Consultation Document

East Sussex and Brighton & Hove
Waste & Minerals Development Framework

Information Paper 4
Waste Management Methods and Technologies

October 2009

East Sussex County Council

Brighton & Hove City Council

Contents

IP4

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1.0 Introduction

1.1 This 'Information Paper' on Waste Management Methods and Technologies, is one in a series that has been produced to support the preparation of the Waste and Minerals Development Framework (WMDF). The WMDF will contain planning documents ('Development Plan Documents' (DPDs)) that will help decide how and where waste should be dealt with and minerals produced in East Sussex and Brighton & Hove in the future (up to 2026). More information about them can be found on the Councils' websites:

- www.eastsussex.gov.uk/environment/planning/development/mineralsandwaste
- www.brighton-hove.gov.uk/index.cfm?request=b1148434

1.2 The Information Papers are being used provide the evidence for the development of the WMDF and to support consultation and discussion with members of the public and key stakeholders who are concerned with waste and minerals in East Sussex and Brighton & Hove.

1.3 The Papers are 'living drafts' which present the evidence as it stands at this stage and they will be periodically updated with any new information that comes to light. This will ensure the Councils' knowledge and understanding of waste and minerals remains robust and the evidence base for the WMDF is 'sound'.

1.4 The Information Papers were first published and consulted upon in July 2007, and were then revised in February 2008. This third version (October 2009) brings them up to date with new information and recent changes in legislation and policy.

1.5 Details of the other Information Papers that have been produced are included in Appendix 1.

1.6 If you would like to comment on or add to the WMDF evidence base that is presented in this Information Paper, please visit the consultation website http://consult.eastsussex.gov.uk and follow the instructions for the Information Papers. Alternatively you can send an e-mail to wasteandmineralsdf@eastsussex.gov.uk or write to:

Waste and Minerals Planning Policy Team

Transport & Environment

East Sussex County Council

C4 Waste and Minerals Policy (AP)

FREEPOST (LW43)

Lewes BN7 1BR

1.0 Introduction

Please make sure that you refer to the section and paragraph numbers that your comments relate to.

2.0 Background

2.1 The waste planning system's role is to provide the land use and spatial planning framework through which waste minimisation can be achieved, and the necessary facilities for waste management (including the ultimate disposal of residual waste) can be planned for and provided.

2.2 Over the next twenty years, there will continue to be a significant shift in emphasis towards a more sustainable waste management system with more reuse, recycling, and energy recovery from waste, and a smaller share of waste being sent to land disposal [(1)].

2.3 The reduction in land disposal means that significant new waste management capacity will be required to enable a shift from disposal of waste to land (by landfill or landraise) to recovery of resources from waste. These new recovery facilities will vary in their physical size and the type of technology employed. This Information Paper outlines the range of facilities and technologies that can help deliver a more sustainable waste management system.

2.4 Facilities that manage waste that cannot be recycled take 'thermal' or 'non-thermal' forms. Examples of thermal technologies include traditional combustion technologies such as Energy Recovery Facilities (ERF) or more innovative advanced thermal technologies such as pyrolysis and gasification. 'Non thermal' technologies are based upon mechanical and biological treatments - these include anaerobic digestion, in-vessel composting and autoclaving (a form of 'pressure cooking' waste). In addition, smaller and 'lower tech' facilities such as local composting, recycling and bulking/transfer facilities will also be needed.

2.5 Several of the technologies described in this Information Paper are able to generate energy from waste. These are classified as renewable energy sources and as such may enable electricity suppliers in meeting targets set under the Government's Renewables Obligation[(2)].

2.6 For further information on the site requirements, inputs and outputs of the various treatment methods, please the see the separate technical study 'Defining the Characteristics of Strategic Waste Management Facilities.'

2.7 The use of various waste management technologies in mainland Europe is considered in Appendix 5.

1 Information Paper 3 - 'Sustainable Resource Use and Management' considers this in more detail.
2 Further information is available at www.berr.gov.uk

3.0 Main Types of Waste Management Facilities

3.1 This section illustrates the various waste management facilities and technologies that are, or could potentially be, used in the processing of waste on sites in Brighton & Hove and East Sussex. Particular sites are not necessarily restricted to just one of these options, indeed there are potential benefits in locating different facilities on the same site. These could include utilising economies of scale by taking advantage of existing infrastructure, and reducing the need for the transportation of waste between facilities over longer distances.

Bring Sites

3.2 Bring Sites are small recycling centres which are located in areas such as supermarket car parks, pub car parks and other community focal points where there are containers (also known as 'banks') for glass, paper, cans and textiles. Members of the public deposit materials in the containers which are then collected and taken to be processed.

Siting and Design Issues: Sites should be easily accessible to the public.

Key Planning Issues: Litter, noise.

Household Waste Recycling Sites

3.3 These sites are provided by the Waste Disposal Authorities (East Sussex County Council and Brighton and Hove City Council), as places where the public can deliver their household waste for recycling or disposal. This usually includes bulky goods such as domestic appliances as well as garden waste. Sites in East Sussex and Brighton & Hove are currently operated on behalf of the Councils by the waste management company Veolia.

3.4 The sites may be 'split level' for ease of access (the site at Crowborough is an example of this) and usually incorporate skips, collection areas for waste fridges and furniture, and recycling banks. A greater diversity of recycling banks are often found at these sites than at local bring banks, including containers for materials such as clothing, waste batteries, paint, oil and wood. Facilities in East Sussex and Brighton & Hove do not accept waste from businesses, although sites in other areas may allow traders to dispose of waste for a fee.

