Department for Environment Food & Rural Affairs

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Mechanical Biological Treatment of Municipal Solid Waste

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Preamble

This Waste Management Technology Brief, originally produced in 2007, is one of a series of documents prepared under the New Technologies work stream of the Defra Waste Implementation Programme. This Brief has been revised to accompany the 2013 Energy from Waste Guide while remaining a standalone document. The Briefs address the main technology types that have a role in diverting Municipal Solid Waste (MSW) from landfill.

This brief addresses mechanical Biological Treatment (MBT). Other titles in this series include: Advanced Biological Treatment, Mechanical Heat Treatment, Advanced Thermal Treatment, and Incineration.

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 but also members of the public who require more detailed information on the technologies mentioned in the 2013 Energy from Waste Guide. It should be noted that these documents are intended as guides to each generic technology area.

These Briefs deal primarily with the treatment and processing of residual MSW.

1. Introduction

Residual Municipal Solid Waste (MSW) is waste that is household or household like. It comprises household waste collected by local authorities some commercial and industrial wastes e.g. from offices, schools, shops etc that may be collected by the local authority or a commercial company. Legislation limits (by implication[1]) the amount of mixed MSW that can be sent to landfill.

One of the guiding principles, now enshrined in law, 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).

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 operated as part of a wider integrated approach involving additional treatment stages.

Historically, technologies similar to Mechanical Biological Treatment plant in the UK were only developed in very limited circumstances. 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. However, new MBT technologies are now second or third generation plants that are well established with proven examples of successful operation and bankable viability. On the continent many of these processes are more widespread and developed, and the aim of this document is to raise awareness and help continued improvement of facilities in the UK.

[1] Targets pertain to the biodegradable fraction in MSW.

2. How It Works

Mechanical Biological Treatment (MBT) is a generic term for an integration of several mechanical processes commonly found in other waste management facilities such as Materials Recovery Facilities (MRFs), 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 the MBT Processes

MBT is a residual waste treatment process that involves both mechanical and biological treatment. 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)[2] 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 plant and highlights the process steps.

[2] Compost-like Output (CLO) is also sometimes referred to as 'stabilised bio-waste' 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.

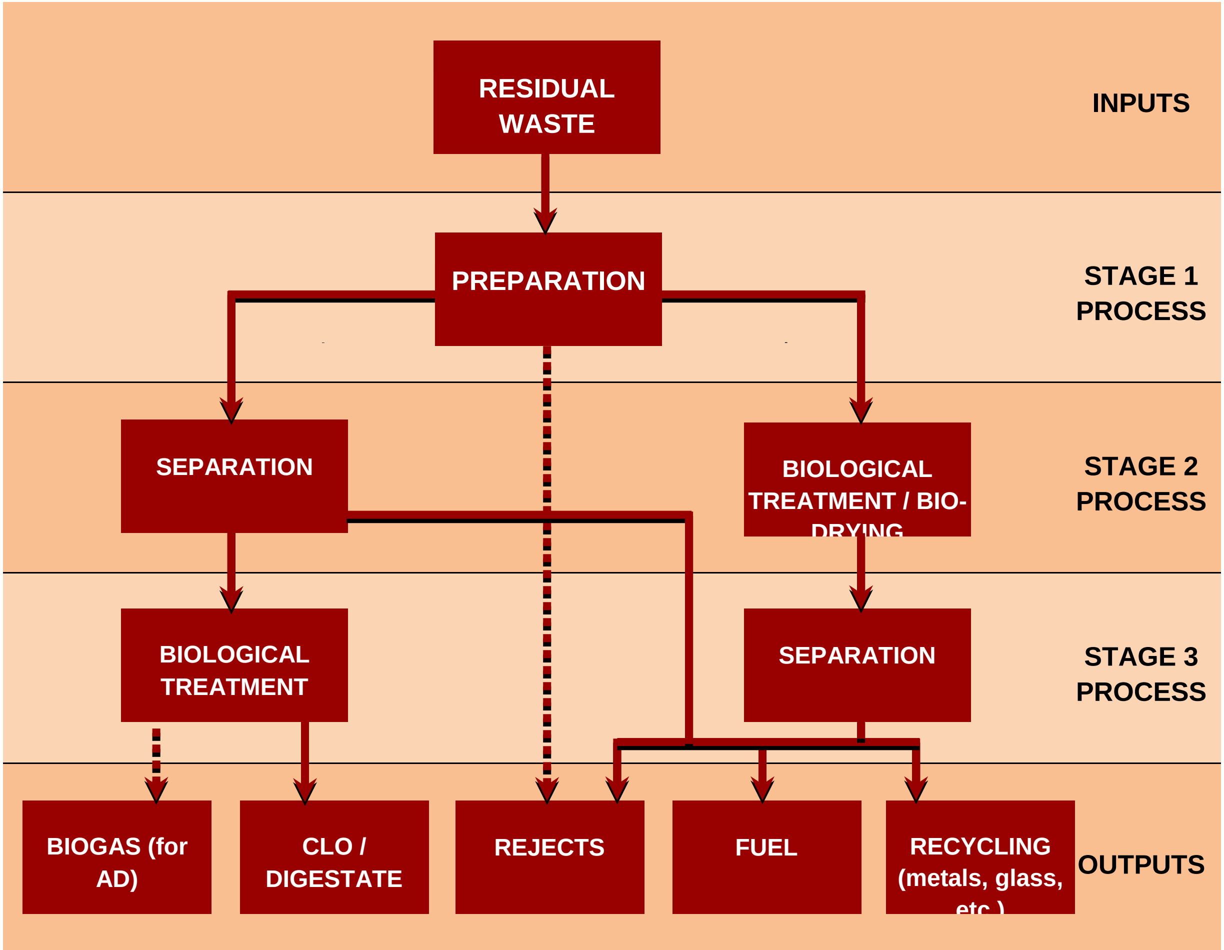


Figure 1: An Illustration of the Potential Mechanical Biological Treatment Options

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.

Technique	Principle	Key Concerns
Hammer Mill	Material significantly reduced in size by swinging steel hammers.	Wear on Hammers. Pulverising and 'loss' of glass / aggregates. Exclusion of pressurised containers.
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 the shredder. Exclusion of pressurised containers.
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.
Ball Mill	Rotating drum using heavy balls to break up or pulverise the waste.	Wear on balls. Pulverising and 'loss' of glass / aggregates.
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.
Bag Splitter	A relatively 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.

Table 1: Waste Preparation Techniques

2.3 Waste Separation

A common aspect of many MBT plant used for MSW management is 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[3], biological treatment, energy recovery through the production of RDF/biomass, 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.

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

[3] Materials output from an MBT process will only qualify for recycling output where strict quality regulations and protocols are met, with varying standards dependent upon the material.

Table 2: Waste Separation Techniques

Optical plastics separation. Image courtesy of New Earth Solutions Ltd.

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. Table 3 below outlines the key categories of biological treatment.

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

Table 3: Biological Treatment Options

Each approach has its own particular application and examples of methodologies are described in the case studies in the track record section. 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.

