Mechanical Biological Treatment of Municipal Solid Waste

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Department for Environment Food and Rural Affairs

Contents

Prepared by Enviros Consulting Limited on behalf of Defra as part of the New Technologies Supporter Programme.

We acknowledge support from the Department for Environment, Food & Rural Affairs (Defra), the Department of Communities & Local Government (DCLG), the Environment Agency (EA) and BeEnvironmental Ltd.

Cover image (MBT facility in Lübbecke, Germany) courtesy of Gesellschaft zur Verwertung organischer Abfälle (GVoA) mbH Co. KG.

Preamble

This Waste Management Technology Brief, updated in 2007, is one of a series of documents prepared under the New Technologies work stream of the Defra Waste Implementation Programme. The Briefs address technologies that may have an increasing role in diverting Municipal Solid Waste (MSW) from landfill. They provide an alternative technical option as part of an integrated waste strategy, having the potential to recover materials & energy and reduce the quantity of MSW requiring final disposal to landfill. Other titles in this series include: An Introductory Guide to Waste Management Options, Advanced Biological Treatment, Mechanical Heat Treatment, Advanced Thermal Treatment, Incineration, Renewable Energy and Waste Technologies, and Managing Outputs from Waste Technologies.

The prime audience for these Briefs are local authorities, in particular waste management officers, members and other key decision makers for MSW management in England. It should be noted that these documents are intended as guides to each generic technology area. Further information can be found at the Waste Technology Data Centre, funded by the Defra New Technologies Programme and delivered by the Environment Agency (www.environment-agency.gov.uk/wtd). These Briefs deal primarily with the treatment and processing of residual MSW. Information on the collection and markets for source segregated materials is available from Defra and from ROTATE (Recycling and Organics Technical Advisory Team) at the Waste & Resources Action Programme (WRAP).

These waste technologies can assist in the delivery of the Government's key objectives, as outlined in *The Waste Strategy for England 2007,* for meeting and exceeding the Landfill Directive diversion targets, and increasing recycling of resources and recovery of energy

The Defra New Technologies Demonstrator Programme has provided nine projects aimed at proving the economic, social and environmental viability (or not) of a selection of waste management technologies. For information on the demonstrator projects see the Defra website or email Wastetech@enviros.com.

1. Introduction

Municipal Solid Waste (MSW) is waste collected by or on behalf of a local authority. It comprises mostly household waste and it may include some commercial and industrial wastes. Historically, the quantity of MSW has risen year on year[1], presenting a growing problem for local authorities particularly as legislation that limits (by implication[2]) the amount of mixed MSW that can be sent to landfill, becomes more stringent over time.

One of the guiding principles for European and UK waste management has been the concept of a hierarchy of waste management options, where the most desirable option is not to produce the waste in the first place (waste prevention) and the least desirable option is to dispose of the waste to landfill with no recovery of either materials and/or energy. Between these two extremes there are a wide variety of waste treatment options that may be used as part of a waste management strategy to recover materials (for example furniture reuse, glass recycling or organic waste composting) or generate energy from the wastes (for example through incineration, or digesting biodegradable wastes to produce usable gases).

At present more than 62% of all MSW generated in England is disposed of in landfills[3]. However, European and UK legislation has been put in place to limit the amount of biodegradable municipal waste (BMW) sent for disposal in landfills[4]. The Landfill Directive also requires waste to be pre-treated prior to disposal. The diversion of this material is one of the most significant challenges facing the management of MSW in the UK.

There are a wide variety of alternative waste management options and strategies available for dealing with MSW to limit the residual amount left for disposal to landfill. The aim of this guide is to provide impartial information about the range of technologies referred to as Mechanical Biological Treatment (MBT). MBT technologies are pre-treatment technologies which contribute to the diversion of MSW from landfill when

1 This is now showing signs of slowing down and in some areas waste arisings are falling, and indeed in 2005/6 there was a 3% fall nationally. However, this may be partly explained by other factors occurring in that particular financial year.
2 Targets pertain to the biodegradable fraction in MSW
3 Results from WasteDataFlow http://www.defra.gov.uk/environment/statistics/wastats/bulletin.htm
4 The Landfill Directive, Waste and Emissions Trading Act 2003 and Landfill Allowances Trading Scheme Regulations

1. Introduction

operated as part of a wider integrated approach involving additional treatment stages. They are part of a range of alternatives currently being assessed and investigated through the New Technologies work stream of Defra. Further details about the new technologies featured in this report are available from Defra's Waste Technology Data Centre:

http://www.environment-agency.gov.uk/wtd

The technologies described in this Brief have a varying track record in the UK. Early examples of similar processes in the UK included 'Refuse Derived Fuel' (RDF) processing plant and residual waste Materials Recovery Facilities ('Dirty MRFs'). This early generation of mixed waste processing facilities often encountered technical and marketing difficulties during operation and most have closed or been reconfigured. The new MBT technologies are now second or third generation plant including many well proven examples. On the continent many of these processes are established, viable and bankable. The aim of this document is to raise awareness and help bring the UK up to that standard.

This guide is designed to be read in conjunction with the other Waste Management Technology Briefs in this series and with the case studies provided on the Waste Technology Data Centre. Other relevant sources of information are identified throughout the document.

2. How it works

MBT is a generic term for an integration of several processes commonly found in other waste management technologies such as Materials Recovery Facilities (MRFs), sorting and composting or anaerobic digestion plant. MBT plant can incorporate a number of different processes in a variety of combinations. Additionally, MBT plant can be built for a range of purposes. This section provides an overview of the range of techniques employed by MBT processes.

2.1 The Aim of MBT Processes

MBT is a residual waste treatment process that involves both mechanical and biological treatment processes. The first MBT plants were developed with the aim of reducing the environmental impact of landfilling residual waste. MBT therefore compliments, but does not replace, other waste management technologies such as recycling and composting as part of an integrated waste management system.

A key advantage of MBT is that it can be configured to achieve several different aims. In line with the EU Landfill Directive and national recycling targets, some typical aims of MBT plants include the:

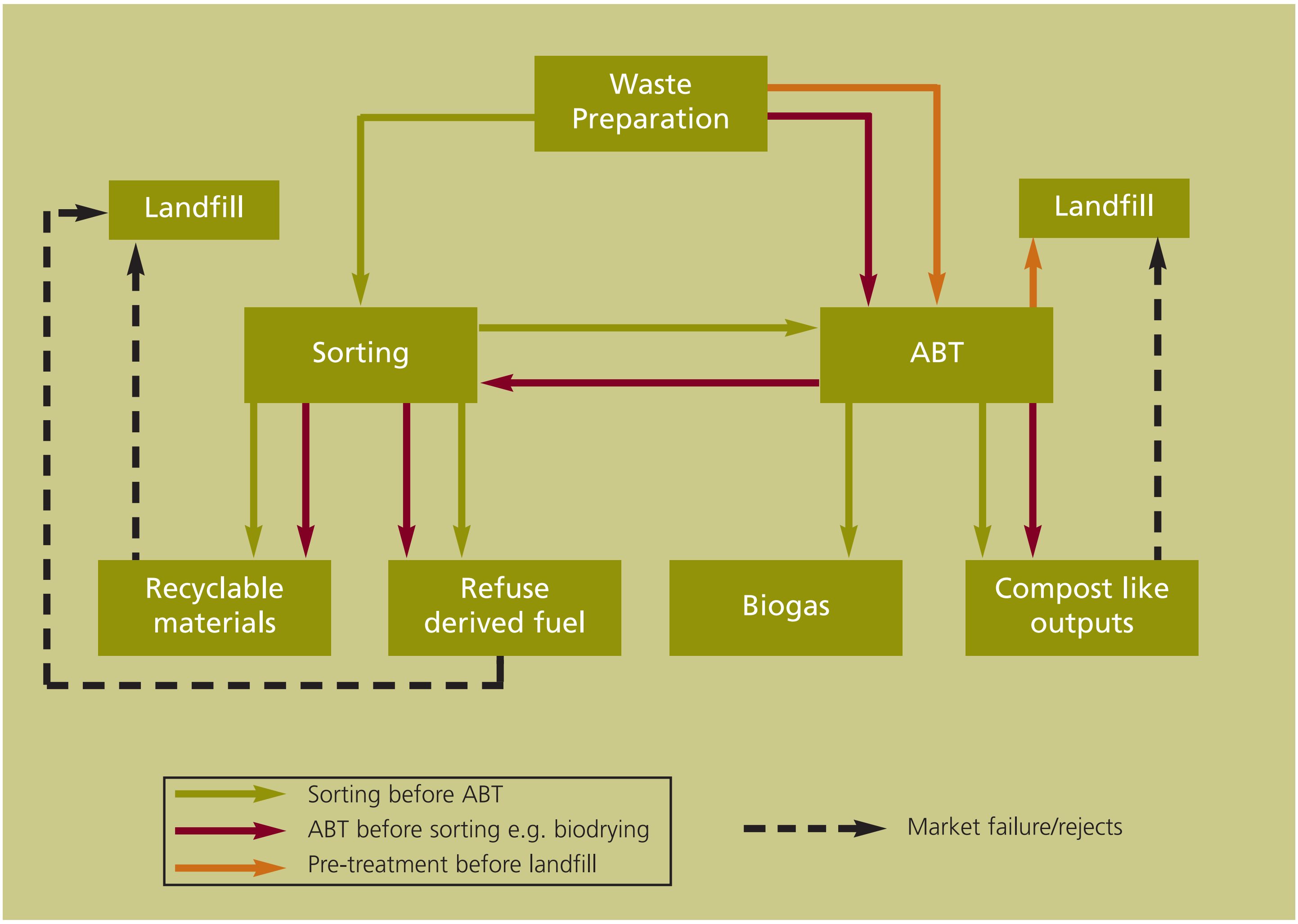
- Pre-treatment of waste going to landfill;
- Diversion of non-biodegradable and biodegradable MSW going to landfill through the mechanical sorting of MSW into materials for recycling and/or energy recovery as refuse derived fuel (RDF);
- Diversion of biodegradable MSW going to landfill by:
  - Reducing the dry mass of BMW prior to landfill;
  - Reducing the biodegradability of BMW prior to landfill;
- Stabilisation into a compost-like output (CLO)[5] for use on land;
- Conversion into a combustible biogas for energy recovery; and/or
- Drying materials to produce a high calorific organic rich fraction for use as RDF.