Siting and Design Issues: Sites should be easily accessible to the public. Traffic queuing issues at peak times

Key Planning Issues: Traffic, visual impact, litter, noise

Waste Transfer Stations

3.5 Waste transfer is the process by which waste is taken from waste producers, including industry, commerce and the general public, and then bulked up prior to be being taken to another facility for treatment or disposal. Transfer stations are commonly used to transfer waste from smaller vehicles, usually with a capacity of around 10–12 tonnes, to larger vehicles of up to 22 tonnes, or from road vehicles to trains or barges for onward transport. This minimises the cost and reduces the environmental impacts of transport.

3.6 Waste Transfer Stations usually consist of a large building where vehicles deliver waste either onto the floor, into bays, or into compaction units. Inert waste may be transferred in the open. Non-inert waste is usually only present for a matter of hours before being transferred, either directly or by front-loading shovel, into larger vehicles for onward transport. Waste is not usually stored within the waste transfer station overnight. Waste transfer stations are often co-located with other waste management activities such as Materials Recovery Facilities, for example at Hollingdean in Brighton.

Siting and Design Issues: Siting will be subject to the scale. Co-location with other waste facilities could minimise transport distances.

Key Planning Issues: Noise, traffic, visual impact, odour, litter

Materials Recovery Facilities

3.7 A Materials Recovery Facility (MRF) is a facility where recyclables can be recovered from an input of mixed waste. Although MRFs can sort many kinds of mixed waste they are generally considered to be facilities for the reception and separation of mixed dry recyclables such as card, paper, cans and plastic bottles, usually collected from households, but sometimes from commercial properties. These are called ‘clean’ MRFs. There are also MRFs where unsegregated mixed waste is sorted; these are known as ‘dirty’ MRFs although this term can be misleading as all facilities are subject to the same environmental controls.

3.8 The operations which take place usually involve a combination of manual and mechanical sorting. Manual sorting involves picking and sorting waste from a conveyor, while mechanical sorting can involve a combination of conveyors and a way of separating the waste e.g. density, magnetic, optical and air separators. While high recycling rates are achieved at MRFs there will always be some rejects which will need to be processed elsewhere, such as through land disposal, energy recovery, or for biodegradable material there is the possibility of a biological treatment process. Unless the materials are to be processed back into raw materials in the same location as the MRF, the recyclables are bulked up and taken away for reprocessing elsewhere.

3.9 In East Sussex and Brighton & Hove there are currently two small scale ‘clean’ MRFs at Lewes (7,000 tpa) and Uckfield (15,000 tpa), as well as a new, larger facility at Hollingdean in Brighton that is permitted to process 50,000 tpa.

Siting and Design Issues: Co-location with other waste facilities possible to minimise transport distances.

Key Planning Issues: Noise, traffic, visual impact, odour, litter.

3.0 Main Types of Waste Management Facilities

Inert Waste Processing

3.10 This is the treatment or recycling of inert waste (usually waste arising from construction and demolition activity such as brick, concrete and soils) at centralised processing facilities or where the material arises. Material is delivered by skip or bulk vehicle for crushing, screening and grading for re-use. Residues from processing operations may be used in landfill engineering (e.g. for the construction of site roads). Operations usually require extensive areas of hardstanding for stockpiles of material, and for locating crushing, screening and grading machinery. Some elements of the operation and storage may be enclosed, but it is mostly undertaken in the open air.

3.11 There are several facilities within East Sussex and Brighton & Hove producing an estimated 370,000 tonnes of secondary and recycled aggregates (2003) [3], generally situated in industrial areas.

Siting and Design Issues: Typically noisier than sites for MSW and C&I waste so should be located a suitable distance from residential areas.

Key Planning Issues: Noise, dust, traffic, visual impact.

Composting

3.12 Composting is the degradation of organic matter through a biological process in which micro-organisms convert biodegradable matter into a stabilised residue known as compost. The process uses oxygen drawn from the air and produces carbon dioxide and water vapour as by-products.

3.13 Industrial composting maximises the efficiency of the process by creating the optimum conditions for the chemical reactions involved, through controlling the inputs of carbon, nitrogen, oxygen and water, and by ventilating and mixing the material as required.

3.14 There are two methods of large scale composting, as follows:

Open Windrow Composting

3.15 Open windrow composting involves placing shredded organic waste (usually green waste) into long piles known as windrows. The windrows are typically up to 3m in height and 4m in width and are turned periodically. The composting process takes about 8 – 10 weeks.

3.16 As the composting process is similar to an agricultural operation, it tends to take place in the countryside either on farms or at landfill sites. Windrow composting often takes place in the open but in some cases it is enclosed in large warehouse-like buildings. Sites require a large surface area, usually a ‘concrete pad’ with drainage.

Machines are used to shred the waste, turn the windrow and screen the finished compost material. Deliveries to the site will usually be by an HGV that has picked up bulked green waste from a waste transfer station or household waste recycling site.

3.17 The Environment Agency requires a 250m buffer zone to be maintained between open windrow sites and residences to guard against odour and bioaerosols. There are currently four open windrow composting operations in East Sussex and Brighton and Hove. A large scale enclosed windrow composting operation capable of managing 46,000 tonnes of waste per annum is currently under construction at Whitesmith, near Chiddingley.

Siting and Design Issues: Best suited to non-sensitive rural sites such as farms or existing landfill sites. 250m buffer zone distance required from residences.

Key Planning Issues: Odour, water resources, noise, traffic, air quality, control of emissions and proximity of sensitive receptors.

Advantages: Composting is a simple technology and well established; markets for the compost.

Disadvantages: Cannot accept kitchen waste.

In-Vessel Composting

3.18 In-vessel composting (IVC) takes place within an enclosed system; air is usually forced through the compost and there is a system for extracting bioaerosols from the process.

3.19 IVC is a more sophisticated process compared to open windrow composting as the enclosed nature allows conditions within the maturing compost to be more closely controlled. It can be used to treat kitchen waste as well as green waste. The system ensures that the waste reaches a temperature of 60° for two days in order to kill any pathogens in the waste and ensure compliance with the Animal Bi-Product Regulations.