Bio-stabilisation hall. Image courtesy of New Earth Solutions Ltd.

2.5 Summary

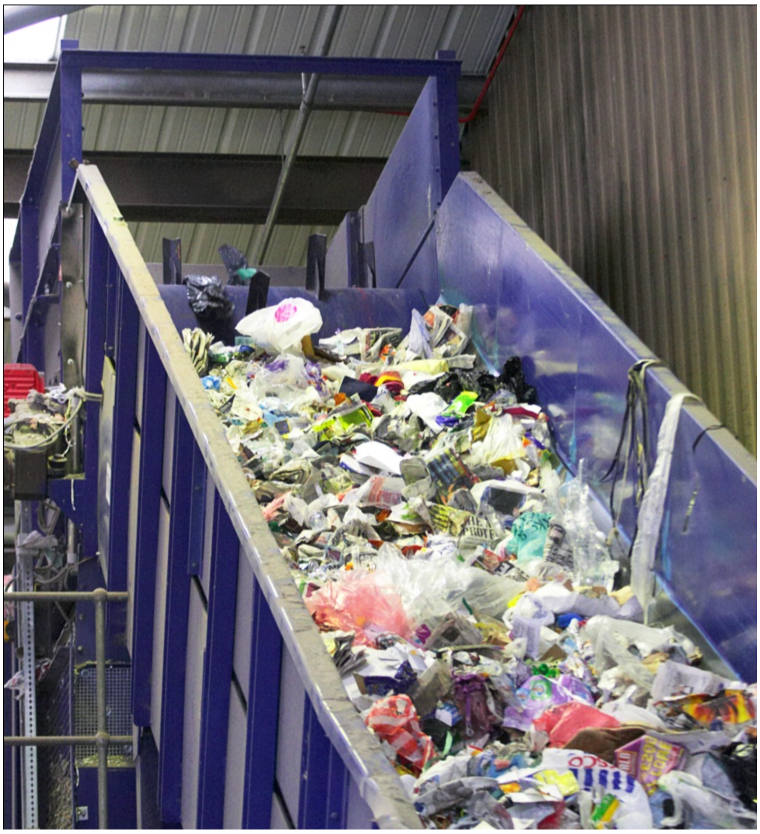
MBT systems can be described as two simple concepts: either to separate the waste and then treat; or to treat the waste and then separate. In some systems only biological treatment (with rudimentary mechanical separation) is required to treat all the residual MSW before disposal to landfill. Whilst a 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 MBT Outputs section).

3. Markets and Outlets for MBT Outputs

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 plants 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.).



Materials recycling process. Image courtesy of WRAP.

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 mixed waste/ broken glass objects.

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 processes can experience problems with the heavier textiles such as carpets. Clearly no facilities processing mixed wastes are likely to separate textiles into different types of fibre.

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.

The use of 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 limited in MBT processes in the UK and its effectiveness has not been fully developed to date. 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 recycling targets see section 9 and WasteDataFlow guidance notes and fact sheets available at http://www.wastedataflow.org.

3.2 Use of Compost-Like Outputs (CLO)

The 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 / market conditions. CLO or digestate from mixed waste processing will not qualify for British Standards Institute (BSi) Publicly Available Specification PAS100[4] and PAS110[5] respectively, and is unlikely to be applicable for inclusion in recycling rates/targets[6]. 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.

[4] 'PAS 100:2011 Specification for composted materials', BSi, January 2011. Further information and specification request form available at http://www.wrap.org.uk/content/bsi-pas-100-compost-specification.

[5] 'PAS 110:2010 Specification for whole digestate, separated liquor and separated fibre derived from the anaerobic digestion of source-segregated biodegradable materials', BSi, February 2010. Further information and specification request form available at http://www.wrap.org.uk/content/bsi-pas-110-specification-digestate.

[6] See; 'Waste National Indicators FAQ', WasteDataFlow, June 2009.

Compost-like Output, MBT plant with AD

It is generally regarded that CLO derived from mixed waste will be of a lower quality and value compared to compost derived from source-segregated materials, largely due to higher contamination levels. In addition CLO from mixed waste sources would not qualify for PAS 100 or PAS 110 specifications which are restricted to outputs from source-segregated treatment processes. Trials on mixed waste derived materials have reported[7] large amounts of physical contaminants (e.g. glass) and levels of potentially toxic elements above limits for the standard PAS 100:2011 for composted materials, potentially for most metals specified.

Table 4 shows the limits for heavy metals and other criteria for PAS 100 compost.

Parameter	BSI PAS 100 limit
Cadmium (Cd)	1.5 ppm (of dry matter)
Chromium (Cr)	100 ppm (of dry matter)
Copper (Cu)	200 ppm (of dry matter)
Mercury (Hg)	1 ppm (of dry matter)
Nickel (Ni)	50 ppm (of dry matter)
Lead (Pb)	200 ppm (of dry matter)
Zinc (Zn)	400 ppm (of dry matter)
Non-stone contaminants >2mm	0.25%; of which 0.12% maximum can be plastic
Gravel & stones	>4mm ('other than' mulch grade): <8% mass (of dry-air sample)
	>4mm (mulch grade): <10% (of dry-air sample)
Pathogens	E.coli: 1000 CFU/g (of fresh mass)
	Salmonella: absent in test of 25g fresh mass
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, and does not apply to MBT output materials.

[7] 'The use and application to land of MBT compost-like output – review of current European practice in relation to environmental protection', Environment Agency, 2009.

Table 4: BSi PAS 100:2011 Criteria*

Environmental Permitting of MBT outputs

The use or disposal of CLO / Digestate from MBT is subject to the waste permitting controls under the Environmental Permitting Regulations. Its use on land must also meet the requirements of the Animal By-Products Regulations (ABPR). Trials on the use of CLO on land have been permitted by the Environment Agency[8].

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 and / or wash the outputs. Subject to its quality, it may be possible to use it in the restoration, reclamation or improvement of previously developed land. This will need to be authorised by the Environment Agency (EA) under a mobile plant permit and deployment form. The deployment form is submitted by the operator and contains the site specific information to demonstrate that the CLO will be beneficial, a risk assessment, and the control measures proposed by the operator.

The use of CLO produced from mixed MSW on agricultural land is currently not permitted by the EA. 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 remaining measured biodegradable content will affect local authority landfill diversion targets.

Further information on Environment Permitting of MBT plants is included in section 6.2.

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.

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 and engines. 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.

[8] http://publications.environment-agency.gov.uk/PDF/GEHO0512BWLS-E-E.pdf

Biogas electricity production per tonne of waste can range from 75 up to 225 kWh, varying according to the feedstock composition, biogas production rates and electrical generation equipment. Generating electricity from biogas is considered 'renewable energy' and benefits from support under the Renewables Obligation[9], Renewable Heat Incentive[10] and Feed-in-Tariff[11] schemes (see Section 9.5).

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 sulphide 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 sulphide. 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 excess electricity produced (potentially in the range of 90%) 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 are available users.