MBT plants may be configured in a variety of ways to achieve the required recycling, recovery and biodegradable municipal waste (BMW) diversion performance. Figure 1 illustrates configurations for MBT and highlights the components within each. ABT is an acronym for an Advanced Biological Treatment process, which are covered in a separate Technology Brief in this series and further information is available on the Waste Technology Data Centre concerning different configurations of plant.

[5] Compost-like Output (CLO) is also sometimes referred to as 'stabilised biowaste' or a soil conditioner; it is not the same as a source-segregated waste derived 'compost' or 'soil improver' that will contain much less contamination and has a wider range of end uses

2. How it works

Figure 1: An illustration of the potential Mechanical Biological Treatment options



2.2 Waste Preparation

Residual waste requires preparation before biological treatment or sorting of materials can be achieved. Initial waste preparation may take the form of simple removal of contrary objects, such as mattresses, carpets or other bulky wastes, which could cause problems with processing equipment down-stream.

Further mechanical waste preparation techniques may be used which aim to prepare the materials for subsequent separation stages. The objective of these techniques may be to split open refuse bags, thereby liberating the materials inside; or to shred and homogenise the waste into smaller particle sizes suitable for a variety of separation processes, or subsequent biological treatment depending on the MBT process employed.

A summary of the different techniques used for waste preparation is provided in Table 1.

Table 1: Waste Preparation Techniques

Ref	Technique	Principle	Key Concerns
A	Hammer Mill	Material significantly reduced in size by swinging steel hammers	Wear on Hammers, pulverising and 'loss' of glass / aggregates, exclusion of pressurised containers
B	Shredder	Rotating knives or hooks rotate at a slow speed with high torque. The shearing action tears or cuts most materials	Large, strong objects can physically damage, exclusion of pressurised containers
C	Rotating Drum	Material is lifted up the sides of a rotating drum and then dropped back into the centre. Uses gravity to tumble, mix, and homogenize the wastes. Dense, abrasive items such as glass or metal will help break down the softer materials, resulting in considerable size reduction of paper and other biodegradable materials	Gentle action – high moisture of feedstock can be a problem
D	Ball Mill	Rotating drum using heavy balls to break up or pulverise the waste	Wear on balls, pulverising and 'loss' of glass / aggregates
E	Wet Rotating Drum with Knives	Waste is wetted, forming heavy lumps which break against the knives when tumbled in the drum	Relatively low size reduction. Potential for damage from large contraries
F	Bag Splitter	A more gentle shredder used to split plastic bags whilst leaving the majority of the waste intact	Not size reduction, may be damaged by large strong objects

2.3 Waste Separation

A common aspect of many MBT plant used for MSW management in the sorting of mixed waste into different fractions using mechanical means. As shown in Figure 1, the sorting of material may be achieved before or after biological treatment. No sorting is required if the objective of the MBT process is to pre-treat all the residual MSW to produce a stabilised output for disposal to landfill.

Sorting the waste allows an MBT process to separate different materials which are suitable for different end uses. Potential end uses include material recycling, biological treatment, energy recovery through the production of RDF, and landfill. A variety of different techniques can be employed, and most MBT facilities use a series of several different techniques in combination to achieve specific end use requirements for different materials.

Separation technologies exploit varying properties of the different materials in the waste. These properties include the size and shape of different objects, their density, weight, magnetism, and electrical conductivity. A summary of the different options for waste separation is shown in Table 2.

2. How it works

Table 2: Waste Separation Techniques

	Separation Technique	Separation Property	Materials targeted	Key Concerns
1	Trommels and Screens	Size	Oversize – paper, plastic Small – organics, glass, fines	Air containment and cleaning
2	Manual Separation	Visual examination	Plastics, contaminants, oversize	Ethics of role, Health & Safety issues
3	Magnetic Separation	Magnetic Properties	Ferrous metals	Proven technique
4	Eddy Current Separation	Electrical Conductivity	Non ferrous metals	Proven technique
5	Wet Separation Technology	Differential Densities	Floats - Plastics, organics Sinks - stones, glass	Produces wet waste streams
6	Air Classification	Weight	Light – plastics, paper Heavy – stones, glass	Air cleaning
7	Ballistic Separation	Density and Elasticity	Light – plastics, paper Heavy – stones, glass	Rates of throughput
8	Optical Separation	Diffraction	Specific plastic polymers	Rates of throughput

Figure 2: Waste separation using a trommel screen

2.4 Biological Treatment

The biological element of an MBT process can take place prior to or after mechanical sorting of the waste, as illustrated in Figure 1. In some processes all the residual MSW is biologically treated to produce a stabilised output for disposal to landfill and no sorting is required. The biological processes used are either:

- Aerobic Bio-drying
- Aerobic In-vessel composting
- Anaerobic digestion

Each approach has its own particular application and examples of methodologies are described in the case studies in the track record section and in more detail on the Waste Technology Data Centre.

There are a variety of different biological treatment techniques which are used in MBT plant. These are described in greater detail in the Advanced Biological Treatment Brief, in this series. Table 3 below outlines the key categories of biological treatment.

Table 3: Biological Treatment options

Options	Biological Treatment
I	Aerobic - Bio-drying / Biostabilisation: partial composting of the (usually) whole waste
II	Aerobic - In-Vessel Composting: may be used to either biostabilise the waste or process a segregated organic rich fraction
III	Anaerobic Digestion: used to process an segregated organic rich fraction

2.5 Summary

This section illustrates that MBT systems can be described as two simple concepts: either to separate the waste and then treat; or to treat the waste and then separate. In some systems only biological treatment is required to treat all the residual MSW before disposal to landfill. Whilst a variety of treatment and mechanical separation options are offered, these need to be optimised in terms of the outputs in order to find outlets for the various materials / fuels derived from the process (see Markets for the Outputs section).

3. Markets and outlets for the outputs

In the UK, at present, the market or outlet for many of the outputs from MBT is still under development. Plants being specified today will need to provide materials into as yet undeveloped markets. It is prudent to install or at least maintain the option of installing for flexibility in the degree and types of separation of materials that any proposed plant can achieve.

The following section summarises some key issues with regard to the outlets for outputs from MBT systems for MSW.

3.1 Materials Recycling

Recyclables derived from the various MBT processes are typically of a lower quality than those derived from a separate household recyclate collection system and therefore have a lower potential for high value markets. The types of materials recovered from MBT processes almost always include metals (ferrous and non-ferrous) and for many systems this is the only recyclate extracted. However these plant can help enhance overall recycling levels and enable recovery of certain constituent items that may not otherwise be collected in household systems (e.g. batteries, steel coat hangers, etc.).

Other materials which may be extracted from MBT processes include glass, textiles, paper / card, and plastics. The most common of these is glass, which may be segregated with other inert materials such as stones and ceramics. These materials are typically segregated and arise as the "dense" fraction from air classifiers or ballistic separation (see Table 2 on mechanical waste preparation technologies). This dense fraction could find application for use as a low grade aggregate; however this would be subject to achieving a suitable quality material. This mixed material from some processes has found application as Alternative Daily Cover (ADC) at landfill sites, though this would not count towards recycling performance or diversion from landfill.

Segregating glass for recycling from residual waste or a mixed waste arising from an MBT plant would require material-specific sorting techniques if recycling into high-value products is to be achieved. Examples of this approach can be found both in MBT plant as well as more traditional "dirty MRF" processes treating mixed residual waste in other countries. In these examples manual sorting of glass has been applied to segregate the material. However, labour costs in the UK are considered to be high, and are likely to preclude this approach as being uneconomic. There are also significant issues with respect to worker Health and Safety, and the handling of broken glass objects from mixed waste streams.

Textiles, paper and plastics, if extracted, are unlikely to receive an income as a recyclate and in some instances may not yield a positive value. Most of these plant can experience problems with the heavier textiles such as carpets. Clearly none are likely to separate textiles into different types of fibre.

3. Markets and outlets for the outputs

Although unlikely, paper can potentially be separated for recycling but often it is combined with textiles and plastics; recycling markets or outlets for the material are very limited. Manual sorting or more sophisticated mechanical sorting can be undertaken on this waste stream. The quality of the paper will be lower than if source segregated and the markets available will be fewer and of lower value. With the improving performance of kerbside recycling schemes there has been an increase in the quantity of paper separately collected for recycling. This paper will be able to secure a market, either in the UK or overseas, more easily than paper separated in an MBT facility. Consequently, few MBT processes attempt to segregate paper for recycling, preferring instead to utilise it as a high calorific value Refuse Derived Fuel (RDF), which is easily achieved using conventional mechanical sorting techniques.

