

RPS

Draft Wales Waste Strategy

Health Impact Assessment

Final Report

22nd December 2008







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Summary

- S.1 The Welsh Assembly Government is in the process of developing an ambitious waste strategy that will deliver a more sustainable and environmentally responsible approach to waste generation and management throughout Wales over the next four decades.
- S.2 In keeping with the Assembly's strategic priorities, the requirements of Technical Advice Note 21 and following the Welsh Health Impact Assessment Support Unit guidance, the Assembly commissioned a Health Impact Assessment (HIA) to:
- support the iterative development of the Draft Strategy;
 - inform the development of a formal position on potential waste management options;
 - investigate and assess the significance and likelihood of potential health outcomes of the key policies and waste management options currently under consideration;
 - investigate factors that may influence the significance of potential health outcomes or their disproportionate impact upon communities and sensitive groups; and
 - provide evidence-based recommendations geared to reduce and remove potential adverse impacts and enhance opportunities to improve health.
- S.3 The HIA concludes that the Draft Strategy constitutes a holistic, targeted approach to waste-resource management which implicitly considers the health and wellbeing of communities through the recommended policies and the in-depth consideration of the waste management options. Following the recommendations of this HIA, and in conjunction with regulatory assessments and environmental permitting requirements set to stringent environmental thresholds to protect environment and community health, the Draft Strategy constitutes a robust document geared to protecting and improving Wales' environment, economy and the health and wellbeing of its people.
- S.4 Being a strategic document, a key feature of the HIA is to provide information that will further support decision making at the regional and local level throughout Wales. As such, the HIA provides a series of recommendations through a dedicated Health Management Plan geared to further support the development and delivery of the Draft Strategy, to aid in managing potential community and occupational health risks, enhance the uptake of benefits and to address relative inequality at the national, regional and project level throughout Wales.
- S.5 In addition to the Health Management Plan, the HIA provides a detailed review of the available scientific health and waste management evidence, supported by formal position papers issued

by organisations including the Environment Agency, the Health Protection Agency and the Chartered Institute for Water and Environmental Management.

1 Introduction

Background

- 1.1 The Welsh Assembly Government is in the process of developing an ambitious waste strategy that will set the framework for the reduction and management of waste throughout Wales over the next four decades.
- 1.2 The core aim of the strategy is to embed the principles of sustainable development into waste and resource management throughout Wales to facilitate a change in attitude towards waste at the industrial, retail and community level and reasserting the principle that can be achieved through increased accountability, more effective recycling initiatives and through facilitating a change in perception from thinking of waste as a valueless commodity to treating waste as a marketable resource.
- 1.3 The end goal, is to not only develop a more sustainable and environmentally responsible attitude to waste generation and management throughout Wales, but to further optimise material resources to the benefit of Wales' people, economy and environment.
- 1.4 To this end a number of specialist assessments have been commissioned to both inform the development of the Draft Strategy and to test it in terms of sustainability and potential risk to the environment, the economy and the health of communities throughout Wales. In keeping with the Assembly's strategic priorities, the requirements of Technical Advice Note (TAN) 21 and following the guidance set out in 'Improving Health and Reducing Inequalities' (WHIASU 2004), the Assembly has commissioned a Health Impact Assessment (HIA) to further inform and assess the Draft Strategy.
- 1.5 The HIA constitutes an additional means to inform decision making by identifying potential health pathways associated with the Draft Strategy, to develop an appropriate evidence base to assess potential health risk, to support the development of a formal position on specific waste management options, to highlight the project level regulatory requirements set to protect health and to address community concerns.
- 1.6 The remainder of this section provides a brief introduction to HIA, the core objectives, approach and methodology alongside the role and responsibility of the independent HIA Steering Group.

Health Impact Assessment

Aim and Objectives

- 1.7 HIA is a multidisciplinary process designed to identify and evaluate the potential health effects of a proposed project or programme and to facilitate opportunities to improve health and wellbeing.
- 1.8 The core objectives of this HIA include:
- support the iterative development of the Draft Strategy;
 - inform the development of a formal position on potential waste management options through the provision of a robust health and waste management evidence base;
 - investigate and assess the significance and likelihood of potential health outcomes (both adverse and beneficial) associated with the Draft Strategy;
 - investigate potential confounding factors that may influence the significance of potential health outcomes or their disproportionate impact upon communities and sensitive groups; and
 - provide evidence-based recommendations geared to reduce and remove potential adverse impacts and enhance opportunities to improve health.
- 1.9 The HIA is also intended to further address commonly perceived risks and community concerns and to provide information and recommendations to support more health conscious waste-resource management planning and decision making at the project level (i.e. during site and technology selection, planning, regulatory assessment and environmental permitting).