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; pressurisation to boost gas pressure; and removal of carbon dioxide to increase the calorific value of the biogas. The cost of the equipment required to upgrade biogas can be significant, however the application of Renewable Heat Incentives is a measure to encourage investment in this type of energy recovery technology.

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

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[9] For more information on the Renewables Obligation (RO) see the DECC website, http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/renew_obs/renew_obs.aspx.

[10] For more information on the Renewable Heat Incentive (RHI) see the DECC website, http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/incentive/incentive.aspx.

[11] For more information in the Feed-in-Tariffs scheme (FITs) see the DECC website, http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/feedin_tariff/feedin_tariff.aspx.

mixed paper, plastics and card, this stream may be known as Refuse Derived Fuel (RDF – see Box 1).

Box 1: Fuel from Mixed Waste Processing Operations

Various terms are in use to describe solid fuel arising from MBT/MHT processes in the UK, the most common being solid recovered fuel and refuse derived fuel.

A CEN Technical Committee (TC 343) has developed standards on fuels prepared from wastes, where the suite of standards uses the terminology Solid Recovered Fuel (SRF) and classify the SRF by a number of characteristics, including by thermal value, chlorine content and mercury content. The use of Refuse Derived Fuel (RDF) as a term has no strict definition and could be generated from a wide variety of waste treatment processes.

A recent development in the UK is the separation between the procurement of waste treatment processes that give rise to a fuel output and the procurement of the market for the utilisation of the fuel generated. In these circumstances a specification of RDF/SRF would be required.

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 addressing any technical barriers for use of the fuel, the market appetite, commercial drivers around carbon trading and energy costs, renewable energy incentives and the cost of waste disposal (gate fees).

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 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 later in this section) in conventional technologies
6. Advanced thermal technologies, such as pyrolysis and gasification which are ROC eligible technologies.

RDF from UK waste treatment facilities (MBT & MHT) is already utilised at industrial facilities in the UK (e.g. cement works) replacing fossil fuels.

There is currently only one dedicated conventional combustion plant (incinerator) in the UK that uses RDF as a fuel to generate electricity[12]. Other incineration facilities that accept prepared fuel, (generated from raw MSW delivered at the front end of the plant) which could be termed crude RDF are the Fluidised-Bed incinerators in Kent and Dundee, illustrated in Table 5.

RDF Combustion plant	Operator	K tonnes/ year
Slough, Berkshire	Slough Heat & Power	145[a]
Allington, Kent	Kent Enviropower	500[a]
Dundee	Dundee Energy Recycling Ltd	85[b]
[a] Source: EA 2010 Incineration inputs and capacity[12] [b] Source: SEPA 2010 Waste sites and capacity report[13]		

Table 5: Combustion Technology Plant Generating Electricity from RDF in England

RDF may also be utilised within some appropriate Advanced Thermal Treatment (ATT) processes, for example the Isle of Wight gasification facility exclusively accepts RDF, and the Dumfries gasifier is projected to accept a 50:50 mix of RDF and treated commercial wastes when fully operational. 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 or incineration 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.

[12] EA Permitted Waste Management Facilities for 2010 Incineration inputs data table, http://www.environment-agency.gov.uk/research/library/data/132647.aspx#England_and_Wales.

[13] SEPA List of Waste Sites and Capacities in Scotland 2010, http://www.sepa.org.uk/waste/waste_data/waste_site_information/waste_sites__capacity.aspx.

The co-combustion of RDF is a relatively young market in the UK. Cement kilns were early entrants into the market for RDF and are now being followed by other large industrial energy users and the power generation sector which between them are likely to provide the majority of potential capacity for using RDF. There is however, competition from other wastes to be processed within industrial processes 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 in intensive energy using industries.

As a developing market there are also some potential risks in terms of the operations of large thermal facilities accepting RDF from mixed waste processing as a fuel source due to the variability of the composition of the waste. Work on standards and specifications for SRF have gone some way to address these concerns. Waste contractors are establishing relationships with the cement industry and other power intensive industries, meeting their specifications to 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 Industrial Emissions Directive (IED)[14]. As with the cement industry, power stations would need to be IED compliant. Operators who combust waste would need to comply with Annex VI of the IED. This would represent a significant capital investment for the industry. However, IED only requires an operator to upgrade those facilities at a power station in which waste is handled to Annex VI standards. 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. The waste and energy generation industries are starting to work together in order to generate electricity from RDF.

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 DECC website,

[14] The Industrial Emissions Directive (2010/75/EU), set a target for transposition no later than 6th January 2013, is a recast of seven previous directives including the Waste Incineration Directive (WID) (2000/76/EC).

http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/renew_obs/renew_obs.aspx.

4. Track Record

4.1 Introduction

The concept of MBT originated in Germany where it is an established waste treatment method. Regulatory restrictions on landfill space, subsequent landfill bans, the search for alternatives to incineration and increased costs of alternative 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.

Anaerobic Digestion tanks and gas holder, Bredbury Parkway. Image courtesy of Viridor

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 330 MBT facilities in operation throughout Europe[15]. In their Waste Infrastructure 2010 Report the Environment Agency reported 19 permitted MBT facilities in England with a total permitted annual capacity of 2,728,300 tonnes, with plants ranging in the capacity of 50,000 to 305,000tpa.

[15] 'The European Market for Mechanical Biological Treatment Plants', EcoProg Consultancy, December 2011.

Location	Operator	Facility Details
Waterbeach, Cambridgeshire	AmeyCespa	179,000tpa capacity. Cost £41.5m as part of PFI agreement.
Leicester	Biffa	100,000tpa capacity. Utilises ball mill and AD technologies.
Cotesbach, Leicestershire	New Earth Solutions	50,000tpa capacity. Operates using bio-stabilisation.
Frog Island & Jenkins Lane, East London	Shanks	2 x 180,000tpa. Operate using bio-drying processes.
Farington, Lancashire	Global Renewables	170,000tpa (site total 305,000tpa) capacity. Incorporates composting and AD post mechanical sorting.
Bredbury Parkway, Stockport & Reliance Street, Manchester	Viridor Laing	2 x 100,000tpa capacities. Utilise AD technology.
Southwark	Veolia	87,500tpa capacity. Operates using bio-drying.

Table 6: Examples of Operational MBT Plant in England

4.2 Case Studies

The following case studies illustrate examples of MBT system using the configurations as described in Section 2.

New Earth Solutions, Avonmouth MBT Facility

Avonmouth MBT. Image courtesy of New Earth

New Earth's fifth and largest facility was formally opened in September 2011 following a 5 month commissioning period. The 200,000tpa capacity facility primarily treats residual household waste from the West of England Partnership, comprising the local authorities of Bath and North East Somerset, Bristol City, North Somerset and South Gloucestershire, but also commercial and industrial waste of a similar composition.

The facility, which was developed on a disused industrial site, extracts metals and plastics, and produces a CLO from the organic waste fraction. This is used in remediation projects, such as the capping of former landfill sites. The facility is currently performing to landfill diversion levels in excess of 95% and customers have reported increased recycling levels alongside the reduction in reliance on landfill disposal.