Any plastics separated from these processes will almost always be mixed plastics. The use of high-tech optical sorting technology, such as Near Infra-Red (NIR), offers the potential to recover high value material-specific waste streams, such as segregated plastic by polymer type. Application of such techniques is currently rare in MBT processes, and its effectiveness is yet to be fully proven in residual waste applications. The capital costs associated with installing such technologies are high, and cost/benefits of adopting them would be significantly influenced by the effectiveness of any recycling achieved upstream through kerbside collection systems serving to limit the quantity of recyclable materials present in residual waste.

For more information on the contribution of MBT to Best Value Performance Indicators and recycling see section 9, and for the latest developments see the local authority performance pages on the Defra website http://www.defra.gov.uk/environment/waste/localauth/perform-manage/index.htm and http://www.wastedataflow.org/Documents/BVPI%20FAQs.pdf

3.2 Use of compost-like outputs (CLO)

MBT processing of mechanically separated organics can produce partially/fully stabilised and sanitised CLO or partially stabilised digestate material. Digestate material is produced from an MBT process that uses anaerobic digestion as the biological process. CLO is usually the term used for an output using an aerobic process such as bio-drying or in-vessel composting. The potential applications of these outputs are dependent upon their quality and legislative and market conditions. CLO and digestate has the potential to be used as a source of organic matter to improve certain low quality soils, e.g. in the restoration of brown field sites, or for landfill cap restoration.

A summary of the estimated size of the potential market outlets for CLO is given in table 4.

3. Markets and outlets for the outputs

Table 4: Market outlets for CLO

Material	Application	Potential market in Tonnes per year	Source
Soil Conditioner / Organic based output from MBT	Land Restoration / Remediation	1,300,000 – 11,900,000 NB: a variety of scenarios considered to constitute this range	Sita Trust 2005[6]
Soil Conditioner / Organic based output from MBT	Land Restoration / Remediation	>6,000,000	WRAP 2002[7]
Soil Conditioner / Organic based output from MBT	Landfill Cap / Restoration	1,200,000 – 4,600,000 NB: a variety of scenarios considered to constitute this range	Sita Trust 2005
Soil Conditioner / Organic based output from MBT	Landfill Cap / Restoration	>5,000,000	WRAP 2002

It is generally assumed that CLO derived from mixed waste will be of lower quality and value compared to compost derived from source-segregated materials, largely due to higher contamination levels. Trials on mixed waste derived materials have reported[8] large amounts of physical contaminants (e.g. glass) and levels of potentially toxic elements above limits for the British Standards Institute (BSI) Publicly Available Specification (PAS) 100: for composted materials, in particular for zinc, lead, cadmium and mercury. Table 5 shows the limits for heavy metals and other criteria for PAS 100 compost.

Table 5: BSI PAS 100 criteria*

Parameter	BSI PAS 100 limit
Cadmium, ppm	1.5
Chromium, ppm	100
Copper, ppm	200
Mercury, ppm	1
Nickel, ppm	50
Lead, ppm	200
Zinc, ppm	400
Impurities >2mm	0.5%; of which 0.25% maximum can be plastic
Gravel & stones	>4mm <8% in grades other than coarse mulch; >4mm in coarse mulch grade <16%
Pathogens	E.coli 1000 cfu/g; No Salmonella in 25g
Microbial respiration rate	16 mg CO_2/g organic matter/day

** BSI PAS 100 is only valid for composts derived from source segregated waste, by definition*

6 MBT: A Guide for Decision Makers- Processes, Policies and Markets, Juniper Consultancy 2003 (produced for SITA Trust

7 Research Analysis for the Market Potential for Lower Grade Composted Materials in the UK, WRc, 2002 (for WRAP)

8 Development of a dynamic housed windrow composting system: performance testing and review of potential use of end products, ORA (March 2005) for Canford Environmental

3. Markets and outlets for the outputs

The quality of CLO produced will vary with different MBT technologies, the quality of raw waste inputs, and the method and intensity of waste preparation and separation prior to biological treatment, as well as the methods used to screen of the outputs.

Due to its low quality, opportunities to apply CLO or digestate produced from mixed MSW to land will be limited. As a waste, these materials require a waste management licence (WML) exemption in order to be used on land. Currently, they can only be used on non-agricultural land and must be shown to be ecologically beneficial. A risk-based assessment is needed in relation to their contamination content, and the nature of the land to which they are to be applied. This is similar approach to regulations covering the use of sewage sludge in agriculture. CLO or digestate that is used on land must also meet the requirements of the Animal By-Products Regulations (ABPR).

If an outlet cannot be found for the CLO then it may have to be disposed to landfill. This will incur a disposal cost and any biodegradability remaining will contribute to local authority BMW landfill allowances under LATS (the Landfill Allowance Trading Scheme). For more information on LATS see http://www.defra.gov.uk/environment/waste/localauth/lats/index.htm.

Waste Management Licensing Regulations

Changes to the Waste Management Licensing Regulations came into force on 1st July 2005[9]. A waste management licence (WML) exemption, under Paragraph 7A of the regulations, is required by land owners/managers before any compost or digestate (fibre or effluent) derived from source-segregated waste materials can be applied to agricultural land[10]. CLO, derived from mixed waste, is not allowed to be applied to agricultural land. These outputs may be applied to brownfield and restoration land under a WML exemption, under Paragraph 9A, provided that ecological benefit is demonstrated.

The Government and the National Assembly for Wales consulted in May 2006 on the requirement for compost or digestate derived from source-segregated materials for it to be permitted to be spread to agricultural land, under a Paragraph 7A WML Exemption. In the light of consultation, the Government has concluded that, for now, the source-segregation requirement should remain. However, the Government views this as an interim measure, and will carry out work to find a longer term, more sustainable solution that will encourage the development of [mixed MSW ABT] technologies that will produce high standard outputs which could be safely spread to land.

Animal By-Products Regulations (ABPR)

MBT plants that intend to use the stabilised organic material on land (including landfill cover) will be considered to be a composting or biogas plant, and will fall within the scope of the ABPR. These sites must therefore meet all treatment and hygiene standards required by source-segregated waste composting/ biogas plants.

Mixed MSW will contain household kitchen ('catering') waste including meat, and as such will, at least, fall under UK national ABPR[11] standards for catering waste containing meat.

9 The Waste Management Licensing (England and Wales) (Amendment and Related Provisions) (No. 3) Regulations 2005 (S.I. No. 1728)

10 Unless the Quality Protocol for Compost applies for source segregated biowaste - The Quality Protocol for the production and use of quality compost from source-segregated biowaste, developed by the Business Resource Efficiency and Waste (BREW) programme, WRAP and the Environment Agency, published March 2007

11 Animal By-products Regulations 2003 (SI 2003/1482); Wales (SI 2003/2756 W.267); Scotland (SSI 2003/411)

3. Markets and outlets for the outputs

In some cases it may also contain certain commercial/industrial waste containing raw meat or fish; classified as 'Category 3' animal by-products. Category 3 animal by-products must be treated in accordance with the EU regulation[12] standards.

3.3 Production of biogas

An MBT plant that uses anaerobic digestion (AD) as its biological process will produce biogas. During AD, the biodegradable material is converted into methane (CH_4) and carbon dioxide (together known as biogas), and water, through microbial fermentation in the absence of oxygen leaving a partially stabilised wet organic mixture known as a digestate.

The biogas can be used in a number of ways. It can be used as a natural gas substitute (distributed into the natural gas supply) or converted into fuel for use in vehicles. More commonly it is used to fuel boilers to produce heat (hot water and steam), or to fuel generators in combined heat and power (CHP) applications to generate electricity, as well as heat.

Biogas electricity production per tonne of waste can range from 75 to 225 kWh, varying according to the feedstock composition, biogas production rates and electrical generation equipment. Biogas is a source of renewable energy, with electricity generated from it being supporter by the Renewables Obligation.

In most simple energy production applications, only a little biogas pre-treatment is required. Biogas used in a boiler requires minimal treatment and compression, as boilers are much less sensitive to hydrogen sulfide and moisture levels, and can operate at a much lower input gas pressure.

Where biogas is used for onsite electricity generation, a generator similar to that used in landfill gas applications can be used, as these generators are designed to combust moist gas containing some hydrogen sulfide. Gas compression equipment may be required to boost the gas pressure to the level required by the generator.

Some electricity is used by the AD plant, but any excess electricity produced can be sold and exported via the local electricity distribution network. Excess heat can also be used locally in a district heating scheme, if there is an available user.

For high specification applications (e.g. vehicle fuel, natural gas substitute), or when using more sophisticated electricity generation equipment (e.g. turbines), biogas will require more pre-treatment to upgrade its quality. This includes the removal of hydrogen sulphide (a corrosive gas); moisture removal; pressurization to boost gas pressure; and removing carbon dioxide to increase the calorific value of the biogas. However, the cost of the equipment required to upgrade biogas can be prohibitive.

3.4 Materials Recovered for Energy

Where the MSW is sorted / treated to produce a high calorific value waste stream comprising significant proportions of the available combustible materials such as mixed paper, plastics and card, this stream may be known as Refuse Derived Fuel (RDF - see Box 1)

[12] Regulation EC 1774/2002 laying down health rules concerning animal by-products not intended for human consumption

3. Markets and outlets for the outputs

Box 1: Fuel from mixed waste processing operations

The current prevalent term used for a fuel produced from combustible waste is Refuse Derived Fuel (RDF). The types of technologies used to prepare or segregate a fuel fraction from MSW include the MBT processes described within this Brief.