HIA Approach and Scope

- 1.10 In accordance with the Welsh Health Impact Assessment Support Unit's guidance (WHIASU 2004), the HIA is set on a broad socio-economic model of health that as shown in figure 1.1 encompasses conventional health impacts such as disease, accidents and risk along with wider determinants of health vital in achieving good health and wellbeing (income, employment, quality of the urban environment, crime and the perception of crime, etc).

Figure 1.1: The Socio Economic Model of Health



Source: Based on Dahlgren G and Whitehead M (1991) Policies and strategies to promote social equity in health. Stockholm, Institute for Futures Studies.

- 1.11 A key aspect of the HIA approach has been to make use of and build upon previous work streams, stakeholder engagement and transferable knowledge gathered during the HIA of the Wales three Regional Waste Plans completed in March 2008 (PBA 2008).

HIA Process

Task-Based Method

- 1.12 Although guidance and a generic HIA process exists ⁽¹⁾, the methods employed in HIA are often tailored to meet the particular assessment requirements of a project. As set out below, the HIA comprises five key stages including: 1) a project profile; 2) a community profile; 3) stakeholder engagement; 4) assessment; and 5) a Health Management Plan.
- 1.13 In addition, an independent Steering Group comprising members of the Sustainable Development Commission; the Welsh Health Impact Assessment Support Unit; the

Environment Agency; the Welsh Assembly Government; and the University of Wales were provided with the opportunity to comment upon the initial scoping of the assessment and the final draft HIA.

Project Profile

- 1.14 The purpose of the project profile is to identify those relevant features associated with the Draft Strategy with the potential to influence health. By developing the project profile it is possible to list potential causal pathways, to aid in refining the development of an appropriate evidence base, to support the development of a meaningful community profile and to focus the core issues to be assessed.
- 1.15 The project profile was developed through a review of the emerging Draft Strategy (Version 1.5), supplemented by a review of the Regional Waste Strategy HIA to gain transferable knowledge and build upon previous community and stakeholder engagement. However, being an iterative document, where appropriate, the HIA refined the scope of the assessment to take into account changes and additions to the Draft Strategy (Versions 1.7 to 1.12).

Community Profile

- 1.16 Evidence suggests that different communities have varying susceptibilities to health impacts and benefits as a result of social and demographic structure and relative economic circumstance (Dahlgren et al 1995), (Acheson1998). A community profile therefore not only forms the basis to the assessment but also allows an insight as to how potential health pathways identified by the project profile might act disproportionately upon certain communities and sensitive receptors throughout Wales. In addition, the community profile has been further applied to identify potential barriers that may limit or delay the effectiveness of the Draft Strategy.

Stakeholder Engagement

- 1.17 An important component of gathering an appropriate evidence base and tailoring the HIA to local circumstance is seeking the views of stakeholders and key representatives of communities likely to be affected. The HIA builds upon the consultation outputs from the Regional Waste Strategy HIA including the detailed response from the National Public Health Service (NPHS 2007).
- 1.18 In addition, the HIA is to support and build upon the planned public engagement exercise for the Draft Wales Waste Strategy and to support and facilitate more effective engagement with key health stakeholders.

Assessment

- 1.19 Being a strategic document with limited project level information, the HIA is largely qualitative in nature addressing each of the core health pathways identified during the preceding stages and providing an appropriate evidence base to assess the significance and likelihood of potential health outcomes associated with the Draft Strategy. In addition, the HIA outlines the regulatory assessments required at the project level to investigate and address potential environmental and health impacts.

Health Management Plan

- 1.20 A Health Management Plan (HMP) expands upon the normal recommendations section within HIA guidance, establishing recommended protocols and monitoring regimes to be implemented to further reduce and remove potential adverse health impacts while maximising opportunities to improve health benefit uptake. The HMP is intended to further inform and support the development of the Draft Strategy, and provides additional recommendations on how to more effectively integrate HIA at the project level.