3.20 An IVC plant will normally include a reception area where the waste is shredded before it is transferred into the enclosed vessels, which can be steel containers, tunnels or enclosed halls. Following the in-vessel processing the final compost will need to mature which often involves a third stage of windrowing, which can occur outside or enclosed in a maturation hall. It may then be screened to remove contaminants such as plastic, glass and stones before it is ready for the market, and produce a range of product grades suitable for various end uses. Facilities which process to BSI PAS 100 and the Quality Protocol for compost produce products which are no longer considered a waste by the Environment Agency.

Siting and Design Issues: Can be sited in a variety locations due to its enclosed nature.

Key Planning Issues: Odour, water resources, visual impact, traffic.

Advantages: Can be used for kitchen waste.

Disadvantages: Technology not well established.

Anaerobic Digestion

3.21 Anaerobic Digestion (AD) is a biological process where biodegradable waste, such as garden and kitchen waste, is broken down into a 'digestate' and biogas. AD facilities are usually fully enclosed in an industrial type building, with some external infrastructure required such as storage tanks. After the plastic, glass, grit and metals has been removed from the waste it is mixed with water and placed in a sealed cylindrical digestion tank, where it is heated and stirred for up to three weeks. This is known as the digestion or fermentation stage where bacteria breakdown the waste to produce the following:

- Biogas, which is rich in methane and can be used to generate heat and/or electricity;
- Digestate which is a nutrient rich compost like material and can potentially be used as a soil conditioner; and
- Liquor, which can potentially be used as a fertiliser.

3.22 Currently there is only one AD facility within East Sussex and Brighton & Hove, which is used by Southern Water to treat sludge from wastewater treatment plants.

3.23 Further information is available in Appendix 4 and at:

www.defra.gov.uk/environment/waste/wip/newtech/pdf/abt.pdf

Siting and Design Issues: Small scale community based schemes can be located on a wide range of sites. Larger centralised facilities will be limited to sites suitable for large built development with appropriate road infrastructure.

Key Planning Issues: Odour, visual amenity, noise, traffic

Advantages: Electricity can be generated from the biogas produced, with the potential for also utilising the excess heat generated. Can accept food waste.

Disadvantages: Technology not well established for household waste in U.K. Markets for the digestate (compost material) are limited.

Mechanical and Biological Treatment (MBT)

3.24 Mechanical Biological Treatment (MBT) is a process that removes metals and other recyclables, and uses bacteria in a biological treatment such as anaerobic digestion to produce a compost-like material from the remainder of the waste. MBT is a generic name for a combination of technologies; systems sometimes undertake the mechanical treatment element first i.e. The removal of recyclables, in other systems the biological process may come first. This flexibility allows bespoke MBT systems to be designed to suit the particular composition of the waste being processed, or to enable a particular output material to be produced.

3.25 During the process the volume and weight of waste is reduced and the waste is stabilised through in-vessel composting or anaerobic digestion. Following the process the waste is then screened by machinery to remove any further metal, glass, stone etc in a similar fashion to a MRF. Metals can be recycled, organic material may go for further processing, while paper and plastic may form Refuse Derived Fuel (RDF) or Solid Recovered Fuel (SRF) and be sent for further recovery as a feedstock for a thermal treatment facility . Guidance on the use and regulation of outputs from MBT facilities is provided by the Environment Agency.[4]

3.26 Depending on the method used and the degree of mechanical and biological treatment that has taken place, the remaining material can either be sent to landfill, used as an agricultural product/ soil additive or used in thermal treatment.

3.27 In the UK the RDF/SRF and soil additive (compost like material) are regarded as waste so the opportunities for their use are constrained by legislation. The soil additive can only be used for use on land if the operator demonstrates that it does not cause harm to human health or pollution of the environment, and that it results in agricultural benefit and /or ecological improvement.

Siting and Design Issues: Usually compatible with general industrial and storage/distribution use areas. Noise sensitive locations should be avoided.

Key Planning Issues: Odour, noise, traffic impact, visual amenity, air quality and proximity of sensitive receptors

Advantages: Can use well-established technologies.

Disadvantages: Markets for the compost like material output may be limited due to issues with the quality of the final product. The soil improver may not be included in the calculation of recycling rates. Recovered recyclabes are often of poor quality.

See Appendix 4 for further information.

Energy Recovery Facilities (ERF)

3.28 Energy Recovery Facilities (ERF) involve the incineration of waste at high temperatures; the heat is then used to generate power. ERFs can be used as a treatment for a variety of wastes, including municipal, commercial and industrial wastes, clinical wastes, hazardous and chemical wastes, and sewage sludge. The term 'ERF' is preferred over 'incinerator' as incinerators do not necessarily recover energy.

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4 See 'The Mechanical Biological Treatment of Waste and regulation of the outputs (Version 1, June 2005)', Environment Agency.

3.0 Main Types of Waste Management Facilities

3.29 Waste vehicles tip their contents into a hopper and the waste is then pushed gradually into the combustion unit. During the combustion process the volume and weight of the waste is reduced and transformed into various gases and ash.

3.30 Before the gases are released into the atmosphere they are treated through a series of emission clean-up technologies. Two forms of ash are produced: The heavier or 'bottom' ash is collected and sent for recovery i.e. used in the construction industry; metals are removed from the bottom ash and recycled; the lighter or 'fly' ash results when fine particles are filtered from the gaseous emissions and is then sent to specialist landfills or treatment facilities.

3.31 An ERF with a capacity of 210,000 tonnes per year is currently under construction in Newhaven.

3.32 Although the public often have a negative perception of ERFs due to perceived risks to public health through emissions, the Health Protection Agency has recently reviewed the latest scientific evidence on the health effects of modern municipal waste incinerators and concluded that while it is not possible to rule out adverse health effects completely, any potential damage from modern, well run and regulated incinerators is likely to be so small that it would be undetectable[5].