A CEN Technical Committee (TC 343) is currently progressing standardisation work on fuels prepared from wastes, classifying a Solid Recovered Fuel (SRF). Preliminary standards have been published in June 2006, and are following an evaluation process, during which the functioning of the specifications will be verified. The technical specifications classify the SRF by thermal value, chlorine content and mercury content. For example, the thermal value class will be based on the number of megajoules one kilogram of recovered fuel contains. In addition, there are many characteristics for which no specific values have been determined. Instead, they can be agreed upon between the producer and the purchaser of SRF.

Along with the standardisation process, a validation project called QUOVADIS (http://quovadis.cesi.it/) on solid recovered fuels is currently being implemented.

It is anticipated that once standards are developed and become accepted by users, then SRF will become the terminology used by the waste management industry. Other terminology has also been introduced to the industry as various fuel compositions may be prepared from waste by different processes. Examples include 'Biodegradable Fuel Product' (BFP) and 'Refined Renewable Biomass Fuel' (RRBF).

European standards for SRF are important for the facilitation of trans-boundary shipments and access to permits for the use of recovered fuels. There may also be cost savings for co-incineration plants as a result of reduced measurements (e.g. for heavy metals) of incoming fuels. Standards will aid the rationalisation of design criteria for combustion units, and consequently cost savings for equipment manufacturers. Importantly standards will guarantee the quality of fuel for energy producers.

Within this Brief, Refuse Derived Fuel will be used as a term to cover the various fuel products processed from MSW.

Potential outlets for RDF

Defra has identified 6 potential outlets for RDF. The viability of some of these is dependent on legislative changes being made, which may or may not happen. The 6 potential outlets are:

1. Industrial intensive users for power, heat or both (Combined Heat and Power - CHP)
2. Cement kilns
3. Purpose built incinerators with power output or power and heat (CHP)
4. Co-firing with coal at power stations
5. Co-firing with fuels like poultry litter and biomass which are eligible for Renewable Obligation Certificates (ROCs – see section 3.3.2) in conventional technologies
6. Advanced thermal technologies, such as pyrolysis and gasification which are ROC eligible technology

RDF from a UK MBT facility is already utilised at a cement works as an energy source, replacing other fuels. Industrial intensive energy users are not yet using RDF but some interest from industry is being shown in the market place.

3. Markets and outlets for the outputs

There is currently only one dedicated conventional combustion plant (incinerator) in the UK that uses RDF as a fuel to generate electricity. Another facility which accepts prepared fuel, (generated from raw MSW delivered at the front end of the plant) which could be termed crude RDF is also combusted in a recently commissioned Fluidised-Bed incinerator in Kent, illustrated in Table 6.

Table 6: Combustion technology plant generating electricity from RDF in England

RDF Combustion plant	Operator	K tonnes/ year
Slough, Berkshire	Slough Heat & Power	100
Allington, Kent	Kent Enviropower	500

RDF may also be utilised within some appropriate Advanced Thermal Treatment (ATT) processes. A suitably scaled, dedicated ATT plant could represent a part of an integrated strategy in combination with MBT. A separate Waste Management Technology Brief, in this series, is available on the subject of ATT processes.

The energy use incurred in the separation of waste typically involves around 15 – 20% of the energy value of the waste. If the RDF is to be used as an energy source then a high efficiency process (e.g. Advanced Thermal Treatment or Incineration with Combined Heat and Power) needs to be used, or the RDF needs to be used as a fossil-fuel replacement fuel to establish any environmental benefit over directly combusting the residual waste in an incinerator. Not all ATT processes will offer the efficiencies appropriate.

The advantage of co-combusting RDF at power stations or other large thermal processes is that the infrastructure may already be in place; a disadvantage is that the outlet for the fuel is subject to obtaining a contract of sufficient duration and tonnage, with a commercial partner. An estimate of the potential market for RDF in the UK is provided in the table 7 below.

Table 7: Estimated size of the RDF market

Output	Outlet	Predicted Market size (t/a)	Source
RDF	UK Cement Kilns	350,000	Resource Recovery Forum, 2004[13]
Packaging & Packaging waste (incl. municipal derived RDF)	UK Cement Kilns	500,000	British Cement Association, 2003[14]
RDF	Paper Industry	300,000 – 600,000 NB: Required construction of dedicated RDF plant at paper mills	Resource Recovery Forum, 2004

The co-combustion of RDF is an emerging market. It is currently anticipated that cement kilns along with large industrial energy users and the power generation sector will provide the majority of potential capacity for using RDF. There is however, competition from other wastes to be processed within the cement production process including tyres, some hazardous wastes, secondary liquid fuels etc. Consequently it is expected that there may be competition (and competitive gate fees) for acceptance of RDF at cement

[13] RDF Opportunities: Coal and Cement Industries, Fichtner Consulting, RRF 2004
[14] Submission of Evidence to House of Commons Select Committee, January 2003

3. Markets and outlets for the outputs

kilns. A local authority currently would have to pay for the RDF to be used in a cement kiln. Emphasis should be put on developing sustainable markets for materials

As an emerging market there are also potential risks in terms of the operations of large thermal facilities accepting RDF from mixed waste processing as a fuel source. However, waste contractors are developing relationships with the cement industry and others to try and meet their specifications and provide a useful industrial fuel and waste recovery operation.

Renewable Energy

RDF is classified as a waste and therefore any facility using the fuel will be subject to the requirements of the Waste Incineration Directive (WID). As with the cement industry, power stations would need to be WID compliant. This would represent a significant capital investment for the industry. However WID only requires an operator to upgrade those facilities at a power station in which waste is handled to WID standards[15]. If an operator has more than one boiler then only one would need to be upgraded. This might make RDF a more attractive option for the power generation industry.

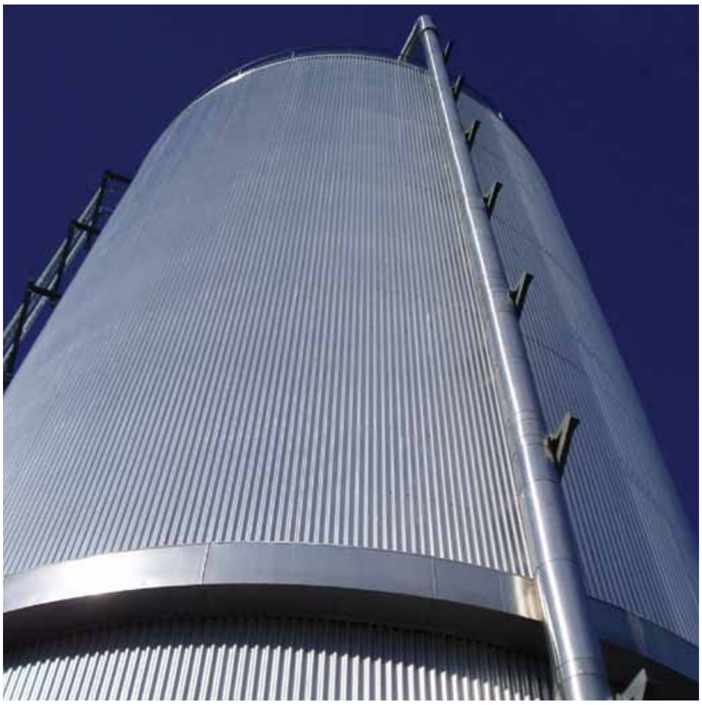
Electricity generated from the biodegradable fraction of waste in certain technologies is eligible for support under the Renewables Obligation (RO). Electricity recovered from the biomass component of RDF qualifies for support if it is generated in 'advanced conversion technologies', including pyrolysis or gasification plant (see the Advanced Thermal Treatment Brief), or in a conventional combustion facility with Good Quality Combined Heat and Power (CHP)

Up-to-date information regarding RDF and ROCs can be obtained from the DTI website http://www.dti.gov.uk/energy/renewables/. Also see the Defra New Technologies Demonstrator Programme for demos using RDF.

[15]Written answers to Alan Whitehead MP from Ben Bradshaw, Minister of State for Defra, 07/03/2007

4. Track record

The concept of MBT originated in Germany where it is an established waste treatment method. Regulatory restrictions on landfill space, the search for alternatives to incineration and increased costs of landfill disposal have been the major drivers for the development of these technologies. The largest European markets for established MBT plant include Germany, Austria, Italy, Switzerland and the Netherlands, with others such as the UK growing fast. Furthermore, other countries outside Europe are also using this technology.



Since the early 1990s, MBT processes have changed significantly, so today, numerous configurations of plant have developed, and these are provided by a variety of companies.

There are over 70 MBT facilities in operation in Europe, with over 40 MBT facilities operating in Germany. However, not all of these facilities are commercial and some of those included in Table 8 include pilot and demonstration plants.