Steering Group

- 1.21 Following discussion with the Environment Agency and the Welsh Assembly Government on the required Steering Group skill sets (i.e. HIA, epidemiology, toxicology, community health, waste management, sustainable development etc), potential participants were identified and the following Steering Group participants confirmed:

- Hilary Neagle Sustainable Development Commission;
- Liz Green Welsh Health Impact Assessment Support Unit;
- Kate Cameron Environment Agency;
- Peter Sykes University of Wales: School of Health Sciences; and
- Chris Brereton Acting Chief Environmental Health Adviser.

- 1.22 Due to relative project constraints and existing participant work commitments, engagement between the group was performed via email and telephone interview, supplemented by a meeting to discuss the draft HIA prior to finalisation.

2 Project Profile

Introduction

- 2.1 The following section provides a brief description of the key features of the Draft Strategy with the potential to influence health (both adverse and beneficial).

The Draft Wales Waste Strategy

- 2.2 The Draft Wales Waste Strategy seeks to achieve more responsible and sustainable practice through a more focused, active and holistic approach to the waste hierarchy that will influence the type, rate and flow of resources between industry, retail and consumers.
- 2.3 The core aim of the Draft Strategy is to ensure sustainable waste management practice to protect and improve the quality of the environment and the health of communities throughout and beyond Wales. However, the Draft Strategy also recognises the economic benefits of achieving a zero waste culture, not only in terms of reducing the cost to communities to collect, treat, transport and dispose of waste, but also the economic benefits in reducing needless packaging and the associated cost passed on to industry, retailers and ultimately consumers. Furthermore, by influencing the type of materials that will enter the waste stream coupled with more effective segregation of materials at the community level, the Draft Strategy seeks to develop and encourage the waste-resource sector, with significant income and employment opportunities throughout Wales.
- 2.4 As such, the Draft Strategy goes beyond the management of a waste issue, but seeks to influence a behavioural change that will streamline industry and retail, reduce costs to consumers, protect the environment and replace the concept of the waste stream with the concept of a waste-resource cycle.
- 2.5 Being a strategic document, the core activities with the opportunity to influence health are the policies, initiatives and the waste management options required to achieve zero waste. The following project profile is therefore structured to investigate the potential health pathways of the individual policies and initiatives proposed and the waste management options selected.

Draft Wales Waste Strategy Policies and Actions

2.6 As detailed in the Draft Strategy (version 1.11) the core policies, initiatives and drivers to facilitate zero waste include:

Support:

- provide support for eco-design minimising the impact of a product throughout its lifecycle and to increase resource reuse and recycling efficiency;
- work with businesses to evaluate and source appropriate supply chains, increase the reuse of materials and streamline their waste streams;
- reduce household waste by working with retailers and consumers to increase the quality of recyclates and recycling;

Lead by Example:

- drive forward change through Public Sector Procurement within the Assembly that will support the emerging waste resource markets and significantly reduce the requirement and cost to treat, transport and disposal of waste;
- drive forward change through Public Sector Grants that will support waste reduction and high quality recyclates and recycling;
- drive forward change with financial institutes to influence more responsible waste-resource behaviour with emerging businesses (i.e. business lending criteria);

Education:

- raise awareness as to the environmental, health and direct economic benefits to industry, retail and consumers for more responsible waste-resource behaviour through national symposia;
- raise awareness to improve the separation of waste in households and increase the quantity, quality and value of recyclates;
- stimulate waste-resource innovation, markets and employment alongside the Green Jobs Strategy;
- reduce Wales' ecological footprint through targeted waste-resource campaigns;

Regulation:

- to influence changes in the regulatory framework to ensure businesses take ownership of the waste they produce by:
 - evaluating the role of extended producer responsibility;

- reviewing the effectiveness of existing legislation on waste prevention;
- to influence changes in legislation driving a statutory duty for Local Authorities to recycle municipal waste and to make the recycling and energy from waste targets statutory;
- to investigate and consult on the potential to place an obligation on households to recycle;

Cross-boundary Partnerships:

- develop cross-boundary relationships and actions with the UK and European Governments on the development of economic, fiscal and legislative measures to support the Draft Strategy and take into account the need for measures where Wales does not have devolved responsibility, or where outcomes are most effectively achieved through joint working;

Monitoring:

- monitor progress at the industry, retail and consumer level.