Siting and Design Issues: Existing waste sites and major industrial areas should be preferred locations

Key Planning Issues: Air quality/emissions, noise, traffic, visual amenity, off-site ecology, siting and scale of operation, disposal of residues. The height of the stack is determined by factors relating to the process design and air dispersion modelling.

Advantages: Technology is well established. Markets are available for the electricity generated.

Disadvantages: Negative public perception. Metal and ash can be recycled although it does not currently count towards recycling targets. Extensive flue gas treatment is required to mitigate against air pollution.

For further information see Appendix 4.

Advanced Thermal Treatment (ATT)

3.33 Advanced Thermal Treatment (ATT) is the name given to the group of technologies that primarily includes **gasification** and **pyrolysis**. ATT facilities heat waste at very high temperatures in an atmosphere that has a restricted amount of oxygen. The production of charcoal is an example of the use of pyrolysis and gasification techniques as the wood is starved of oxygen and therefore does not fully combust.

5 www.hpa.org.uk/webw/HPAweb&HPAwebStandard/HPAweb_C/1251473371954

3.0 Main Types of Waste Management Facilities

3.34 Gasification is a partial oxidation thermal process which takes place in the presence of air, or air enriched with oxygen. Temperatures reach 900–1100°C when in air and 1000–1400°C using oxygen. Pyrolysis occurs when there is a complete absence of oxygen, and as a result the waste does not burn with a visible flame during the combustion process. There are three products of pyrolysis: gas, liquid and a solid known as char. The chemical reaction takes place at temperatures of between 400°C and 800°C.

3.35 Energy is generated from pyrolysis and gasification in one of two ways:

- The syngas is combusted and the hot gases are fed through a heat-exchanger whereby steam is produced and this is used to generate energy in a steam turbine.
- The syngas is refined to a high quality and used in a gas engine to produce electricity.

3.36 Both processes avoid the complete combustion of the waste, as happens in an incinerator. Some processes leave recyclables such as glass and metal intact for recycling, and the char that is produced can often be used as a stable energy-rich fuel for further energy recovery.

3.37 **'Plasma arc technology'** is another variant of ATT. This process uses extremely high electrical energy and temperatures which are created by an electrical arc to break down pre-treated waste into two recyclable products: a hydrogen rich syngas and a vitrified (glass like) material suitable for use as a replacement aggregate or building material.

3.38 ATT produces fewer pollutants are produced than through conventional incineration. This means pollution control measures are less costly and the process may be economically viable at a smaller scale than traditional Energy Recovery Facilities.

3.39 Currently there are no gasification or pyrolysis plants in East Sussex and Brighton & Hove. There are numerous providers of ATT systems, however most have operated only as small scale pilots and so lack the proven commercial track record of more established conventional technologies such as traditional energy from waste incineration. Defra is funding a number of ATT pilot schemes as part of the New Technologies Demonstrator Programme in order to help establish the economic, social and environmental viability of the technologies. Further details on the Demonstrator Programme are available at www.defra.gov.uk/ENVIRONMENT/waste/wip/newtech/dem-programme/. Further information on ATT is available at www.defra.gov.uk/environment/waste/wip/newtech/pdf/att.pdf and www.juniper.co.uk/services/Our_services/P&GFactsheet.html

Siting and Design Issues: Generally not compatible with residential areas. Existing waste sites and major industrial areas should be preferred

Key Planning Issues: Air quality, noise, traffic, visual amenity

Advantages: Markets are available for the electricity which is produced. Cleaner than ERFs. Can operate at smaller scales than ERFs

Disadvantages: Technology is not yet well established for use with household waste.

Further information is available in Appendix 4.

Autoclave

3.40 This process is well established in sterilisation of clinical waste at dentists or hospitals, and is also known as Mechanical Heat Treatment. Mixed waste is loaded into a sealed cylinder and high temperature steam (approximately 160C) cleaning treatment is applied, while the vessels rotate or oscillate grinding the waste and breaking it up. The 'cooking' process causes the biodegradable part of the waste to be broken down into an organic fibre, while causing plastics to soften and flatten, paper and other fibrous material to disintegrate into a fibrous mass and bottles and metal objects to be cleaned and labels to be removed.

3.41 The main reason for using the autoclave system is to enable individual material types to be easily recovered from a mixed waste stream. The recovered metals and glass are cleaned enhancing their value to the market. Plastics form mixed lumps from which individual plastics cannot be recovered - these lumps can be used in products with low performance requirements.

3.42 The fibre can be sent for thermal or biological treatment or potentially it has a use in the manufacture of cardboard like products, although markets are still being developed for this. A portion of the heat content of the steam and water can be recovered by various well-established engineering methods, thus improving the economic and energy efficiency of the process.

3.43 Currently there are no waste autoclaves operating in East Sussex and Brighton & Hove. For further information see:

www.defra.gov.uk/environment/waste/wip/newtech/pdf/mht.pdf

Siting and Design Issues: Generally not compatible with residential areas. Existing waste sites and major industrial areas should be preferred

Key Planning Issues: Air quality, noise, traffic, visual amenity.

Advantages: Range of potential markets for the main flock product which can be used in low performance fibre composites, or in the manufacture of cardboard-like products. A higher proportion of dry recyclable material can be recovered for recycling.

Disadvantages: Technology is not yet fully established. Markets are currently limited.

Landfill

3.44 The term landfill relates to waste disposal mainly within a void space although landraise, is also generically referred to as landfill and refers to waste disposal mainly above pre-existing ground levels.

3.45 Landfill sites can be restricted to the types of waste they may accept, some landfills are inert only, while others are permitted to accept biodegradable waste, liquid wastes or hazardous wastes. The EU Landfill Directive bans the landfilling of liquid wastes and the co-disposal of hazardous and non-hazardous solid waste.