Table 8: Examples of MBT plant operational in Europe

Technology Provider	Country	Number of Plants
Hese Umwelt (Leicester)	UK	1
EcoDeco (ELWA)	UK	1
Civic Environmental Systems (Durham)	UK	1
New Earth Solutions (Dorset)	UK	1
CRS (Argyll and Bute, Northumberland)	UK	2
Hot Rot (Western Isles)	UK	1
Sutco	Germany	5
Electrowatt-Ekono	Germany	1
Herhof	Germany	3
Dranco	Germany	2
ISKA	Germany	1
Horstmann	Germany	4
Wehrle Werk	Germany	1
BTA	Germany	1
BTA	Italy	1
Dranco	Italy	1
Ionics Itabila	Italy	1
Snamprogetti	Italy	1
Valorga	Italy	1
EcoDeco	Italy	4
Herhof	Italy	1
Valorga	Spain	2
Linde	Spain	1
Dranco	Spain	1
BTA/Roediger	Poland	1
Citec	Finland	1
Citec/Vagron	Holland	1
Valorga	Belgium	1
Valorga	France	2
Valorga	Netherlands	1
Dranco	Switzerland	1
Dranco	Austria	1
VKW	Austria	1
VKW	Italy	1
VKW	Turkey	1

4. Track record

4.1 Case Studies

The following case studies illustrate examples of MBT system using the different mechanical preparation, separation and biological treatment techniques, described in Section 2.

Shanks East London Sistema Ecodeco MBT facility on Frog Island

This facility is designed to take up to 180,000 tonnes per year of mixed residual waste from the East London Waste Authority. It is a fully enclosed bio-drying system. Waste is shredded before being placed into a bio-drying area where the material is treated using a suction forced-aeration system in the floor. The material is biologically treated for two weeks. The dry material is then put through a mechanical separation process to remove metals and a glass / aggregate fraction. The remaining dried waste (consisting mainly of dried organics, card, paper, plastics and other miscellaneous materials) is highly calorific and used as RDF. The RDF is currently used by a cement kiln, however, it will be utilised by an Advanced Thermal Treatment (ATT) process operated by Novera Energy Ltd at the Ford Dagenham plant, which will be part funded by the Defra New Technologies Demonstrator programme.

Bournemouth Council's New Earth MBT facility

The £4.4 million New Earth MBT facility based at Poole in Dorset is designed to take 50,000 tonnes per year of mixed MSW. The waste is shredded and an organic-rich fraction is screened out. The organic fraction is then composted in elongated piles (windrows) placed on forced-aeration ducts inside one of two composting buildings. The material is turned using specialised machinery 3 times during a two-week process. The material is then composted in a second building with suction forced aeration for a further two weeks. The facility produces around 9,000 tonnes of compost-like output per year.

Earth Tech Western Isles MBT facility

This is a £10 million project to build 2 treatment facilities. The main facility in Stornoway on the Isle of Lewis treats 21,000 tonnes per year of source-separated organics and residual waste. Anaerobic digestion (using Linde technology) is used to treat the source separated waste and in-vessel composting (by HotRot) is used to treat the residual waste. Mixed residual MSW is shredded and screened to produce a fine organic fraction which is composted to produce a CLO for landfill restoration.

Biffa/Leicester MBT facility and AD plant

This MBT facility (estimated to cost £20 million) has a capacity of up to 150,000 tonnes per year of mixed residual waste. The facility is spread over two sites: Bursom, home to a large ball mill used to crush the waste before it is screened and classified into various usable fractions; and Wanlip, where an AD facility is used to process the fine (<5mm) organic-rich fraction from the milled waste. The AD process is designed to handle up to around 50,000 tonnes per year. The AD plant uses a two-stage process: first, the fines are made into wet slurry that is then pumped with air during a 24 hour aerobic hydrolysis process; and second, this pre-treated (biologically heated and acidified) slurry is then sent to an 18 day thermophilic wet AD process. The plant is expected to produce enough biogas to provide 1.5 MW of electricity. The digestate undergoes further treatment to produce a CLO.

4. Track record

4.2 Summary

The case studies represent a selection of MBT projects currently operational in the UK. Numerous MBT projects can be found abroad and especially across Europe, where MBT has been well established for many years. MBT process configurations can vary significantly and can be designed to suit local market conditions and the regulatory framework specific to the country in which it operates. More information on different MBT systems can be found on the Environment Agency's website in the Waste Technology Data Centre – www.environment-agency.gov.uk/wtd

MBT as illustrated by the case studies, represent significant facilities, which are capital intensive (see Cost section) and are anticipated to be in operation for 15 – 25 years. With the emergent nature of markets/outlets for outputs from such processes, it is prudent to ensure sufficient installed capacity for flexibility within any plant (which may require new equipment, etc) to adapt to the needs of the market over time.

5. Contractual and financing issues

5.1 Grants & Funding

Development of MBT plant will involve capital expenditure of several million pounds. There are a number of potential funding sources for Local Authorities planning to develop such facilities, including:

Capital Grants: general grants may be available from national economic initiatives and EU structural funds;

Prudential Borrowing: the Local Government Act 2003 provides for a 'prudential' system of capital finance controls;

PFI Credits and Private Sector Financing: under the Private Finance Initiative a waste authority can obtain grant funding from central Government to support the capital expenditure required to deliver new facilities. This grant has the effect of reducing the financing costs for the Private Sector, thereby reducing the charge for the treatment service;

Other Private-Sector Financing: A contractor may be willing to enter a contract to provide a new facility and operate it. The contractor's charges for this may be expressed as gate fees; and

Existing sources of local authority funding: for example National Non-Domestic Rate payments (distributed by central government), credit (borrowing) approvals, local tax raising powers (council tax), income from rents, fees, charges and asset sales (capital receipts). In practice capacity for this will be limited.

The Government is encouraging the use of different funding streams, otherwise known as a 'mixed economy' for the financing and procurement of new waste infrastructure to reflect the varying needs of local authorities.

5.2 Contractual Arrangements

Medium and large scale municipal waste management contracts are likely to be through the Competitive Dialogue procedure under the Public Contract Regulations (2006).

The available contractual arrangement between the private sector provider (PSP) and the waste disposal authority (or partnership) may be one of the following:

Separate Design; Build; Operate; and Finance: The waste authority contracts separately for the works and services needed, and provides funding by raising capital for each of the main contracts. The contract to build the facility would be based on the council's design and specification and the council would own the facility once constructed;

Design & Build; Operate; Finance: A contract is let for the private sector to provide both the design and construction of a facility to specified performance requirements. The waste authority owns the facility that is constructed and makes separate arrangements to raise capital. Operation would be arranged through a separate Operation and Maintenance contract;

Design, Build and Operate; Finance: The Design and Build and Operation and Maintenance contracts are combined. The waste authority owns the facility once constructed and makes separate arrangements to raise capital;

Design, Build, Finance and Operate (DBFO): This contract is a Design and Build and Operate but the contractor also provides the financing of the project. The contractor designs, constructs and operates the plant to agreed performance requirements. Regular performance payments are made over a fixed term to recover capital and financing costs, operating and maintenance expenses, plus a reasonable return. At the end of the contract, the facility is usually transferred back to the client in a specified condition;

DBFO with PFI: This is a Design, Build, Finance and Operate contract, but it is procured under the Private Finance Initiative. In this case the waste authority obtains funding for future payment obligations from Government as a supplement to finance from its own and private sector sources.

The majority of large scale waste management contracts currently being procured in England are Design, Build, Finance and Operate (DBFO) contracts and many waste disposal authorities in two tier English arrangements (County Councils) are currently seeking to partner with their Waste Collection Authorities (usually District or Borough Councils). Sometimes partnerships are also formed with neighbouring Unitary Authorities to maximise the efficiency of the waste management service and make the contract more attractive to the Private Sector Provider.

Before initiating any procurement or funding process for a new waste management treatment facility, the following issues should be considered: performance requirements; waste inputs; project duration; project cost; available budgets; availability of sites; planning status; interface with existing contracts; timescales; governance and decision making arrangements; market appetite and risk allocation.

Further guidance on these issues can be obtained from the following sources:

- Local Authority funding http://www.defra.gov.uk/environment/waste/localauth/funding/pfi/index.htm
- The Local Government PFI project support guide www.local.odpm.gov.uk/pfi/grantcond.pdf
- For Works Contracts: the Institution of Civil Engineers 'New Engineering Contract' (available at www.ice.org.uk).
- For large scale Waste Services Contracts through PFI and guidance on waste sector projects see the 4ps, local government's project delivery organisation http://www.4ps.gov.uk/PageContent.aspx?id=90&tp=Y

A number of PFI funded/contracted waste management projects have and will continue to involve large scale MBT technologies some of these are shown in Table 9).

Table 9: Examples of PFI Contracts in Local Authority Waste Management including MBT technology

Year	Local Authority	Lead Contractor	Solutions
2003	East London	Shanks	2 MBT with Bio-drying
2003	Leicester	Biffa	MRF + AD
In progress	Lancashire	Global Renewables	4 MBT + 5 Transfer Stations
In progress	Cambridgeshire	Donarbon	2 MBT, EfW, AD
In progress	Northumberland	SITA	3 Civic Amenity sites, MRF, MBT, composting

6. Planning and permitting issues

This section contains information on the planning and regulatory issues associated with MBT facilities based on legislative requirements, formal guidance, good practice and in particular drawing on information contained in the Office of the Deputy Prime Minister's research report on waste planning published in August 2004[16].

6.1 Planning Application Requirements

All development activities are covered by Planning laws and regulations. Minor development may be allowed under Permitted Development rights but in almost all cases new development proposals for waste facilities will require planning permission.

Under certain circumstances new waste facilities can be developed on sites previously used for General Industrial (B2) or Storage and Distribution (B8) activities. In practice even where existing buildings are to be used to accommodate new waste processes, variations to existing permissions are likely to be required to reflect changes in traffic movements, emissions etc.