- 2.7 The policies comprise a mixture of targeted information and support to demonstrate the environmental and economic benefits of improving efficiency through reducing waste at the industrial, retail and consumer level, but also support the development of products that provide and facilitate more effective resource recycling and/or ownership of waste.
- 2.8 The policies are also intended to provide businesses support in 'Greening' their supply chains, creating a market demand for materials and products that comply with the requirements of the Draft Strategy. In so doing, the Draft Strategy will influence the full life cycle of products, where the earliest stage of product development will be influenced by its resource recycling value or the cost to treat and dispose of (eco-design support).
- 2.9 The Draft Strategy also outlines how the Assembly intends to spearhead and support fledgling waste resource markets by appropriately amending Public Sector Procurement, providing grants and further influencing financial institutes to encourage more responsible waste-resource management in the businesses they support.
- 2.10 Raised awareness and education is also key in developing a zero waste culture, where consumers require information on why such a change is necessary, what the benefits are to them, what they can do at home and how to differentiate between products that are compliant with the Draft Strategy from those that are not. The Draft Strategy therefore places an emphasis on raising awareness through targeted campaigns and symposia to further facilitate and speed up a behavioural change at the industrial, retail and consumer level.
- 2.11 The Draft Strategy also recognises that support, guidance and leadership alone will not be sufficient in achieving a zero waste culture, and at the start, products compliant with the Draft Strategy may be at an economic disadvantage to those that are not. As such, the Assembly

also aims to evaluate the role of the extended producer responsibility and the effectiveness of existing legislation on waste prevention. The consequence of this review may result in fiscal benefits for producers and retailers that are compliant with the Draft Strategy and/or punitive action against those that are not. In so doing, the Draft Strategy will seek to level the economic playing field, encourage more responsible waste-resource behaviour and increase accountability.

- 2.12 The Draft Strategy also indicates the requirement to consider the wider influence a zero waste culture may have on domestic export and foreign imports and in particular, the requirement to work with the UK and EU to support the effectiveness of the Draft Strategy and uptake of similar attitudes internationally.
- 2.13 A recurring theme throughout the Draft Strategy, is that the public sector, industry, retail and consumers all have a part to play in achieving zero waste, and that a joined up approach is vital to not only achieve the core objective, but to support Wales during the transition and to retain and share the benefits of a more responsible waste-resource attitude throughout Wales.

Draft Wales Waste Strategy Waste-Resource Management Options

- 2.14 The Assembly recognises that change will not be immediate and that there is a current and future requirement to separate, treat and manage waste in a safe and environmentally responsible manner. Potential waste resource management options currently under consideration include:
- Bio-organic waste treatment, including Open Composting, In-vessel Composting and Anaerobic Digestion;
 - Mechanical waste treatment, including Mechanical Biological Treatment, Mechanical Heat Treatment and Autoclaving;
 - Thermal Treatment Processes, including Mass Burn Incineration, Pyrolysis and Gasification;
 - Materials Recycling Facilities, Civic Amenity Sites and Waste Transfer Stations;
 - Landfills, including inert, municipal solid waste and hazardous waste landfills;
 - Waste Electrical and Electronic Equipment (WEEE) Directive drivers including processes for the dismantling, treatment and recovery of used electrical equipment and components;
 - End of Life Vehicles (ELV) Directive drivers, including processes for the dismantling and treatment of end of life vehicles and their components; and
 - Hazardous waste treatment processes, including the bulking of hazardous waste for onward shipment for treatment/disposal and/or the on-site treatment of these materials.

- 2.15 Due to the strategic nature of the Draft Strategy with limited information on the type, size, location and capacity of each of the waste resource management options, the HIA has provided a detailed review of the available health evidence base on each of the options, a discussion of the key health pathways and how they are addressed through regulatory processes at the project level.

Potential Health Pathways

- 2.16 Key health pathways associated with the Draft Strategy are largely environmental and socio-economic.
- 2.17 Potential environmental health pathways associated with the Draft Strategy include:
- reducing needless resource use and waste generation at the industrial and retail level with a subsequent reduction in mineral use, environmental impact and potential diffuse risk to health within and beyond Wales;
 - reducing the transportation of waste in terms of both volume and management close to source with subsequent reduction in vehicle emission and risk of road traffic incidents;
 - reducing environmental impacts to treat and dispose of waste through a reduction in waste generation;
 - potential local environmental benefits through improved household waste-resource management (i.e. home composting and use with a subsequent decrease in the need to purchase fertilisers);
 - reducing the level of waste sent to landfill, the requirement for new landfills and subsequent impacts to communities;
 - the selection of future waste resource management options that increase the reuse and recycling of resources diverting waste from disposal;
 - reduction in waste management emissions to air, water and ground with subsequent reductions in local community exposure and contribution towards reducing greenhouse gas emissions;
 - potential risk from inappropriate or incorrect household waste resource management (i.e. there is a requirement to consider household type and barriers that may limit composting, recycling or storing of recyclates for collection or pose a risk to residents);
 - potential offset of environmental benefit from the selection of new materials that pose a greater environmental cost at the start of its lifecycle in order to increase the value and quality of recycling at the end of its life cycle (i.e. new materials need to be selected in terms of their total environmental cost and not solely selected for their recycling value);