From the fraction of the waste which cannot be recycled, New Earth produces a refuse-derived fuel product. Currently this is being shipped to Europe under the trans-frontier shipment regulations. However, on land adjacent to the MBT facility, New Earth is currently installing an energy recovery plant utilising their patented New Earth Advanced Thermal (NEAT) energy recovery technology. When fully operational in 2013 the plant will generate 13MW of electricity, enough to meet the needs of nearly 25,000 homes in the Bristol area.

Veolia, Southwark MBT facility

This £60m inner-city facility located off the Old Kent Road is designed to complement a MRF on the same site. The site will handle all 120,000 tonnes per year of waste collected by Southwark Council, with an overall capacity of 200,000 tonnes per annum. The MBT facility has an annual capacity of 87,500 tonnes, and the MRF an annual capacity of 85,000 tonnes.

Veolia Southwark Integrated Waste Management Facility incorporating MBT and MRF. Image courtesy

The MBT facility sorts mixed waste by size, incorporates advanced sensors to separate recyclables, before composting waste in tunnels (each with 350 tonnes capacity) for 8-12 days. The SRF produced after drying of material is used at the nearby SELCHP incinerator to produce renewable energy.

Viridor-Laing / Greater Manchester Waste Disposal Authority, Reliance Street MBT facility

As part of a £631m recycling and waste management contract between Viridor-Laing (Greater Manchester) ltd and the Greater Manchester Waste Disposal Authority (GMWDA – incorporating nine of the ten Metropolitan Borough Councils of Greater Manchester – excepting Wigan) five MBT facilities are to be built in the conurbation, four incorporating Anaerobic Digestion, to handle 450,000 tonnes of mixed non-recyclable wastes. The Reliance Street facility was the first to be completed under the contract, and has a capacity to treat 100,000 tonnes per year of waste through a mixture of mechanical sorting methods including sieving, shredding, screens, separators and crushing followed by wet AD (Enpure technology). During the AD process waste will be matured for 25 days with biogas from the process being utilised by CHP. The remaining digestate will then be de-watered and dried, with the five facilities producing a combined total of 275,000 tonnes per annum of SRF/RDF which will be used to produce heat and power at a combined heat and power facility being constructed in Runcorn with partners INEOS Chlor.

4.3 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.

MBT as illustrated by the case studies, represent significant facilities, which are relatively capital intensive (see Cost section) and are typically anticipated to be operational 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 and 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, which is covered in detail by the Chartered Institute of Public Finance and Accountancy (CIPFA) 2009 Prudential Code for Capital Finance;

Waste Infrastructure (WI) credits and Private Sector Financing: waste authorities were able obtain grant funding from central Government to support the expenditure required to deliver new facilities.. However, there is no intention to issue new WI credits at the date of this publication;

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;

Existing sources of local authority funding: for example from National Non-Domestic Rate payments (distributed by central government)[16], credit borrowing where government credit approvals are received, local tax rising powers (council tax), and 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. The Government Green Investment Bank is investing in waste infrastructure. This option may provide financing for appropriate projects moving forward.

[16] Except, for example, in 'Core Cities' where authorities may be eligible for infrastructure support through the application of business rates under the 'New Development Deals' and 'Economic Investment Funds' mechanisms of the Governments City Deals programme. See 'Unlocking Growth in Cities: City Deals – Wave 1', HM Government Cabinet Office, July 2012.

5.2 Contractual Arrangements

Medium and large scale municipal waste management contracts, since January 2007, are likely to be procured through the EU Competitive Dialogue (CD) programme under the Public Contact Regulations[17]. This is dialogue between an authority and the bidders with the aim of developing a suitable technical or legal position against which all the bidders can submit a formal bid. More information on CD is available from the Local Partnership website at http://www.localpartnerships.org.uk/PageContent.aspx?id=9&tp=Y.

The available contractual arrangement between the Private Sector Provider (PSP) and the waste disposal authority (or partnership) may be one of the following:

[17] The Public Procurement (Miscellaneous Amendments) Regulations 2011 (SI 2011/2053).

<table>
<tr><th>Design</th><th>Build</th><th>Operate</th><th>Finance</th><th>Contractual arrangement description</th></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>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.</td></tr>
<tr><td colspan="2">A</td><td>B</td><td>C</td><td>Design and 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.</td></tr>
<tr><td colspan="3">A</td><td>B</td><td>Design, Build and Operate; Finance: The Design, Build, Operation and Maintenance contracts are combined. The waste authority owns the facility once constructed and makes separate arrangements to raise capital.</td></tr>
<tr><td colspan="4">A</td><td>Design, Build, Finance and Operate (DBFO): This contract is a Design, 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.</td></tr>
<tr><td colspan="4">A</td><td>DBFO with WI: This is a Design, Build, Finance and Operate contract, but it is procured under the Waste Infrastructure (WI) Initiative (formerly PFI). In this case the waste authority obtains grant funding from Government as a supplement to finance from its own and private sector sources. The WI grant is only eligible for facilities treating residual waste and is payable once capital expenditure is incurred.</td></tr>
</table>

Table 7: Available Contractual Arrangement Configurations

The majority of large scale waste management contracts currently being procured in England are 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, for example the Greater Manchester Waste Disposal Authority combining nine of ten unitary authorities in the city region.

Contracts are becoming more ‘output’ led since contractors increasingly have to build proposals around obligated targets placed on authorities such as for recycling yields.

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.

A number of WI funded and/or contracted waste management projects have involved large scale MBT technologies (some examples of these are shown in Table 8).

Year Signed	Status	Local authority	WI/PFI Credits Value	Lead Contractor	Solutions
2002	Fully Operational	East London Waste Authority	£47m	Shanks	2 MBT with Bio-drying at Frog Island and Jenkins Lane and 3 MRFs.
2003	Fully Operational	Leicester	£30.8m	Biffa	1 MBT and 1 AD.
2007	Fully Operational	Lancashire	£90m	Global Renewables	2 MBT with AD, 3 Transfer Stations
2007	Fully Operational	Southwark	£34.5m	Veolia	1 MBT and 1 MRF.
2008	Fully Operational	Cambridgeshire	£35m	Donarbon	1 MBT and 1 IVC.
2009	Partially Operational	Greater Manchester Waste Disposal Authority	£124.5m	Viridor/ Laing	5 MBT (4 with AD) all either built or under construction, 4 IVC, 1MRF and 1 EfW.
2012	PrContract Signed	Essex	£100.9m	Urbaser / Balfour Beatty	1 MBT (Biodrying / Biostabilisation)

Table 8: Examples of WI Funded Contracts in Local Authority Waste Management Including MBT Technologies

A fundamentally important issue in consideration of the bankability of any waste treatment project is the acceptable risk profile of the procurement in question (i.e. risk allocation within the contract), and project risk in terms of ability to deliver the infrastructure required (planning, technology, availability, reliability and available secure markets for process outputs). There are a number of steps that may be taken by contracting authorities and waste management solution providers in order to minimise the risk profile and help in the delivery of the project as a whole. The following examples of further reading explore these issues:

- ‘Rubbish to Resource: Financing New Waste Infrastructure’, Associate Parliamentary Sustainable Resource Group (APSRG), September 2011, available at http://www.policyconnect.org.uk/apsrg/rubbish-resource-financing-new-waste-infrastructure.
- Local Authority funding examples http://www.defra.gov.uk/environment/waste/local-authorities/widp/pfi-projects/
- Guidance documents on waste management procurement http://www.defra.gov.uk/environment/waste/local-authorities/widp/widp-guidance/.