3.46 Modern landfill practice requires a significant degree of engineering in order to contain the waste, control emissions and minimise potentially harmful environmental effects. The primary by-products of landfilling, where biodegradable materials are disposed of, are:

- landfill gas – (a combination of methane and carbon dioxide, along with trace organics); this can be used to generate electricity in a power generation plant and sent to the national grid or power nearby industrial uses
- leachate (a liquid resulting from rainwater passing through biodegradable waste)

3.47 Much landfill engineering is geared towards dealing with these substances. As such, landfill sites require containment lining systems and abstraction systems for both landfill gas and leachate.

3.48 Beddingham landfill site near Lewes closed in 2009, leaving Pebsham, located between Bexhill and Hastings, as the only operational site within East Sussex and Brighton & Hove.

3.49 More information on landfill and landraise is contained in Information Paper 5 – 'Residual Waste Disposal'.

Siting and Design Issues: Incompatible with residential areas. Landfilling locations restricted to where voids are located.

Key Planning Issues: Air quality, climate change, noise, vermin, traffic, visual amenity, ecology, effect on water resources.

Advantages: Well established. Relatively cheap although becoming less so as landfill tax increases. Landfill gas can be used to generate electricity. Can be used to restore former mineral workings.

Disadvantages: Policy at all levels of Government discourages land disposal. Negative effects on the environment due to methane and leachate outputs. Least sustainable means of waste management.

3.0 Main Types of Waste Management Facilities

Combined Heat and Power

3.50 Combined Heat and Power (CHP) refers to systems that put to use the by-product heat from electricity production that is normally wasted to the environment. Although not a waste management process in its own right, CHP systems can be created around all waste management technologies that recover energy from the waste, and the captured heat is normally used to provide hot water or heating systems to nearby buildings.

3.51 In order for CHP to be viable, a large heat[(6)] user with consistent demand for the heat is required to receive the heat that is produced. Theoretically the heat user could be some distance away, however the logistical and engineering problems associated with constructing the infrastructure required to transport the heat often mean a heat user in close proximity is the only economically viable solution. Integrated district heating systems to serve groups of houses or blocks have flats have also been developed.

3.52 As CHP systems make use of the heat energy produced during the electricity production process, they have much higher overall energy efficiencies. Overall efficiencies of over 80% can be obtained, which compares well with the 20-30% commonly found in standard energy from waste facilities.

3.53 A separate background study has been produced specifically to assess the feasibility of utilising CHP in new waste management facilities in East Sussex and Brighton & Hove.

Biomass

3.54 Biomass is a renewable fuel derived from living, or recently living, organisms. The most obvious source of biomass is plant based material such as waste wood, but it can also apply to animal and vegetable based products. Energy can be recovered from the waste through processes such as incineration, gasification and pyrolysis which generate electricity, with the potential for also capturing the heat generated to create a Combined Heat and Power system. Biomass can also be managed using biological techniques such as anaerobic digestion.

6 Large heat users can include hospitals, leisure centres, university campuses and large industrial sites.

4.0 Regulation of Waste Management Facilities

4.1 East Sussex County Council and Brighton and Hove City Council are responsible for granting planning permission (the physical use of the land) for waste facilities such as those outlined in Section 3 above.

4.2 The Environment Agency is responsible for permitting and regulating waste sites. The Environmental Permitting Regulations (EPR) came into force on 6 April 2008. Under these regulations the Environment Agency regulates waste management sites by issuing legally binding permits which set out the conditions and standards that the facility will have to meet, for example the quantity of certain substances that can be released from the facility into the environment. The decision on whether or not to grant an Environmental Permit can only be made by the Environment Agency and is separate to planning permission.

4.3 There are two types of permit, standard and bespoke, as follows:

- Standard permits can be issued when a facility is in accordance with a set of rules setting out the types and volumes of waste that can be accepted, how it can be treated and how it must be stored. Limits are also placed on the proximity to neighbouring sites and environmentally sensitive areas.
- Bespoke permits are written specifically for a particular facility when it does not conform to the set rules which would allow a standard permit to be automatically issued. This is a more time-consuming and expensive process.

4.4 Certain activities are exempt from requiring an Environmental Permit, these are invariably low-risk or very small scale activities[(7)]

7 Further information is provided at www.environment-agency.gov.uk/business/topics/permitting/default.aspx

Appendices

Appendix 1 – List of other Information Papers prepared

1. The Future Need for Waste Management
2. The Future Need for Minerals Production and Management
3. Sustainable Resource Use and Management
4. Waste Management Methods and Technologies
5. Residual Waste Disposal
6. Spatial Portrait of East Sussex and Brighton & Hove
7. Hazardous Waste
8. Transportation of Waste and Minerals
9. Climate Change and Waste and Minerals
10. Wastewater and Sewage Sludge Treatment

Appendix 2 – National and international legislation relevant to this Information Paper

- EU Landfill Directive
- Environment Act 1995
- Environmental Protection Act 1990
- Landfill (England and Wales) Regulations 2002 SI 1559
- The Landfill (England and Wales) (Amendment) Regulations 2004
- The Landfill (England and Wales) (Amendment) Regulations 2005
- The Pollution Prevention and Control (England and Wales) Regulations 2000 – and amendments
- Waste Incineration Directive 2002
- The Waste Incineration (England and Wales) Regulations 2002
- Town and County Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 and Circular 2/99 Environmental Impact Assessment
- Environmental Permitting (England and Wales) Regulations 2007