- potential environmental impacts from future waste resource management options and subsequent influence on health (i.e. local air quality, noise, odour, vehicle movements etc);
- potential increase in the transportation of non compliant foreign products with subsequent increase in fuel consumption, vehicle emissions, risk of road traffic accidents and the environmental impact to treat and dispose of waste.

2.18 Potential socio-economic health pathways associated with the Draft Strategy include:

- improving industry and retail resource efficiency throughout Wales with subsequent increased profit margin and/or savings passed onto consumers;
- reducing the cost of transporting waste including the capital and maintenance cost of vehicles and fuel to Local Authorities and communities throughout Wales;
- reducing the cost of treating and disposing of waste and the remediation of future waste treatment sites to Local Authorities and communities throughout Wales;
- reducing the local and national expenditure on waste disposal presents an opportunity for increased expenditure on health care, community support and regeneration schemes;
- potential income and employment impact on the waste management sector as it is phased out;
- potential income and employment benefit to the waste-resource management sector as it is phased in;
- initially, a potential risk of increasing the cost of products and services as industry and commerce comply with the Draft Strategy requirements. This presents an income and employment risk to producers as they compete with non compliant and potentially cheaper products, but also runs an initial risk of increasing the cost of living in Wales;
- potential risk of increasing the cost of domestic export, reducing the competitiveness of Welsh products with subsequent risk on income and employment;
- potential risk of increasing the importation of cheaper, non compliant foreign products, increasing socio-economic pressure upon national industry and retail, compounded by the cost to transport and treat associated non compliant waste.

Tailoring the HIA Scope to the Project Profile

2.19 Based upon the project profile set out above, key health pathways by which the Draft Strategy may act principally relate to the environmental influence of the current waste-resource

management options under consideration and broad socio-economic health influence of the policies and actions under consideration to achieve the Draft Strategy.

2.20 On this basis, the assessment stage will concentrate on investigating:

- the potential environmental effect from the proposed waste resource management options and associated activities upon health; and
- the potential effect of the proposed policies and actions upon socio-economic health pathways.

3 Community profile

Introduction

- 3.1 Evidence suggests that different communities express varying sensitivity to health effects (both adverse and beneficial) as a consequence of relative socio-economic status, deprivation and existing health burden.
- 3.2 In HIA, a community profile not only provides a means to establish changes in community exposure to certain health pathways but also provides a means to consider local circumstance to further interpret the distribution and significance of effect upon both health and wellbeing. However, in this instance, the community profile has also been applied to identify potential issues and barriers that may limit or impede the success of the Draft Strategy.

The National Picture of Health

- 3.3 Wales exhibits a large and varied population distribution comprising a contrast of urban and rural areas with varying demographic, socio-economic and relative health trends throughout its five regions, 22 Local Authorities and at the community level (i.e. sub ward level). Due to the strategic nature of the HIA, the following community profile provides a high level review of available health and socio-economic statistics, focussing at the Local Authority level where appropriate.
- 3.4 The principal picture is that although health throughout Wales continues to improve, the rate of improvement is not uniform and the gap between certain communities appears to be widening (Wales Centre for Health, 2006b).

Population Structure

- 3.5 In 2006 there were approximately three million residents in Wales with a slightly higher ratio of women to men (1,053 females for every 1,000 males) and approximately 60% of the population within working age (16% under 16 and 21% of retirement age) (Statistics Bulletin 40 2007).