- For Works Contracts: the NEC3 contracts (available at www.neccontract.com – formerly the Institute of Civil Engineers 'New Engineering Contract').
- Local Partnerships provide guidance to local authorities concerning partnership opportunities and achieving optimum service delivery and efficiencies, http://www.localpartnerships.org.uk/PageContent.aspx?id=198&tp=Y.

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 and good practice..

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 10 'Planning for Sustainable Waste Management' (PPS 10), first published in July 2005 and revised in March 2011. Supplementary guidance is also contained within the

Companion Guide to PPS 10[18]. Both of these documents can be accessed via the www.gov.uk the website. website.

It should be noted that with the publication of the National Planning Policy Framework (NPPF) in March 2011, virtually all pre-existing Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) notes have now been replaced. However, as the Framework does not contain specific waste policies since these will be published alongside the national waste management plan for England, PPS 10 will remain in place until the new Plan is adopted.

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[19]. 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 (which is likely to be referred to as the 'Local Plan' in the future under the NPPF system). It is important that prospective developers liaise closely with their Local Planning Authorities over the content and scope of planning applications.

Key Issues

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

- Plant/Facility Siting;
- Traffic;
- Air Emissions / Health Effects;
- Dust / Odour;
- Bio-aerosols;
- Flies, Vermin and Birds;
- Noise;
- Litter;
- Water Resources;
- Design Principles and Visual Intrusion;
- Size and Landtake; and
- Public Concern.

A brief overview of the planning context for each of these issues is provided in the following pages.

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[18] http://www.communities.gov.uk/documents/planningandbuilding/pdf/150805.pdf.
[19] http://www.communities.gov.uk/documents/planningandbuilding/pdf/1505220.pdf.

Plant / Facility Siting

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

> *"Most waste management activities are now suitable for industrial locations, many fall within the general industrial class in the Use Classes Order (as amended).*[20]

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:

- Buildings which might house MBT 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 ATTs can be advantageous. The potential for co-location of such facilities on resource recovery parks or similar is also highlighted in the PPS 10 and the Companion Guide; and
- General concerns about bio-aerosols from biological processing may require an MBT site to be located away from sensitive receptors.

Traffic

MBT facilities may be served by large numbers of Large (Heavy) goods vehicles (LGVs) (depending on the scale of the facility) with a potential impact on local roads and the amenity of local residents. It is likely that the site layout/road configuration

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[20] For more information on change of use classes see, http://www.planningportal.gov.uk/permission/commonprojects/changeofuse/

will need to be suitable to accept a range of light and heavy 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. For a 50,000tpa capacity plant, 20-30 Refuse Collection Vehicles per day would be anticipated. This would be reduced if bulk transport systems are used.

Air Emissions / 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, such as those related to bio-aerosol emissions.

Bio-aerosols are normally found in higher concentrations at facilities where large amounts of organic matter are processed. Although studies on composting facilities have found no increase in cancer or asthma in populations nearby, there have been public concerns that open composting operations could in theory affect the health of those living in close proximity.

Available evidence suggests that communities located more than 250m away from composting facilities are unlikely to be exposed to harmful levels of bio-aerosols; however they may experience odours associated with the process as these can travel much further. Bio-aerosol emissions can be mitigated by conducting operations that may give rise to higher quantities of bio-aerosols (such as screening and shredding) within an enclosed building.

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 where composting operations take place in a housed environment.

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 an RDF. Combustion of RDF is currently subject to the stringent emission control requirements of the Industrial Emissions 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.

Dust / Odour

Any waste management operations can give rise to dust and odours. The control of odour from waste reception areas and from any composting component of 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.

Bio-filtration systems, thermal systems or other thermal abatement plant can be used to control of 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.

Bio-aerosols

Bio-aerosols may comprise of complex mixtures of micro-organisms transported in the air. They are common in rural environments and may arise from a wide variety of activities including agriculture. Some bio-aerosols can cause health problems, notably *Aspergillus Fumigatus*, but also some other fungal spores and bacteria. It is also apparent that there is a wide variety of susceptibility to bio-aerosols in individuals. One source of bio-aerosols is composting operations and similar waste treatment processes. Raised levels of community exposure to bio-aerosol may arise within 250m downwind of a composting facility and under rare circumstances at distances of up to 0.5 km[21].

The Environment Agency regulate waste management processes and whilst some small scale composting facilities do not require an environmental permit to operate, larger (e.g. municipal waste management) scale facilities will need to operate under an environmental permit issued by the Agency. This will either be a bespoke permit or a standard rules permit. Standard rules permits are available for composting facilities which are to be located more than 250m from dwellings or workplaces as a consequence of risks over bio-aerosols. This aspect is likely to also apply for In-Vessel Composting processes where there is an external maturation / composting element, dry AD processes where the digestate is matured in windrows after the digestion phase and similar aspects of Mechanical Biological Treatment processes[22].

[21] 'Exposure-response relationships for bio-aerosol emissions from waste treatment processes', WR0606, Defra, 2008.

[22] 'Composting and potential health effects from bio-aerosols: our interim guidance for permit applicants', EA, 2010.

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 passed through fresh inputs waste so temperatures exceed levels at which flies can survive. Similarly, waste storage time in some MBT plant is designed to be less than the breeding cycle of vermin such as rats.

Noise

Noise is an issue that will be controlled under permitting regulations and noise levels at nearby sensitive receptors can be 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 waste preparation, shredders, screens, trommels, air classification, ball mills;
- Air extraction fans and ventilation systems; and
- Operations associated with preparation, turning and aeration of the biomass.

Litter

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

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/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.

Design Principles and Visual Intrusion

Current planning guidance in PPS 10 emphasises the importance of good design in new waste facilities, the importance of which echoed by the NPPF in relation to the design of the built environment as a whole. Good design principles and architect input to the design and physical appearance of large scale buildings and structures such as MBT plant 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 having regard to issues such as:

- Site access and layout;
- Energy efficiency;
- Water efficiency; and
- The general sustainability profile of the facility.

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;
- 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;
- Appropriate use of landscaping features (trees, hedges, banks etc.) not for screening but to enhance the setting of the facility;
- The number of vehicles accessing the site and their frequency; and
- Many of these facilities are housed in ‘warehouse’ type clad steel buildings, however use of good design techniques can help minimise visual intrusion.