Appendices

Appendix 3 - Background Documents and further reading

- CIWM/SLR Consulting (Nov 2005) Delivering key waste management infrastructure: lessons from Europe. www.ciwm.co.uk/mediastore/files/12134.pdf
- Defra (2005) Advance Thermal Treatment of Municipal Solid Waste. www.defra.gov.uk/environment/waste/wip/newtech/pdf/advancedthermaltreat.pdf
- DEFRA (2005) Introductory Guide: Options for the Diversion of Biodegradable Municipal Waste from Landfill. www.defra.gov.uk/environment/waste/wip/newtech/pdf/introductoryguide_bmw.pdf
- DEFRA (2005) Mechanical Biological Treatment and Mechanical Heat Treatment of Municipal Solid Waste. www.defra.gov.uk/environment/waste/wip/newtech/pdf/mechbiotreat.pdf
- DEFRA/ERM/Golder Associates December (2006) Carbon Balances and Energy Impacts of the Management of the UK Wastes. http:/www.defra.gov.uk/science/project_data/DocumentLibrary/WR0602/WR0602_470_FRP.pdf
- DEFRA Climate Change and Waste Management: The Link. Waste Implementation Programme: www.defra.gov.uk
- Defra. Pollution Prevention and Control: The Waste Incineration Directive www.defra.gov.uk/Environment/ppc/wasteicin/index.ht
- DEFRA/Enviros/University of Birmingham (May 2004) Review of Environmental and Health Effects of Waste Management: Municipal solid waste and similar wastes www.defra.gov.uk/environment/wasteresearch/health/pdf/health-summary.pdf
- DEFRA Waste Strategy 2007 and annexes www.defra.gov.uk/environment/waste/strategy/index.htm The Environment Agency. Waste Technology Data Centre. www.environment-agency.gov.uk
- Health Protection Agency (2009) The Impact on Health of Emissions to Air from Municipal Waste Incinerators, available at www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1251473372218
- HUANG Jian-jun et al (2003) A new waste disposal technology - plasma arc pyrolysis system. Plasma Science & Technology, Vol 5:2
- ODPM (2004) Planning for waste management facilities: a research study. http:/communities.gov.uk/pub/713/planningforwastemanagementfacilitiesrsearchproject_id1145713.pdf
- Planning Policy Statement 1: Delivering Sustainable Development
- Planning Policy Statement 10: Sustainable Waste Management
- Planning Policy Statement 10: Companion Guide
- Planning Policy Statement 23: Planning and Pollution Control

Appendix 4 – Detailed Description of Selected Newer Technologies

Anaerobic Digestion (AD)

AD is a similar process to composting in that the process reduces organic waste matter into a material similar to compost called a digestate. It is also an energy from waste process as biogas produced can be used as a fuel. The process can range from small single units to multiple vessels.

Waste Input

AD is suited to wet organic wastes i.e. sewage and foodstuffs from the household waste stream. Segregation of wastes whether by the householder or at a MRF can benefit the process by removing non-biodegradable items such as plastics, glass, and textiles.

Process

The waste material is broken down into small pieces and can be mixed with other wastes to facilitate degradation by ensuring that the feedstock is well-balanced in nutrients and carbon to nitrogen ratio. Water can be added to the waste which helps in sieving the waste to remove unwanted materials such as glass and plastics. The waste and water ‘slurry’ is then placed into an anaerobic digester unit, which is sealed to prevent oxygen entering. The slurry can be in the digester unit for 10-25 days, where a mechanical stirrer ensures the microbes and wastes are mixed. Due to the microbial activity the waste inside the digester heats to between 50°C and 60°C.

Animal matter can be included in the AD process as long as care is taken to ensure destruction of pathogenic organisms in line with the Animal by Product Regulations (2005). The Regulations state that the slurry must be pasteurised at 70°C for one hour.

Output

There are three outputs from an AD plant:

- Biogas: has a high methane content, and can be used to generate heat and/or electricity.
- Digestate: contains biosolid material and can be used as a soil conditioner for use in agriculture once it has undergone a period of aerobic composting.
- Liquor: this can be used as a liquid bio-fertiliser.

Mechanical and Biological Treatment (MBT)

MBT is a generic name for a combination of mechanical and biological processes used to treat waste in order to reduce the volume, weight and biodegradable content of the waste. The process can take place as either mechanical processes followed by biological processes, or vice versa.

The specific design of a MBT plant is dependent upon the type and quantity of waste it is intended to process. The feedstock is usually mixed municipal waste. Typical processes for the mechanical and biological stages of treatment are described below.

Mechanical Treatment

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Oversized rejects such as mattresses and carpets are removed for disposal to landfill. The waste is then prepared for mechanical sorting by processes which reduce the size of the waste materials. These processes include shredding and the use of ball mills which pulverise the waste with metal balls inside a large drum until it is reduced to a size that enables it to pass through holes in the side of the drum.

The waste can then be separated using a number of different processes, such as:

- Magnets and eddy current separators which separate waste fractions into ferrous and non-ferrous metals.
- Trommel screens using centrifugal force to throw larger materials away from the centre of a drum which has different size holes to allow different materials to fall through at different points.
- A ballistic separator can separate larger material with a particle size of greater than 80mm into heavy (e.g. stones, plywood) and light (e.g. textiles, tissue) fractions.
- An optical separation process, which uses light to identify certain recoverable plastics and air jets to blast them off a conveyor belt into a container.

Biological Treatment

Biological waste treatment processes involve the decomposition of biodegradable wastes by living microbes (bacteria and fungi), which use biodegradable waste materials as a food source. There are three methods of biological processing that can be used within a MBT facility. These are:

- Aerobic bio-drying: waste is subjected to the initial stages of open windrow composting process to partially stabilise the waste and reduces its weight by approximately 25%. Air is passed through the waste to dry it and increase the breakdown of organic matter in the waste. The material can be used to produce Refuse Derived Fuel (RDF), or alternatively the drying process can continue for longer to further reduce the biodegradability of the waste if it is intended for land disposal.
- Aerobic in-vessel composting
- Anaerobic digestion

These latter two processes listed above are described in more detail elsewhere in this Information Paper.