Births, Deaths and Natural Change

- 3.6 An important demographic trend for Wales is that for the first time since 1997 there have been more births than deaths in Wales, with a natural change (i.e. births less deaths) of approximately 1,900 compared to -300 for the year ending in mid 2005, and -1,300 for the previous year (Statistics Bulletin 40 2007).
- 3.7 As of 2006, Wales expressed an average population change of 1.9% from 2001. However, such growth is not uniform throughout Wales, where Merthyr Tydfil and Blaenau Gwent have continued to express a population decline (down 1.2% and 0.9% respectively) whereas Powys and Pembrokeshire showed a population increase significantly higher than the national trend of 3.8% and 3.7% respectively (Statistics Bulletin 40 2007).

Migration Projections

- 3.8 On 30 June 2008, population projections based upon 2006 statistics were calculated for the 22 Local Authority areas in Wales up to 2031. In each year of the projection period it is predicted that, with the exception of Merthyr Tydfil and Torfaen, all of the local authorities will experience a net increase in people moving in. However, Carmarthenshire will see the greatest net inflow of migrants of approximately 1,600 each year (Welsh Assembly Government / Statistics for Wales 2008)

Ethnicity

- 3.9 The 2001 Census indicates that Wales exhibits a predominantly white population (96 % White British, 0.6 % White Irish and 1.3 % from another White background), with the remaining 2.1% of the population (approximately 62,000 people) characterised as individuals from ethnic backgrounds other than white.
- 3.10 The distribution of such communities is largely concentrated within the three biggest cities, where in Cardiff, ethnic backgrounds other than white constituted 8% of the total population, 5% in Newport and 2% in Swansea.
- 3.11 On a national perspective, Welsh ethnic backgrounds other than white tend to concentrate in urban areas, where approximately half of Wales' Black and Asian communities and a third of the Mixed and Chinese groups lived in the capital.

Socio-Economic Health Indicators

Education

- 3.12 The latest National Statistics on qualification levels produced by the Welsh Assembly Government were released on 28 August 2008 (Statistics for Wales 2008). The key points include the following:
- qualification levels in Wales were in general lower than in England, Scotland and the UK as a whole, but higher than in Northern Ireland;
 - in general, qualification levels in Wales have continued to increase with a 1% increase in the proportions of adults with education level 2, 3 or 4 and above;
 - approximately 15% of all adults of working age in Wales reported having no qualifications;
 - approximately 69% of working age adults in Wales held at least level 2 qualifications with 27% holding a degree-level qualifications (NQF levels 4 or above); and
 - in general, education levels were highest in Cardiff, Monmouthshire and The Vale of Glamorgan and lowest in the South Wales valleys authorities.
- 3.13 Recent data appears to indicate that although education levels throughout Wales have in general improved, there remain pockets of lower education attainment of which the distribution has not significantly changed since the 2001 census (Statistics for Wales 2008).

Employment

- 3.14 As shown in table 3.1, the latest statistics on employment type (Welsh Assembly Government/Statistics for Wales 23 July 2008) indicate that the key sector of employment throughout Wales is broadly similar to UK figures with the exception of finance and business.

Table 3.1: Employment by Industry in Wales in 2006 (Welsh National Statistics, 2008)

Employment category	Percentage of employed persons in Wales	Percentage of employed persons in UK
Health, education and public administration	29	25
Retail, wholesale, hotels and restaurants	23	22
Finance and business	14	21
Production	13	11
Construction	8	7
Other industries	13	14
TOTAL	100%	

3.15 However, there is substantial variation in the employment distribution at the Local Authority level with, as to be expected, higher proportions of jobs in the agriculture sectors in the more rural areas, and higher proportions of jobs in the production and construction and service sectors in the more urban areas.

3.16 The summary points of the latest statistical bulletin (Welsh Assembly Government / Statistics for Wales 23 July 2008) indicate that in 2006:

- Powys and Ceredigion expressed the highest shares of workplace employment in the agriculture sector (14% and 10% respectively);
- Flintshire had the highest share of employment in the production and construction sectors (38%), followed by Blaenau Gwent (32%) and Neath-Port Talbot (30 per cent). Swansea had the lowest share (12%), followed by Cardiff (13%) and Ceredigion and Conwy (14%); and
- Swansea and Cardiff had the highest shares of workplace employment in the service sectors (both 87%), whilst Flintshire, Powys and Blaenau Gwent had the lowest shares (61, 67 and 67 % respectively).

Unemployment

3.17 The monthly economic statistics for Wales (Statistics for Wales September 2008) indicates that although in keeping with the current level of unemployment in the UK (5.5% for both the UK and Wales), the current rate of unemployment in Wales is higher than that recorded during the 2001 census.