Under changes to the planning system introduced in 2006 all waste development is now classed as 'Major Development'. This has implications with respect to the level of information that the planning authority will expect to accompany the application and also with respect to the likely planning determination period. The target determination periods for different applications are:

- Standard Application – 8 weeks
- Major Development - 13 weeks
- EIA Development - 16 weeks

The principal national planning policy objectives associated with waste management activities are set out in Planning Policy Statement (PPS) 10 'Planning for Sustainable Waste Management' published in July 2005. Supplementary guidance is also contained within the Companion Guide to PPS 10. . Both of these documents can be accessed via the Department of Communities and Local Government (DCLG) website[17].

PPS 10 places the emphasis on the plan led system which should facilitate the development of new waste facilities through the identification of sites and policies in the relevant local development plan. Separate guidance on the content and validation of planning applications is also available from DCLG through their website[18]. Individual Planning Authorities can set out their own requirements with respect to supporting information and design criteria through Supplementary Planning Documents linked to the Local Development Framework. It is important that prospective developers liaise closely with their Local Planning Authorities over the content and scope of planning applications.

6.2 Key Issues

When considering the planning implications of an MBT facility the key issues that will need to be considered are common to most waste management facilities and are:

- Plant/Facility Siting;
- Traffic;
- Air Emissions / Health Effects;
- Dust / Odour;
- Flies, Vermin and Birds;
- Noise;

16 http://www.communities.gov.uk/embeddedindex.asp?id=1145711
17 http://www.communities.gov.uk/index.asp?id=1143834
18 http://www.communities.gov.uk/pub/494/BestPracticeGuidanceontheValidationofPlanningApplicationsPDF326Kb_id1144494.pdf

- Litter;
- Water Resources;
- Visual Intrusion; and
- Public Concern.

A brief overview of the planning context for each of these issues is provided below.

6.3 Plant Siting

PPS 10 and its Companion Guide contains general guidance on the selection of sites suitable for waste facilities. This guidance does not differentiate between facility types but states that:

"Most waste management activities are now suitable for industrial locations, many fall within the general industrial class in the Use Classes Order.[19]

The move towards facilities and processes being enclosed within purpose designed buildings, rather than in the open air, has accentuated this trend. The guidance goes on to state:

"With advancement in mitigation techniques, some waste facilities may also be considered as light industrial in nature and therefore compatible with residential development. In more rural areas, redundant agricultural and forestry buildings may also provide suitable opportunities, particularly for the management of agricultural wastes"

Mixed waste processing (such as MBT) can take place in many different buildings at a variety of locations but the following issues should be considered:

- MBT processes can be similar in appearance and characteristics to various process industries. It would often be suitable to locate facilities on land previously used for general industrial activities or land allocated in development plans for such (B2) uses;
- Facilities are likely to require good transport infrastructure. Such sites should either be located close to the primary road network or alternatively have the potential to be accessed by rail or barge;
- The location of such plants together with other waste operations such as MRFs and thermal treatment plants can be advantageous. The potential for co-location of such facilities on resource recovery parks or similar is also highlighted in the Companion Guide; and
- General concerns about bio-aerosols from biological processing may require an MBT site to be located away from sensitive receptors.

6.4 Traffic

Centralised waste facilities will most likely be served by large numbers of HGVs with a potential impact on local roads and the amenity of local residents. It is likely that the site layout/road configuration will need to be suitable to accept a range of light and heavy

[19]The Town and Country Planning (Use Classes) Order 1987. SI 1987 No. 764

vehicles. Mixed waste processing operations are designed to split a mixed waste stream into a number of individual streams some of which are low tonnage or low bulk density. As a result traffic implications may be greater than initially considered.

The traffic movements anticipated from a 50,000tpa plant would be 20 – 30 refuse collection vehicles per day. This would be reduced if bulk transport systems are used.

6.5 Air Emissions and Health Effects

No studies specifically looking at the health effects of MBT facilities have been carried out. Depending on the nature of an individual facility, the health effects of MBT facilities might be expected to be comparable to those of in-vessel composting facilities.

Studies have found no increase in cancer or asthma in populations close to composting facilities. There have been public concerns that open composting facilities could in theory affect the health of people living in close proximity to the facility. The Environment Agency suggests that risk assessments may be undertaken on sites where there are sensitive receptors nearby. Emissions and potential risks to health can be more readily controlled in an in-vessel composting system, or MBT facility.

MBT processes result in the production of a fibrous material. This could be recycled or disposed to landfill as a stabilised waste material, or could be burnt as a refuse-derived fuel. Combustion of RDF is subject to the stringent emission control requirements of the Waste Incineration Directive and would result in a similar range of emissions to those from the incineration of waste, although this may well take place at a separate facility to the MBT process.

6.6 Dust / Odour

Any waste management operations can give rise to dust and odours. The control of odour at MBT facilities needs careful consideration. Because MBT facilities are located within an enclosed building, potential odour emissions can normally be controlled through the building ventilation system. If there is a combustion element to the facility, odorous air extracted from process areas can be used in the combustion stage.

If there is no combustion element, the process of air extraction and ventilation will nevertheless dilute odorous air. It may be necessary to disperse extracted air from an elevated point, and/or treat the air. Biofiltration systems can be used to control odours in air extracted from working areas if required. The need for, and design of odour control systems would need to be assessed on a site-by-site basis.

6.7 Flies, Vermin and Birds

The enclosed nature of MBT operations will limit the potential to attract vermin and birds. However, during hot weather it is possible that flies could accumulate, especially if they have been brought in during delivery of the waste. Effective housekeeping and on site management of tipping and storage areas is essential to minimise the risk from vermin and other pests. In some operations waste heat from the process may be used in fresh input waste to bring temperatures to levels above which flies can live. Similarly, waste storage in some MBT plant is designed to be less that the breeding cycle of vermin such as rats.

6.8 Noise

Noise is an issue that will be controlled under the permitting regulations and noise levels received at nearby sensitive receptors can be

6. Planning and permitting issues

limited by a condition of a planning permission. The main contributors to noise associated with MBT are likely to be:

- vehicle movements / manoeuvring;
- traffic noise on the local road networks;
- mechanical processing such as shredders, screens, trommels and ball mills; and
- air extraction fans and ventilation systems.

6.9 Litter

Any waste which contains plastics and paper are more likely to lead to litter problems. With MBT as long as good working practices are adhered to and vehicles use covers and reception and processing are undertaken indoors, litter problems can be minimised.

6.10 Water Resources

Common to many new waste treatment processes the enclosed nature of the operations significantly reduces the potential for impacts on the water environment. The greatest potential for pollution to surface and ground water is linked to the arrangement for delivery of waste and the collection of processed materials.

Pollution of water is unlikely due to MBT facilities being under cover and rainfall is unlikely to come into contact with the process. Even so, any wash down waters or liquid within the waste will need to be managed using a drainage system on site.. This is often cited as being reused within the process, but again such process water will need to be managed.

The level of water usage will be specific to the technology and therefore it is not possible to provide detail on the nature of the effluent that might be generated and how it should be managed. However, as part of the permitting requirements for a facility a management plan would be required for effluent.

The case studies on the Waste Technology Data Centre include an assessment of water usage.

6.11 Design Principles and Visual Intrusion

The new planning guidance emphasises the importance of good design in new waste facilities. Good design principles and architect input to the design and physical appearance of waste facilitates is essential. Buildings should be of an intrinsically high standard and should not need to be screened in most cases.

Good design principles also extend to other aspects of the facility including issues such as:

- Site access and layout;
- Energy efficiency;
- Water efficiency; and
- General sustainability profile

Construction of any building will have an effect on the visual landscape of an area. Visual intrusion issues should be dealt with on a site specific basis and the following items should be considered:

- Direct effect on landscape by removal of items such as trees or undertaking major earthworks;

6. Planning and permitting issues

- Site setting; is the site close to listed buildings, conservation areas or sensitive viewpoints;
- Existing large buildings and structures in the area;
- The potential of a stack associated with some air clean up systems for mixed waste processing operations may impact on visual intrusion;
- Use of screening features (trees, hedges, banks etc);
- The number of vehicles accessing the site and their frequency; and

6.12 Size and Landtake

Table 10 shows the land area required for the building footprint and also for the entire site (including supporting site infrastructure, although this is likely to vary greatly depending on the specific technology used and the quantities of waste being handled.

Table 10: Landtake estimates for MBT facilities

	Size	Buildings Area	Total Landtake
MBT Plant A[b]	50,000tpa	3,000m^2	
MBT Plant B[c]	75,000tpa	5,500m^2	15,000m^2
MBT Plant C[c]			0.36 m2/t
MBT Plant D[a]	140,000tpa	9,000m^2	
MBT Plant E[a]	180,000tpa		35,000m^2

a Source: Review of Residual Waste Treatment Options, 2003, AiIE

b Source: Planning for Waste Management facilities, ODPM, 2004

c Source: Waste Technology Data Centre, 2004

An average MBT plant may have a height of 10 – 20m. Some facilities may also have a stack if using particular air clean-up systems, potentially increasing overall height. For more information on landtake for specific waste management operations, see Defra's Waste Technology Data Centre.

www.environment-agency,gov.uk/wtd

6.13 Public Concern

Section 7, Social and Perception Issues, relates to public concern. In general public concerns about waste facilities in general relate to amenity issues (odour, dust, noise, traffic, litter etc). With facilities which include thermal treatment of the RDF, health concerns can also be a perceived issue. Public concern founded upon valid planning reasons can be taken into account when considering a planning application.