For more information on the role of good design in waste facilities, please see the Defra publication ‘Designing Waste Facilities: A Guide to Modern Design in Waste’, which can be found at http://archive.defra.gov.uk/environment/waste/localauth/documents/designing-waste-facilities-guide.pdf.

Size and Landtake

Table 9 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.

Facility	Capacity	Buildings Area	Total Landtake
Bredbury Park Way, Stockport	135,000 tpa	5,927.5 m^2	89,000 m^2
Reliance Street, Manchester	100,000 tpa	5,913 m^2	38,000 m^2
Farington, Lancashire	305,000 tpa	-	146,000 m^2
Thornton, Lancashire	225,000 tpa	-	170,000 m^2
Southwark	87,500 tpa (total site 200,000 tpa)	16,200 m^2 (total buildings including MRF 27,130.5 m^2)	56,000 m^2
Waterbeach, Cambridgeshire	110,000 tpa	17,750 m^2	30,000 m^2 (part of larger 200ha. site)
Note: All data taken from planning application documents.			

Table 9: Landtake Estimates for MBT Facilities

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.

Public Concern

Section 7, Social and Perception Issues, relates to public concern. In general ublic concerns about waste facilities relate to amenity issues (odour, dust, noise, traffic, litter etc.). For facilities that form part of a larger development which include thermal treatment of the RDF, health concerns can also be a perceived issue. Public concern founded upon valid planning reasons (known as ‘material considerations’) can be taken into account when considering a planning application.

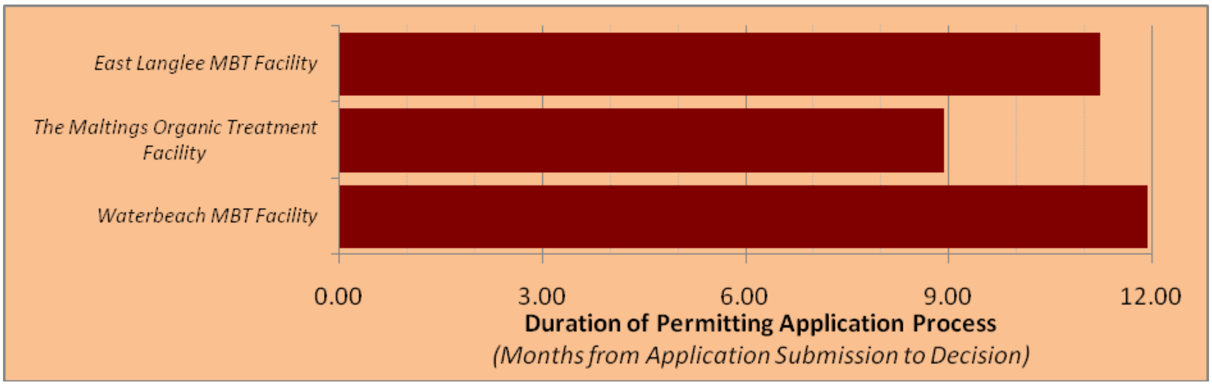
Environmental Impact Assessment

It is likely that an Environmental Impact Assessment (EIA) will be required for an MBT facility as part of the planning process. Whether a development requires a statutory EIA is defined under the EIA Regulations 2011[23]. Care should be taken with the difference in meaning between 'treatment' and 'disposal' when applying these regulations. An MBT facility is a waste treatment facility and is not a waste disposal installation. The existing additional guidance in DETR circular 02/99 is to be withdrawn following the publication of the new EIA Regulations; however no proposals have yet been made as to a replacement.

6.2 Licensing / Permitting

The Environmental Permitting Regulations (EPR) have been amended on several occasions[24] and combined the previously separate Pollution Prevention and Control (PPC) and Waste Management Licensing (WML) Regulations. All commercial scale MBT facilities require a permit. There are Standard Rules designed to deliver a standard Environmental Permit, which can save time and money for the operator, where the rules apply to the treatment facility in question. The Standard Rules document no. 18 applies to Non Hazardous Mechanical Biological (aerobic) Treatment facilities[25]. Where the standard rules do not apply a bespoke permit is required.

It is the scope of the proposal, in addition to local environmental circumstances, that will determine the nature and complexity of the permit, and hence the process and, to a certain degree, timescale from initiation to permit determination. Figure 2 shows example permit timescales for MBT processes in the UK.



[23] 'The Town and Country Planning (Environmental Impact Assessment) Regulations 2011 (SI 2011/1824).
[24] The latest amendment is the Environmental Permitting (England and Wales) (Amendment) Regulations 2012
[25] For further information, see http://www.environment-agency.gov.uk/business/topics/permitting/118404.aspx

Figure 2 Example Timescales for obtaining an Environmental Permit for an MBT plant

The three examples above show a 9 – 12 month determination period, and the nature of the proposal can have a notable influence on the duration of the process as a whole and a wider range of timescales is possible than shown here. Furthermore in some instances multi-operator permits are needed where for example the MBT process may be operated by one contractor and the CHP plant (for AD processes) may be operated by another contractor, again such aspects can add time and complexity into the permitting process.

The process of obtaining an environmental permit is an initial step in an on-going management process for delivery of the requirements of the Permit and ensuring compliance and use of Best Available Techniques. This may include reporting, improvement plans and other on-going activities. There is also a facility within the regulations for the variation of Permits. In the case of municipal waste treatment facilities, where there is a significant operational life anticipated (15 – 30 years), the option to vary may be an important one to allow incorporation of new technology or methods within the installation. In addition, the Permit may be transferred or surrendered (e.g. at the end of a project's operational life). These aspects should be appropriately considered and will involve management processes and reporting / actions as required by the Environment Agency (for example completion reports, decommissioning plans, etc.).

For more information, please see the permitting pages of the Environment Agency's site at http://www.environment-agency.gov.uk/business/topics/permitting/default.aspx.

Animal By-Products Regulations (ABPR)

Mechanical Biological Treatment (MBT) plants are mixed waste treatment facilities, which generally seek to stabilise biodegradable material prior to landfill (to reduce its capacity to generate methane), or to reduce its moisture content (hence increasing its calorific value) prior to thermal treatment. Most MBT plants rely upon a composting process (or in some cases, anaerobic digestion) to stabilise residual waste.

The scope of the EU Animal By-Products Regulation is such that it applies to catering waste only when:

(i) from means of transport operating internationally;

(ii) destined for animal consumption; or

(iii) destined for use in a biogas or composting plant;

(iv) destined for treatment in a rendering plant.

Thus the controls will apply to MBT plants only if they are producing compost for land application or landfill cover. If they are simply treating the material to remove recyclables prior to landfill or incineration of the residual waste, they will not be controlled. If it becomes apparent that the operation of such plants does pose a risk to animal health, the Animal Health & Veterinary Laboratories Agency (AHVLA) shall consider the need for suitable controls[26]. MBT plants will still be subject to environmental permitting by the Environment Agency or Waste Management licensing, or in some instances a Pollution Prevention and Control permit, by SEPA.