Outputs

Outputs from MBT facilities are dependent on which technologies are used in the processing of the waste. They can include:

- Biogas - if AD process is used
- Refuse Derived Fuel
- Compost-like outputs
- Materials for recycling

Energy Recovery Facilities (ERF)

Energy Recovery Facilities use a proven combustion process which significantly reduces the volume of the waste and recovers energy from it to produce electricity. The process often takes place after recycling and composting have occurred, reflecting its position in the Waste Hierarchy. Advanced Thermal Treatments are another form of energy recovery technology and are described separately in this Information Paper.

The Process

The residual waste is received in a reception hall and any oversized or inappropriate fractions of waste are removed for recycling or disposal to land. The remaining waste is deposited in a deep bunker, usually large enough to house several days of waste. Older and new waste are mixed by the grab hook as it is placed in the hopper to achieve a balanced calorific value and then into the furnace. ERFs can also operate using Refuse Derived Fuel which has the benefit of being consistently high in calorific value.

In a moving grate incinerator[(8)] waste is fed continuously into the furnace. The waste first dries, then the volatile elements are combusted at a temperature of approximately 900°C[(9)]. Injecting secondary air increases oxygen levels and aids in burning the resulting gases, which are treated prior to discharge. The organic component of the waste is oxidised to form carbon dioxide and water while the solid residues are transformed into a mineralised form called bottom ash, which is constantly discharged from the incinerator. The volume and weight of the waste are reduced by approximately 90% and 75% respectively.

Steam is generated whilst cooling the gases produced during combustion. The steam is then used to power turbines and generate electricity. The excess heat produced can be harnessed to provide heating or hot water for nearby heat users in a Combined Heat and Power (CHP) system. Using CHP can increase the energy efficiency of the process from approximately 27% to over 80%.

After passing through the boiler tubes, the cooler gases are cleaned using scrubbers which remove the acid gas, and baghouse filter which remove fine particles. Urea or ammonia is injected into the furnace to reduce nitrogen oxides to nitrogen. Dioxins and heavy metals are absorbed onto activated carbon, which is then removed by the scrubbers and baghouse filters. The cleaned gases enter the atmosphere through the exhaust stack. Emissions are strictly monitored by the Environment Agency, and operators often publicise emission records to encourage neighbour confidence in the process.

8 This is the most commonly used system, however other types of process can be used, for example rotary, drum kiln, oscillating grate and fluidised bed furnace.

9 A minimum temperature of 850°C must be reached for at least two seconds in the presence of air (with at least 6% oxygen)In order to comply with the Waste Incineration Directive (2000/76/EC).

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Outputs (% by weight of original input in brackets)

- Bottom ash- biologically inert so it can be used as an aggregate in construction or road building (20-30%)
- Metals- can be recycled although quality is likely to be lower than those removed before combustion (2-5%)
- APC residues (fly ash, reagents and waste water)- these are hazardous and must be sent for disposal at a permitted site (2-6%)
- Gaseous emissions to the atmosphere (70-75%)

Advanced Thermal Treatment

ATT processes involve the thermal treatment of waste to produce electricity and/or heat, but differ from conventional incineration in that the quantity of oxygen present is restricted. Pyrolysis occurs in the complete absence of oxygen whereas gasification involves the partial combustion of waste with a limited amount of oxygen.

The specific design of a system is dependent upon the type and quantity of waste it is intended to process. Examples of feedstock include mixed municipal waste and single waste streams such as clinical waste. Large objects and recyclables are usually removed as biodegradable materials and plastics are more suited to the processes, and the waste can be processed to remove excess moisture and shredded to reduce its size. ATT processes can also use Refuse Derived Fuel that has been created in MBT or autoclave facilities.

Pyrolysis chambers generally have a temperature of 400°C - 800°C although the Waste Incineration Directive requires a temperature of 850°C to be reached for a minimum of two seconds. Gasification processes operate at higher temperatures, 900°C - 1,100°C when in air and 1000°C - 1,400°C when in oxygen. The thermal decomposition of the organic fraction results in the formation of a gas (syngas) and a solid char residue. Char is a combination of non-combustible material and carbon.

The ferrous and non ferrous material can be recovered for reprocessing. The condensible fraction of the syngas can be collected by cooling; this can potentially be used as a liquid fuel. The remaining char can be treated further in the gasification process.

Outputs

Solid metals and carbon are discharged from the process. In the case of gasification the level of carbon is small; with pyrolysis it is significant. Depending on the type of process used mixtures of gaseous, liquid and solid fuels are produced:

- The liquid can potentially be used as a fuel although care must be taken depending on its chemical composition.
- The main product is syngas, which is burnt to produce electricity through a steam turbine for export to the national grid.

- Slag produced in the gasification process can be use as an aggregate.
- Char from pyrolysis is a hazardous waste but could be used as coal replacement in certain combustion applications

Plasma Arc

At present plasma arc technology is primarily used on a small scale to process waste streams such as clinical waste, military waste and industrial waste. This is because of the high electrical consumption required to achieve the high temperatures for decomposition may make it uneconomic for large scale plants. However the technology has been used to treat municipal waste, and a proposal has been brought forward in Hirwaun, Wales, to use the technology [10].

The process is normally a two stage process based on gasification. Firstly, waste is gasified producing a syngas, usually contaminated with tars and soot as well as a solid char and ash. Secondly, using a plasma arc treatment to convert the residual soot tars and chars into a cleaner syngas, while simultaneously producing a vitrifed ash.

The waste is fed into the gasifier via a conveyor and feed hopper. High current electricity is passed between two electrodes. A carrier gas passes between the electrodes at above 3,000°C which then ionises and becomes electrically conductive. The gas changes its properties and becomes more viscous and forms a plasma. In the plasma state the ironised gas can conduct electric current, but due to its resistance, the electric energy is converted to heat producing temperatures ranging from 1650 to 13,000 °C, and this extreme heat rapidly breaks down the waste feedstock.