3.18 Furthermore, as shown in Table 3.2, there is significant variation in the distribution and level of unemployment throughout Wales, where levels of unemployment expressed in Torfaen (approximately 8%) are in stark contrast to the unemployment rates of 2.5% in Flintshire.

Table 3.2: Unemployment Rates by Local Authority (Year ending 31st March 2008)

Local Authority	Unemployment Rate (%)
Torfaen	8
Merthyr Tydfil	7.9
The Vale of Glamorgan	7
Bridgend	6.8
Cardiff	6.6
Caerphilly	6.4
Rhondda Cynon Taff	6.3
Gwynedd	6.1
Isle of Anglesey	6
Newport	5.9
Swansea	5.7
Neath Port Talbot	5.7
Ceredigion	5.4
Denbighshire	5.3
Carmarthenshire	5.2
Blaenau Gwent	5.0*
Wrexham	4.9
Conwy	4.3*
Pembrokeshire	4.3
Powys	4.0*
Monmouthshire	3.3*
Flintshire	2.5**

* Data item based on approximately 25-40 responses to the survey and categorised as being of limited quality.
** Data item based on approximately 10-25 responses to the survey and categorised as being of low quality.

- 3.19 As such, certain Local Authorities express significant levels of socio-economic inequality and relative sensitivity to activities that might influence employment gains or losses.

Health and Lifestyle Indicators

Life Expectancy

- 3.20 As of 2004, the average life expectancy of a male born in Wales was 76 years. However, there is a significant variation in life expectancy at the Local Authority level with a difference of up to five years between Monmouthshire (78 years) and Blaenau Gwent (73 years).
- 3.21 Areas exhibiting male life expectancy significantly lower than the national trend are generally clustered to the South, including:
- Rhondda Cynon Taff (74.8 years);

- Caerphilly (74.8 years);
- Neath Port Talbot (74.5 years);
- Merthyr Tydfil (73.8 years); and
- Blaenau Gwent (73.8 years).

3.22 Areas exhibiting male life expectancy significantly higher than the national trend are broadly located in the centre of Wales and include:

- Monmouthshire (78 years);
- Ceredigion (77.7 years);
- Powys (77.5 years); and
- Gwynedd (76.8 years).

3.23 The latest statistics indicate that since 2005, the average male life expectancy has increased to 76.6 years. However, overall, the differences between local authorities have not appeared to change with Monmouthshire still having the highest life expectancy at 78.7 years and Blaenau Gwent (74.8) and Merthyr Tydfil (75.5) still exhibiting the lowest male life expectancy in Wales.

3.24 Female life expectancy in Wales has followed a similar trend where although generally improving, there remains a similar cluster of lower life expectancy in the South of Wales and significant inequality between South and Central Wales.

Age Standardised Mortality

3.25 Between 2001-2003 Wales exhibited an Age Standardised Mortality Rate (ASMR) of 703 deaths per 100,000 individuals. However, as shown in Table 3.3, there is a significant variation between the Local Authorities, and a similar pattern of distribution where Blaenau Gwent and Merthyr Tydfil express all cause mortality rates significantly higher than the national trend (Wales Centre for Health 2006).

Table 3.3: European Age Standardised Mortality Rates at the Local Authority Level

Local Authority	Age Standardised Mortality rate per 100,000
Blaenau Gwent	831.8
Merthyr Tydfil	826.1
Rhondda Cynon Taff	770.8
Caerphilly	763.1
Neath Port Talbot	743.4
Bridgend	735.5
Carmarthenshire	735
Wrexham	723.1
Newport	706.8
Cardiff	698.5
Torfaen	697.6
Swansea	696.6
Pembrokeshire	694.3
Conwy	680
Denbighshire	676.4
Flintshire	674.3
The Vale of Glamorgan	667.3
Isle of Anglesey	658
Gwynedd	643.8
Powys	637.9
Monmouthshire	628.6
Ceredigion	573.9

Source: Wales Centre for Health. Picture of Health in Wales 2006

Cancer

- 3.26 The Welsh Cancer Intelligence and Surveillance Unit indicate that during 1992-2006 the incidence of all cancers (excluding nonmelanoma skin cancer) has increased in both males and females by 22% and 12% respectively. However, if the European Age Standardised Rates (EASR) are compared, these figures are actual increases of 3% for males and 4% for females. To clarify, although there has been a large increase in numbers, the increase is largely due to an improvement in diagnosis (in particular diagnosis of the elderly).
- 3.27 The data on incidence by local health board in Wales highlights areas that are statistically significantly higher or lower than the Wales average. Results for all persons (both male and female) in the period 2002—2006 show that Merthyr Tydfil has the highest incidence of rates

for both males and females for this time period. Other areas expressing significantly higher rates than the national average include Denbighshire, Flintshire and Wrexham.

