ASTUITHE GÁIS CEAPTHA TEASA NA HÉIREANN

- Cainníochtú astuithe gáis ceaptha teasa na hÉireann i gcomhthéacs ár dtiomantas Kyoto.
- Cur i bhfeidhm na Treorach um Thrádáil Astuithe, a bhfuil baint aige le hos cionn 100 cuideachta atá ina mór-ghineadóirí dé-ocsaíd charbóin in Éirinn.

TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Taighde ar shaincheisteanna comhshaoil a chomhordú (cosúil le caighdéan aeir agus uisce, athrú aeráide, bithéagsúlacht, teicneolaíochtaí comhshaoil).

MEASÚNÚ STRAITÉISEACH COMHSHAOIL

- Ag déanamh measúnú ar thionchar phleananna agus chláracha ar chomhshaol na hÉireann (cosúil le pleananna bainistíochta dramhaíola agus forbartha).

PLEANÁIL, OIDEACHAS AGUS TREOIR CHOMHSHAOIL

- Treoir a thabhairt don phobal agus do thionscal ar cheisteanna comhshaoil éagsúla (m.sh., iarratais ar cheadúnais, seachaint dramhaíola agus rialacháin chomhshaoil).
- Eolas níos fearr ar an gcomhshaol a scaipeadh (trí cláracha teilifíse comhshaoil agus pacáistí acmhainne do bhunscoileanna agus do mheánscoileanna).

BAINISTÍOCHT DRAMHAÍOLA FHORGHNÍOMHACH

- Cur chun cinn seachaint agus laghdú dramhaíola trí chomhordú An Chláir Náisiúnta um Chosc Dramhaíola, lena n-áirítear cur i bhfeidhm na dTionscnamh Freagrachta Táirgeoirí.
- Cur i bhfeidhm Rialachán ar nós na treoracha maidir le Trealamh Leictreach agus Leictreonach Caite agus le Srianadh Substaintí Guaiseacha agus substaintí a dhéanann ídiú ar an gcrios ózóin.
- Plean Náisiúnta Bainistíochta um Dramhaíl Ghuaiseach a fhorbairt chun dramhaíl ghuaiseach a sheachaint agus a bhainistiú.

STRUCHTÚR NA GNÍOMHAIREACHTA

Bunaíodh an Ghníomhaireacht i 1993 chun comhshaol na hÉireann a chosaint. Tá an eagraíocht á bhainistiú ag Bord lánaimseartha, ar a bhfuil Príomhstiúrthóir agus ceithre Stiúrthóir.

Tá obair na Gníomhaireachta ar siúl trí ceithre Oifig:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig um Fhorfheidhmiúchán Comhshaoil
- An Oifig um Measúnacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáide

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag ball air agus tagann siad le chéile cúpla uair in aghaidh na bliana le plé a dhéanamh ar cheisteanna ar ábhar imní iad agus le comhairle a thabhairt don Bhord.

NDP

National Development Plan 2007 - 2013

Science, Technology, Research and Innovation for the Environment (STRIVE) 2007-2013

The Science, Technology, Research and Innovation for the Environment (STRIVE) programme covers the period 2007 to 2013.

The programme comprises three key measures: Sustainable Development, Cleaner Production and Environmental Technologies, and A Healthy Environment; together with two supporting measures: EPA Environmental Research Centre (ERC) and Capacity & Capability Building. The seven principal thematic areas for the programme are Climate Change; Waste, Resource Management and Chemicals; Water Quality and the Aquatic Environment; Air Quality, Atmospheric Deposition and Noise; Impacts on Biodiversity; Soils and Land-use; and Socio-economic Considerations. In addition, other emerging issues will be addressed as the need arises.

The funding for the programme (approximately €100 million) comes from the Environmental Research Sub-Programme of the National Development Plan (NDP), the Inter-Departmental Committee for the Strategy for Science, Technology and Innovation (IDC-SSTI); and EPA core funding and co-funding by economic sectors.

The EPA has a statutory role to co-ordinate environmental research in Ireland and is organising and administering the STRIVE programme on behalf of the Department of the Environment, Heritage and Local Government.

epa Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

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