The waste streams are melted at the high temperatures and normally separate into two layers to form a molten bath. The gasified organic compounds react with steam and oxygen to produce a hydrogen rich syngas. The glass and other non-biodegradable materials are melted and turn into a non-leachable vitrified slag formed of two layers- glass and metal. The glass layer acts as a barrier from volatile metals, and also acts as a medium for chemically binding many metals in a non-leachable manner by vitrification.

The hot syngas exits from the plasma converter at approximately 1,200 °C and is then cooled in a water tube heat exchanger to reduce the gas temperature to 200°C. The syngas also passes through a strongly alkaline solution. The acidic components react and are neutralised in the solution leaving a cooled clean fuel gas suitable for using in a gas engine.

During this process, energy is recovered in the form of low-pressure steam and a proportion of the steam is used in the gasification process.

10 See www.letsrecycle.com/do/ecco.py/view_item?listid=37&listcatid=217&listitemid=9136.

Appendices

Outputs

The amount of solid by-products, i.e. glass and metal, produced by the process can be between 2 and 50%, depending on the composition of the original waste stream. A synthetic gas which can be used to generate electricity is produced. The vitrified waste can be used as road fill, concrete aggregate and other commerical products.

A benefit of the process is that virtual elimination of pollution occurs as the waste is processed by plasma heating, rather than by combustion by incineration or biologically through landfill. The creation of the syngas by pyrolysis (rather than combustion), as well as the gas being cleaned prior to use in energy generation, means that dioxins and furans are virtually eliminated.

Autoclave

Autoclave is also known as Mechanical Heat Treatment. Steam is used in a sealed unit under high pressure to ‘clean’ the waste. The process does not destroy any of the material input in the system, but can change the characteristics of some fractions e.g. plastics can soften and form lumps.

Input

The specific design of an autoclave system is dependent upon the type and quantity of waste it is intended to process. Examples of feedstock include mixed municipal waste and single waste streams e.g. clinical waste.

Process

Residual waste is received in a large reception hall, and unloaded into an autoclave unit, which is then sealed and the rotation begins. The autoclave unit is usually a large metal cylindrical vessel; typically they are 12m long, with a diameter of 2 - 2.5m. This would give a capacity of 5-8 tonnes (approx) of waste. Some larger units can have a capacity of 10 – 15 tonnes.

Steam at a temperature of 160°C is injected into the sealed unit for approximately 30mins, although the amount of time may vary depending on the waste composition and density. The pressure is maintained, rather like a pressure cooker, to clean and sterilise the waste.

The waste can then be subjected to further mechanical separation techniques, similar to those used in the Mechanical Biological Treatment process described above, such as:

- Large rotating trommel screen which throws the mixed recyclable material away from the centre through different size holes. This separates the different fractions such as fibrous fraction, glass and grit, plastics and metals.

- Ferrous and non ferrous metals can be recovered using magnets and an eddy current separator
- Some plastics, such as drinks and milk bottles can be recovered through an optical separation process, which uses air jets to blast the recoverable plastic from a conveyor belt.

Output

The separated recoverable materials such as metal and plastic are sent for reprocessing. Other remaining fine residual fractions and non-recoverable materials are sent to landfill.

Some of the residual material can be used for Refuse Derived Fuel.

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Appendix 5 - Waste Technologies in Europe

There are already many waste treatment plants operational in other European countries, all of which face the same EU targets to reduce the amount of waste they send to landfill. The Chartered Institute of Wastes Management (CIWM) looked at facilities in Europe in their report “Delivering key waste management infrastructure: lessons from Europe”, and noted that with the exception of Ireland and perhaps Spain, all the Member States are ahead of the UK in developing infrastructure to reduce reliance on landfill, with five “advanced” Member States - Germany, Austria, Denmark, Sweden, Netherlands – having already met their final targets for diversion of biodegradable municipal waste (BMW) from landfill as required under the Landfill Directive.

Both Belgium and Switzerland use MBT and AD to treat more than 40% of their waste, the technologies are also used in Germany and Italy.

Energy from Waste is widely used in many European countries. In 2003, EfW was used to manage more than half of Denmark’s household waste (53.8%) and nearly half of Sweden’s (45%). Both France and the Netherlands use the process for roughly a third of their waste, compared to just 7.4% of household waste in the UK. All of these countries also have excellent recycling and composting rates – the Netherlands recycles well over 45% of its household waste and Denmark manages over 40%.

A report by the National Audit Office, which scrutinises public spending, looked into why so many European countries are ahead of the UK. The report said that:

“The United Kingdom’s historic reliance on landfill left it poorly positioned in relation to many European countries who have already achieved their targets to reduce their reliance on landfill, partly due to geological, cultural and historic differences in approach to waste management." The report suggested that there are six common features of countries that had made greater progress:

1. a greater acceptance of energy from waste as an alternative method of waste disposal;
2. timely and clear promotion of preferred alternatives to landfill;
3. encouraging investment in facilities through strategic planning and clear guidance on measurement of waste and operating standards of facilities;
4. provision for municipalities to charge for waste collection;
5. comparatively high landfill costs through taxes or high industry costs;
6. infrastructure development risks shared between private investors and central or local Government”

Waste and Minerals Planning Policy Team
Planning Service – Transport & Environment
East Sussex County Council
County Hall
St Anne's Crescent
Lewes
East Sussex
BN7 1UE

01273 481846

Planning Strategy & Projects
Brighton & Hove City Council
Hove Town Hall
Norton Road
Hove
East Sussex
BN3 3BQ

01273 292505

wasteandmineralsdf@eastsussex.gov.uk
http://consult.eastsussex.gov.uk