An MBT plant which intends to use the material it produces on land, including as cover for landfill, will be considered to be a composting or biogas plant, and will fall inside the scope of the Regulation. Such operations must be approved by Defra, and must therefore meet all the treatment and hygiene requirements that ordinary composting plants must achieve. As with any other approved composting plant, the MBT plant would need to meet one of the national standards if the plant processes only catering waste or the EU treatment standard if it processes other animal byproducts. It will also require approval from the Environment Agency/SEPA before any of the treated material is applied to land.

[26] Current AHVLA guidance available at http://animalhealth.defra.gov.uk/managing-disease/animalbyproducts/compost-biogas-manure/composting-biogas-of-abp.htm

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 local residents and may result in 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 and Permitting chapter 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 chapter of this Brief provides an estimate of potential vehicle movements.

An MBT facility may also provide positive social impacts in the form of employment and educational opportunities. Employment figures for these types of facilities would be dependent on the size of the facility and shift patterns during operation. A provision for both unskilled and semi-skilled workers as well as professionals will be required. As a guide based on current and proposed facilities up to 8 people would be needed for a MBT plant of 50,000tpa capacity, 40 for 265,000tpa plant and 85 for a 417,000tpa plant. 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

Changes to waste management arrangements in local areas as a result of continually improving recycling and landfill diversion performance, often creates a higher profile for the service through the media. Many people as a result of greater publicity, targeted education and more comprehensive waste services are participating, to a greater extent, in waste reduction and recycling activities. This leads to a greater level of engagement in waste management activity. There is still however a significant challenge with regard to acceptance of waste management facilities.

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, or indeed to have an extra wheeled bin or box. It should be recognised that there is always likely to be some resistance to any waste management facility within a locality, despite the necessity to have the capacity to deal with societies' waste.

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.

At present there is a relatively low level of public understanding on the concept of MBT. In public consultations these technologies score 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 2, below. Box 3 provides an example of pre planning public engagement.

Box 2: Public Consultation on MBT

A public consultation covering part of the Midlands region demonstrated a mixed response from stakeholders and councillors concerning MBT as a preferable waste management solution. Respondents to this consultation felt that an incineration based EfW plant was the most desirable method of treating the area's residual waste.

In a public consultation for a County Council in the South of England, MBT was indicated to be preferable to EfW technologies. Reasons for this result were given as public perception concerns over the emissions from an incinerator, and a wide held belief that MBT was a greener technology with better recycling potential. The consultation indicated that the majority of respondents were prepared to incur an additional £30 council tax cost if it meant procurement of an MBT facility over an EfW.

Box 3: Pre-planning Public Engagement for the Biffa MBT Facility at Brookhurst Wood, Sussex

This public engagement exercise started in 2009 concerning pre-application plans for a revised design MBT facility on the Brookhurst Wood Landfill site. The public engagement followed previous engagement for alternative plans on the site in 2004.

A combination of techniques were utilised to gather and inform public opinion including; a three-day public exhibition event; a newsletter; a project website; letters to near neighbours; appointment of interested stakeholders as 'local elected representatives'; and presentations to local stakeholders. The campaign was designed to be transparent and accessible to the public in order to gain acceptance and backing, and resulted in only one objection alongside feedback demonstrating stakeholder concerns.

The Associate Parliamentary Sustainable Resource Group (APSRG) have produced a report concerning waste infrastructure developments including 'incentivising community buy-in'[27], which provides examples of waste infrastructure development in the UK with the techniques utilised to gain public approval.

[27] 'Waste Management Infrastructure: Incentivising Community Buy-In', APSRG, February 2011. More information and download available at http://www.policyconnect.org.uk/apsrg/waste-management-infrastructure-incentivising-community-buy.

8. Cost

In this section, the cost of MBT facilities with anaerobic and aerobic processes is discussed.

There are a wide range of costs dependent upon the complexity of the technology, including the biological process adopted, and the degree of mechanisation and automation employed.

It should also be noted that MBT systems are particularly 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. 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.

One approach to managing market risk for outputs from the process in the development of MBT procurement exercises has been to separate the procurement of the MBT process from the contract for acceptance of the RDF generated from the process. In these instances the MBT process would be designed to generate a fuel of a known specification.

It is vital in any negotiation, that there is a true appreciation of the cost of essential repairs and refurbishment. These facilities need to be viewed as large capital investments with a lifespan of not less than 10, or more usually 20 years. Any building housing MBT processes should have sufficient capacity to house new separation equipment to enable response to changing market demands for materials and fuels.

Capital costs for MBT facilities are relatively high. Recent example estimates and actual costs for the construction of MBT plants fall in the range of:

- £50m – £125m for MBT facilities in the capacity range 80 – 225ktpa.

The WRAP Gate Fees Report 2012[28] states that the average received gate fee income from wastes into MBT processes is £79 per tonne in November 2011 / February 2012, with variances from £65 to £84 per tonne. This compares to £84 per tonne in the 2011 report, £75 per tonne in 2010 and £62 per tonne in 2009.

[28] 'Gate Fees Report, 2012: Comparing the cost of alternative waste treatment options', WRAP, 2012.

9. Contribution to National Targets

9.1 Recycling

Recyclate derived from a mixed waste processing plant (including MBT) of household waste qualifies as recycling, and therefore would contribute to national and local targets. Typical materials extracted for recycling from an MBT process may include glass, metals and hard plastics. 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.

The revised Waste Framework Directive includes national targets for recycling and composting for household waste set at 50% for 2020. At present the UK (and England) are on course to meet this target.

9.2 Composting

Where MBT processes are configured to produce an organic-rich (biodegradable) stream to be further composted to produce a low grade compost-like output (CLO), this material may (but is 'unlikely to' see below) qualify as composting under Defra policy. The CLO could be utilised in applications such as 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 recycling guidance[29] if the output meet 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 guidance 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 contribute towards recycling and composting targets.

[29] http://www.wastedataflow.org.

Digestate from MBT process

9.3 Landfill Directive Diversion Performance

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 systems 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 not landfilled, will count directly towards diversion targets. Initially Landfill Allowance and Trading Scheme (LATS) credits were attributed to local authorities prescribing individual targets. These are due to be scrapped in April 2013 as continuing rises to Landfill Taxes will provide sufficient economic incentive to divert BMW from landfill. The ability of MBT to meet a high level of landfill diversion will therefore depend upon the availability of markets for, and the quality of, the process outputs.

However, MBT plant may contribute to partial bio-stabilisation of waste. 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 waste treatment plant which are sent to landfill. This test can be used to determine the amount of biodegradable material being landfilled.

Guidance on monitoring of MBT for the purposes of landfill diversion targets has been prepared by the Environment Agency, http://publications.environment-agency.gov.uk/PDF/SCHO1009BREB-E-E.pdf.

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.

9.4 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 / Industrial process), or the biological stream that is processed in an Anaerobic Digestion plant.

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 is currently set at 15% by 2020. In essence, the RO provides a significant boost to the market price of renewable electricity generated in eligible technologies. The RO will close to new operators at the end of the 2016/17 financial year. Those already accredited under the RO will continue to receive their full lifetime of support until the scheme closes in 2037.