6.14 Environmental Impact Assessment

It is likely that an Environmental Impact Assessment (EIA) will be required for MBT facilities as part of the planning process.

Whether a development requires a statutory EIA is defined under the Town and Country Planning (Environmental Impact Assessment)(England and Wales) Regulations 1999. Care should be taken with the difference in meaning between 'treatment' and 'disposal' when applying these regulations. A MBT facility is a waste treatment facility and is not a waste disposal installation. The existing additional guidance in DETR circular 02/99 is currently being revised. This new guidance is likely to focus on appropriate criteria for establishing need for EIA and not relate to the general nature of proposals.

6. Planning and permitting issues

For more information on Planning issues associated with waste management options see Planning for Waste Management Facilities – A Research Study. Office of the Deputy Prime Minister, 2004. http://www.communities.gov.uk/pub/713/PlanningforWasteManagementFacilitiesAResearchStudy_id1145713.pdf

6.15 Licensing/Permitting

If a MBT plant processes over 50 tonnes per day it may be assumed that they will require a Pollution Prevention & Control (PPC) permit to operate, if processing less than this quantity a waste management licence would be required. If the process is shown to produce a fuel (e.g. RDF) rather than a waste, then it would be subject to PPC irrespective of the tonnage threshold. The Environmental Permitting Programme (EPP) is due to be implemented in April 2008 which will combine waste licensing and permitting systems.

For more information on licensing & permitting see the Environment Agency site[20].

For more information on licensing & permitting see http://www.environment-agency.gov.uk/subjects/waste/?lang=_e

Box 2 illustrates some of the key planning features of the Frog Island MBT facility operated by Shanks in the planning authority of Havering Borough Council.

Box 2: Frog Island MBT facility

- One of two MBT facilities, 180,000 tpa each, built for the East London Waste Authority (ELWA) 25 year PFI waste management contract
- Located on a 4.2 ha site, together with a Material Recycling facility (MRF), within the Ferry Island Industrial Estate near Rainham
- Site was allocated in the Havering Unitary Development Plan for light and industrial uses and is surrounded by other industrial users
- Application submitted January 2003, went to committee in March and approved with conditions in November 2003
- The Council consulted with the Mayor of London in February who considered the planning report in July and advised the proposal was acceptable with regard to strategic planning policy
- To meet the condition that it is aesthetically pleasing from the River Thames, the facility has timber cladding
- Refuse derived fuel produced from the Frog Island facility will be processed by the proposed nearby Novera Gasification facility, which was granted planning permission in October 2006

20 http://www.environment-agency.gov.uk/subjects/waste/?lang=_e

7. Social and perception issues

This section contains a discussion of the social and public perception considerations of MBT facilities.

7.1 Social Considerations

Any new facility is likely to impact on the local residents and may provide both positive and negative impacts. Potential impacts on local amenity (odour, noise, dust, landscape) are important considerations when siting any waste management facility. These issues are examined in more detail in the Planning Section of this brief. Transport impacts associated with the delivery of waste and onward transport of process outputs may lead to impacts on the local road network. The Planning and Permitting section of this document provides an estimate of potential vehicle movements.

An MBT facility may also provide positive social impacts in the form of employment opportunities and educational opportunities. Typical employment for a MBT plant of 50,000tpa capacity would be 2 – 8 persons at any one time (more if manual picking operations are used). The plant may be operated on a shift system, for example to allow for 24 hour operations. Many new facilities are built with a visitors centre to enable local groups to view the facility and learn more about how it operates.

7.2 Public Perception

Recent changes in waste management arrangements in many areas has raised the profile of municipal waste services. Many people as a result of greater publicity and targeted education are now embracing the need for waste reduction, recycling and to a lesser extent the need for new waste facilities. The wider perception of waste facilities as a bad neighbour will take longer to overcome. New waste facilities of whatever type are rarely welcomed by residents close to where the facility is to be located.

Public opinion on waste management issues is wide ranging, and can often be at extreme ends of the scale. Typically, the most positively viewed waste management options for MSW are recycling and composting. However, this is not necessarily reflected in local attitudes towards the infrastructure commonly required to process waste to compost, or sort mixed recyclables. It should be recognised that there is always likely to be some resistance to any waste management facility within a locality.

7. Social and perception issues

At present there is a relatively low level of understanding of the concept of MBT by the public. In public consultations these technologies scores inconsistently when explained in detail as a residual waste treatment technology.

Two examples of public consultations highlighting the diversity of opinion with regard to MBT are illustrated in Box 3, below.

Box 3: Public consultation on MBT

A public consultation in an area of Wales resulted in a clear preference that any waste that could not be recycled or composted should be dealt with through MBT. Respondents felt that an MBT-led strategy was a positive approach for residual waste whether it aims to achieve or exceed diversion targets.

Conversely, a large scale public consultation in an area of England revealed the opposite reaction with MBT being the least favoured approach of the residual waste treatment options.

Overall, experience in developing waste management strategies has highlighted the importance of proactive communication with the public over waste management options. The use of realistic and appropriate models, virtual 'walk – throughs' / artists impressions should be used to accurately inform the public. Good practice in terms of public consultation and engagement is an important aspect in gaining acceptance for planning and developing waste management infrastructure. Defra is funding the development of small to medium scale demonstration plant in England for local authorities to visit and for Defra to publish data on performance. For more information contact Wastetech@enviros.com.

8. Cost

The cost of constructing, operating and maintaining MBT facilities are addressed using a common cost model on Defra's Waste Technology Data Centre. Both capital and operating costs are included on specific technologies which may be used for the purposes of indicative comparisons rather than accurate reflections of actual costs. The table below shows indicative capital expenditure (Capex) and operational expenditure (Opex) for aerobic and anaerobic MBT facilities. There are a wide range of costs dependent upon the complexity of the technology and the degree of mechanisation and automation employed.

Table 11: Typical MBT cost using Anaerobic and Aerobic processes

	Aerobic processes		AD processes	
Capacity	Capex £/t/yr	Opex £/t	Capex £/t/yr	Opex £/t
<50,000	70 – 150	up to 140	160 – 420	From 23
>50,000	28 – 225	20 – 69	107 – 278	16 – 69

Sources: Waste Technology Data Centre 2007 and Juniper Consultancy Services (2005) Mechanical Biological Treatment: A Guide for Decision Makers Processes, Policies and Markets

These costs provided are predominantly based on European examples. Costs in the UK will involve differing site specific issues such as permitting, labour, emission controls and other requirements.

It should also be noted that MBT systems are sensitive to the markets and outlets for recycled materials, RDF and soil conditioners that are produced by different processes. It is likely that many of the material outputs from MBT will have a negative value and these are not included in the above costs. The impact of the markets/outlets for these materials is not reflected in the costs provided, nor is the cost associated with the landfill of any residues should a market fail to emerge. Partnerships between MBT operators and potential users of outputs should be established at the earliest opportunity and care should be taken to ensure plant can deliver materials of sufficient quality for the required market outlet.

It is vital in any negotiation, that there is a true appreciation of the cost of essential repairs and refurbishment. Additionally the undeveloped markets/outlets (and risks associated with loss of markets) for products / outputs of these processes needs to be reflected in cost models. Any building should have sufficient capacity to house new separation equipment. The above costs are also not the same as the price a Local Authority may pay for a treatment service, which will also include other factors such as finance costs and profit margins.

For cost information on examples of different processes see Defra's Waste Technology Data Centre www.environment-agency.gov.uk/wtd

9. Contribution to national targets

9.1 Recycling

Recyclate derived from a MBT plant processing household waste qualifies for BVPI 82a (Recycling) at the point at which it leaves the plant to be sent to the reprocessor. The material must pass to the reprocessor (and not be rejected for quality reasons) to count as recycling. The same would also apply to glass used as an aggregate. It should be noted that some materials may have market limitations due to being derived from a mixed MSW source. For example British Standard BS EN 643 states that 'Recovered paper from refuse sorting stations is not suitable for use in the paper industry.' Although this standard is not legally binding, it is supported by the main trade associations for the paper recycling sector.

The Government has recently increased national recycling and composting targets for household waste through the *Waste Strategy for England 2007.* Targets are at least 40% by 2010, 45% by 2015 and 50% by 2020. For more information on the contribution of MBT to Best Value Performance Indicators and recycling see the local authority performance pages on the Defra website

http://www.defra.gov.uk/environment/waste/localauth/perform-manage/index.htm and http://www.wastedataflow.org/Documents/BVPI%20FAQs.pdf

9.2 Composting

Compost generated through the processing of source segregated organic material by in-vessel composting will contribute to BVPI 82b, the indicator for the amount of composting a local authority has achieved. The definition of BVPI 82b now also includes waste which has been treated through a process of anaerobic digestion.

Where MBT processes are configured to produce an organic rich stream known as an CLO from mixed residual MSW to be utilised as a low grade soil conditioner for example, this material may (but is 'unlikely to') qualify as composting under BVPI 82b. The CLO could be utilised in applications such as brownfield restoration, landfill restoration or some bulk fill uses (provided that the appropriate engineering and quality standards are met).