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. Therefore, MBT facilities which utilise processes with conversion technologies like Anaerobic Digestion for the biodegradable fraction of waste have the opportunity to generate additional revenue under the scheme providing all qualifying requirements are met. 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, in addition to other renewable energy incentives available.

An MBT facility that incorporates an advanced conversion technology may also be eligible under the DECC Feed-in-Tariffs and Renewable Heat Incentive schemes. The Feed-in-Tariffs (FiTs) were introduced by DECC in April 2010 with the intention to encourage deployment of small-scale low-carbon energy generation. Anaerobic Digestion qualifies for FiTs provided energy production is below 5MW per annum. There are three financial benefits associated with FiTs:

1. Generation tariff – Payment per KW energy produced from chosen electricity supplier.

2. Export tariff – If the energy is not used on-site it may be exported to the national grid.
3. Energy bill savings – If the energy generated is used on-site.

Renewable Heat Incentives (RHI) is a £25m support scheme to provide support to the installation of renewable technologies for heat generation, implemented by DECC. The second stage of the scheme is under development at the time of this publication, and further advice will be available on the DECC website.

10. Further Reading and Sources of Information

CIWM Mechanical Biological Treatment guidance: http://www.ciwm.co.uk/CIWM/InformationCentre/AtoZ/MPages/Mechanical_Biological_Treatment.aspx.
DCLG planning guidance: http://www.communities.gov.uk/planningandbuilding/planningenvironment/.
'Designing Waste Facilities: A Guide to Modern Design in Waste', Defra, 2008: http://archive.defra.gov.uk/environment/waste/localauth/documents/designing-waste-facilities-guide.pdf.
'England's Waste Infrastructure: Report on facilities covered by environmental permitting: 2010', Environment Agency, October 2011:   http://www.environment-agency.gov.uk/research/library/data/134327.aspx.
General organics recycling information available from: http://www.organics-recycling.org.uk/, http://www.wrap.org.uk/, http://www.nnfcc.co.uk/ and http://www.adbiogas.co.uk/.
'Integrated Pollution Prevention and Control, Reference Document on Best Available Techniques for the Waste Treatments Industries, European Commission' – Directorate General Joint Research Centre, August 2006: http://ec.europa.eu/environment/ippc/brefs/wt_bref_0806.pdf.
Local Authority funding: http://www.defra.gov.uk/environment/waste/local-authorities/widp/ .
Local Partnerships guidance: http://www.localpartnerships.org.uk/PageContent.aspx?id=198&tp=Y.
'PAS 100:2011 Specification for composted materials', BSi, January 2011:

http://www.wrap.org.uk/content/bsi-pas-100-compost-specification.

'PAS 110:2010 Specification for whole digestate, separated liquor and separated fibre derived from the anaerobic digestion of source-segregated biodegradable materials', BSi, February 2010: http://www.wrap.org.uk/content/bsi-pas-110-specification-digestate.

'Quality Protocol: Compost: The Quality Protocol for the production and use of quality compost from source-segregated biodegradable waste', Environment Agency and WRAP, 2010: http://www.environment-agency.gov.uk/static/documents/081027_QUALITY_PROTOCOL_FOR_COMPOST.pdf_PROTOCOL_FOR_COMPOST.pdf.

'Quality Protocol: Anaerobic Digestate: End of waste criteria for the production and use of quality outputs from anaerobic digestion of source-segregated biodegradeable waste', Environment Agency and WRAP, 2010: http://www.environment-agency.gov.uk/static/documents/Business/W524AnaerobicDigestatev4(1).pdf.

'Review of Environmental & Health Effects of Waste Management', Enviros Consulting Ltd, University of Birmingham, Open University & Maggie Thurgood, Defra, 2004:

http://archive.defra.gov.uk/environment/waste/statistics/documents/health-report.pdf.

Renewables Obligation (RO), Renewable Heat Incentives (RHI) and Feed-in-Tariffs (FiTs) guidance:

http://www.decc.gov.uk/en/content/cms/funding/funding_ops/funding_ops.aspx.

'Rubbish to Resource: Financing New Waste Infrastructure', Associate Parliamentary Sustainable Resource Group (APSRG), September 2011:

http://www.policyconnect.org.uk/apsrg/rubbish-resource-financing-new-waste-infrastructure

'Waste Management Infrastructure: Incentivising Community Buy-In', APSRG, February 2011: http://www.policyconnect.org.uk/apsrg/waste-management-infrastructure-incentivising-community-buy.

WRATE (Waste and Resources Assessment Tool for the Environment):

http://www.environment-agency.gov.uk/research/commercial/102922.aspx.

11. Glossary

Advanced Thermal Treatment (ATT)	Waste management processes involving medium and high temperatures to recover energy from the waste. Primarily pyrolysis and gasification based processes, excludes incineration.
Aerobic	In the presence of oxygen.
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 under 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.
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.
Biogas	Gas resulting from the fermentation of waste in the absence of air (methane / carbon dioxide).
Composting (Aerobic Digestion)	Biological decomposition of organic materials by micro-organisms under controlled, aerobic conditions, to form a relatively stable humus-like material called compost.
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.
Feed-in Tariffs (FiTs)	Introduced by the Department of Energy and Climate Change in April 2010 to stimulate deployment of small-scale (less than 5MW) low-carbon energy generation installations. The tariff will guarantee set payments from an electricity supplier of their choice for the electricity they generate and use as well as a guaranteed payment for unused surplus electricity they export back to the grid.
Greenhouse Gas (GHG)	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 / Garden 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.
In-Vessel Composting (IVC)	The aerobic decomposition of shredded and mixed organic waste within an 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.
Local Authority Collected Municipal Waste (LACMW)	Refers to the previous ‘municipal’ element of the waste collected by local authorities. That is household waste and business waste where collected by the local authority and which is similar in nature and composition as required by

	the Landfill Directive. This is the definition that will be used for LATS allowances.
Local Authority Collected Waste (LACW)	All waste collected by the local authority. This is a slightly broader concept than LACMW as it would include both this and non-municipal fractions such as construction and demolition waste. LACW is the definition that will be used in statistical publications, which previously referred to municipal waste.
Materials Recycling Facility / Materials 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)	LACMW plus commercial and industrial waste similar to that generated by households which is collected by commercial operators (i.e. not by or on behalf of a local authority). This is the definition which will be used by the UK for reporting against EU landfill diversion targets. It includes all waste types included under European Waste Catalogue Code 20 and some wastes under Codes 15 and 19.
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.
Renewable Heat Incentives (RHIs)	A long-term tariff scheme to encourage the replacement of fossil fuel heating with renewable alternatives, led by the Department of Energy and Climate Change. It opened for applications in November 2011 and currently supports renewable heat installations in business, industry and the public sector as well as district heating schemes.
Solid Recovered Fuel	Refuse Derived Fuel meeting a standard specification (CEN 343).
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.