These materials will only qualify as 'composted' under the Best Value Performance Indicator (BVPI 82b) if the output meets the appropriate criteria for use in the intended application. Some waste management contractors have demonstrated that there is a market for these materials, however the current Best Value Performance Indicator Guidance (as of November 2004) states the criteria for composting should be '*a product that has been sanitised and stabilised, is high in humic substances, and can be used as a soil improver, as an ingredient in growing media or blended to produce a top soil that will meet British Standard BS2882 incorporating amendment no.1…*' It also states that it is '*unlikely that products of a Mechanical Biological Treatment process will meet this definition*.' However if the definition could be achieved then the product would qualify as BVPI 82b.

9.3 Landfill Allowance Trading Scheme (LATS)

The European Landfill Directive and the UK's enabling act, the Waste & Emissions Trading Act 2003, require the diversion of biodegradable municipal waste (BMW) from landfill. MBT processes have the potential to divert BMW from landfill. Any outputs that are recycled, used as soil conditioner (under an exemption) or burnt as RDF and which are

9. Contribution to national targets

not landfilled will count directly towards diversion targets. The ability of MBT to meet a high level of landfill diversion will therefore depend upon the availability of markets or outlets for the outputs, and the quality of the process outputs.

However, MBT plant can also be used to bio-stabilise waste prior to landfilling. In this case biological treatment is used to reduce the waste's potential to degrade and produce methane once landfilled. The Environment Agency (EA) has developed a methodology to determine the 'stability' or 'biodegradability' of any outputs from an MBT plant which are sent to landfill. This methodology can be used to determine the actual amount of biodegradable material being landfilled. This information could help an authority achieve allowance allocations under the Landfill Allowance Trading Scheme (LATS). The testing is not a statutory requirement currently. Detailed guidance on how the diversion of biodegradable waste is measured in MBT processes can be found on the Environment Agency website:

http://www.environment-agency.gov.uk/commondata/acrobat/mbt_1154981.pdf

As any MBT plants developed in the UK are likely to vary in their method of operation, the stability test is likely to be applied to each MBT plant on a regular basis. Up to date information can be obtained from Defra's LATS information webpage:

http://www.defra.gov.uk/environment/waste/localauth/lats/index.htm

As the requirements of the Landfill Directive relate to the amount of biodegradable material landfilled, the stability of materials diverted from landfill via MBT will not need to be measured.

9. Contribution to national targets

9.4 Recovery

MBT technologies will only contribute towards recovery targets through the waste streams that are sent to an energy recovery process. This may be either RDF combusted or degraded in a thermal plant (e.g .Incineration with Energy Recovery, Advanced Thermal Treatment or co-combusted in a Cement Kiln), or the biological stream that is processed in an Anaerobic Digestion plant (see the specific guidance for BVPI 82c and also 82b for AD). The Government has recently increased national recovery targets for municipal waste through the *Waste Strategy for England 2007.* Targets are 53% by 2010, 67% by 2015 and 75% by 2020. For more details see

http://www.defra.gov.uk/environment/waste/localauth/perform-manage/index.htm

9.5 Renewables

The Renewables Obligation (RO) was introduced in 2002 to promote the development of electricity generated from renewable sources of energy. The Obligation requires licensed electricity suppliers to source a specific and annually increasing percentage of the electricity they supply from renewable sources, demonstrated by Renewables Obligation Certificates (ROCs). The target currently rises to 15.4% by 2015/16. In essence, the RO provides a significant boost to the market price of renewable electricity generated in eligible technologies.

Electricity generated from the biomass (renewable) fraction of waste (including RDF) in 'advanced conversion technologies' (including AD, gasification and pyrolysis) or incineration plant with good quality heat and power is eligible for support under the RO. This can provide an important additional revenue stream for a proposed plant, as long as it meets the qualifying requirements. As the value of a ROC is not fixed, the long term value would need to be assessed in detail to determine its overall financial value to the project.

The Department for Industry (DTI) is considering providing greater support to technologies producing renewable energy and assessing methods for removing barriers to renewable energy generation.

Up-to-date information regarding RDF and ROCs can be obtained from the DTI website

www.dti.gov.uk/energy/sources/renewables/index.html.

10. Further reading and sources of information

WRATE (Waste and Resources Assessment Tool for the Environment)

http://www.environment-agency.gov.uk/wtd/1396237/?version=1&lang=_e

The Waste Technology Data Centre

www.environment-agency.gov.uk/wtd

New Technologies Demonstrator Programme Wastetech@enviros.com

Defra New Technologies website,

http://www.defra.gov.uk/environment/waste/wip/newtech/index.htm

Integrated Pollution Prevention and Control, Draft Reference Document on Best Available Techniques for the Waste Treatments Industries, *European Commission – Directorate General Joint Research Centre*, January 2004

Refuse Derived Fuel, Current Practice and Perspectives (B4-3040/2000/306517/Mar/E3), *European Commission – Directorate General Environment*, July 2003

Local Authority funding

http://www.defra.gov.uk/environment/waste/localauth/funding/pfi/index.htm

The Local Government PFI project support guide

www.local.odpm.gov.uk/pfi/grantcond.pdf

For Works Contracts: the Institution of Civil Engineers 'New Engineering Contract'

(available at www.ice.org.uk).

For large scale Waste Services Contracts through PFI and guidance on waste sector projects see the 4ps, local government's project delivery organisation

http://www.4ps.gov.uk/PageContent.aspx?id=90&tp=Y

Planning for Waste Management Facilities – A Research Study. ODPM, 2004

http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_030747.pdf

AiIE Ltd, 2003, Review of residual waste treatment technologies, Report prepared on behalf of Kingston upon Hull City Council and East Riding of Yorkshire Council

http://www.eastriding.gov.uk/environment/pdf/waste_treatment_technologies.pdf

The Additional Paper to the Strategy Unit, Waste Not Want Not study, 'Delivering the Landfill Directive: The Role of New & Emerging Technologies', Dr Stuart McLanaghan

http://www.number10.gov.uk/files/pdf/technologies-landfill.pdf

11. Glossary

Aerobic	In the presence of oxygen.
Aerobic Digestion/Composting	Biological decomposition of organic materials by micro-organisms under controlled, aerobic, conditions to a relatively stable humus-like material called compost.
Anaerobic	In the absence of oxygen.
Anaerobic Digestion	A process where biodegradable material is encouraged to break down in the absence of oxygen. Material is placed in to an enclosed vessel and in controlled conditions the waste breaks down typically into a digestate, liquor and biogas.
Animal By-Products Regulation	Legislation governing the processing of wastes derived from animal sources.
Biodegradable	Capable of being degraded by plants and animals.
Biogas	Gas resulting from the fermentation of waste in the absence of air (methane/carbon dioxide).
Biodegradable Municipal Waste (BMW)	The component of Municipal Solid Waste capable of being degraded by plants and animals. Biodegradable Municipal Waste includes paper and card, food and garden waste, and a proportion of other wastes, such as textiles.
Co-combustion	Combustion of wastes as a fuel in an industrial or other (non waste management) process.
Digestate	Solid and / or liquid product resulting from Anaerobic Digestion.
Feedstock	Raw material required for a process.
Floc	A small loosely aggregated mass of flocculent material. In this instance referring to Refuse Derived Fuel or similar.
Greenhouse Gas	A term given to those gas compounds in the atmosphere that reflect heat back toward earth rather than letting it escape freely into space. Several gases are involved, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone, water vapour and some of the chlorofluorocarbons.
Green Waste	Waste vegetation and plant matter from household gardens, local authority parks and gardens and commercial landscaped gardens.
Incineration	The controlled thermal treatment of waste by burning, either to reduce its volume or toxicity. Energy recovery from incineration can be made by utilising the calorific value of the waste to produce heat and / or power.

11. Glossary

In-vessel Composting	The aerobic decomposition of shredded and mixed organic waste within and enclosed container, where the control systems for material degradation are fully automated. Moisture, temperature, and odour can be regulated, and stable compost can be produced much more quickly than outdoor windrow composting.
Materials Recycling Facility/ Material Recovery Facility (MRF)	Dedicated facility for the sorting / separation of recyclable materials.
Mechanical Biological Treatment (MBT)	A generic term for mechanical sorting / separation technologies used in conjunction with biological treatment processes, such as composting.
Municipal Solid Waste (MSW)	Household waste and any other wastes collected by the Waste Collection Authority, or its agents, such as municipal parks and gardens waste, beach cleansing waste, commercial or industrial waste, and waste resulting from the clearance of fly-tipped materials.
Recyclate/Recyclable materials	Post-use materials that can be recycled for the original purpose, or for different purposes.
Recycling	Involves the processing of wastes, into either the same product or a different one. Many non-hazardous wastes such as paper, glass, cardboard, plastics and scrap metals can be recycled. Hazardous wastes such as solvents can also be recycled by specialist companies.
Refuse Derived Fuel (RDF)	A fuel produced from combustible waste that can be stored and transported, or used directly on site to produce heat and/or power.
Renewables Obligation	Introduced in 2002 by the Department of Trade and Industry, this system creates a market in tradable renewable energy certificates (ROCs), within each electricity supplier must demonstrate compliance with increasing Government targets for renewable energy generation.
Solid Recovered Fuel	Refuse Derived Fuel meeting a standard specification, currently under development by a CEN standards committee.
Source-segregated/ Source-separated	Usually applies to household waste collection systems where recyclable and/or organic fractions of the waste stream are separated by the householder and are often collected separately.
Statutory Best Value Performance Indicators	Local Authorities submit performance data to Government in the form of annual performance indicators (PIs). The Recycling and Composting PIs have statutory targets attached to them which Authorities are required to meet.