Respiratory Disease

- 3.28 As shown in table 3.4, during 2005 to 2007 the percentage of individuals being treated for a respiratory illness is generally in keeping with the national trend (i.e 14%). However, areas such as Merthyr Tydfil, Blaenau Gwent, Rhondda Cynon Taff, Neath Port Talbot and Caerphilly indicate a marginally higher burden of poor respiratory health.

Table 3.4 : Adults Being Treated for Respiratory Illness at the Local Authority Level

Local Authority	Adults reporting treatment for a respiratory illness	
	Expressed as a percentage of the total population	Un-weighted base
Isle of Anglesey	14	1194
Gwynedd	13	1033
Conwy	13	992
Denbighshire	13	1051
Flintshire	14	1231
Wrexham	12	1155
Powys	13	1174
Ceredigion	11	1231
Pembrokeshire	14	1030
Carmarthenshire	14	1291
Swansea	14	1600
Neath Port Talbot	16	1059
Bridgend	14	1168
The Vale of Glamorgan	15	1116
Cardiff	13	2139
Rhondda Cynon Taff	16	1658
Merthyr Tydfil	19	1056
Caerphilly	16	1400
Blaenau Gwent	16	1069
Torfaen	13	986
Monmouthshire	12	1160
Newport	12	1067
Wales	14	26860

Source: Welsh Health Survey 2005-2007

Circulatory Mortality Figures

- 3.29 The numbers of deaths from circulatory disease (including conditions such as heart disease, high blood pressure and stroke) are an important interconnected indicator within a community profile often connected to smoking, obesity, excessive alcohol consumption and poor diet.
- 3.30 Data on premature deaths (those under 75) from circulatory disease between 2001-2003 indicate that the national average premature mortality rate per 100,000 people was 117.3. However, as shown in Table 3.5, there is significant variation throughout Wales, where the highest rates are again clustered around southern Local Authorities.

Table 3.5 : Circulatory Mortality Figures at the Local Authority Level

Local Authority	Premature deaths from circulatory disease (rate per 100,000)
Merthyr Tydfil	160.4
Blaenau Gwent	152.1
Rhondda Cynon Taff	144.4
Caerphilly	142.9
Newport	131.8
Neath Port Talbot	130.5
The Vale of Glamorgan	104.5
Monmouthshire	103.4
Conwy	103.1
Powys	100.1
Gwynedd	94
Isle of Anglesey	89.6
Ceredigion	84

Source: Wales Centre for Health (2006b) Pictures of Health in Wales: A Technical Supplement.

- 3.31 In addition, the Welsh 2005/2007 Health Survey provides statistics on high blood pressure and heart conditions at the Local Authority level.
- 3.32 The survey indicates that on average, the incidence of high blood pressure throughout Wales is approximately 20%. However, at the Local Authority level, a similar pattern emerges where Merthyr Tydfil exhibits an incidence of high blood pressure above the national trend (approximately 26%), followed by
- Rhondda Cynon Taff (23%);
 - Caerphilly (23%);
 - Neath Port Talbot (23%);

- Blaenau Gwent (22%); and
 - Torfaen (22%).
- 3.33 The Local Authorities that exhibit an incidence of high blood pressure significantly lower than the national trend include:
- Conwy (16%);
 - Powys (16%);
 - Ceredigion (16%);
 - the Vale of Glamorgan (17%);
 - Swansea (17%);
 - the Isle of Anglesey (17%);
 - Gwynedd (18%); and
 - Monmouthshire (18%).
- 3.34 The national health survey further indicated that, on average 9% of the population are currently being treated for a heart condition. The area with the highest incidence is Caerphilly at 13%, followed by Merthyr Tydfil (12%) and Wrexham, Neath Port Talbot and Bridgend (all with a result of 10%). Again, these areas are typically within the southern cluster consistently exhibiting a high burden of poor health and relative health inequality.
- 3.35 Areas with a lower than average incidence of heart disease are the Isle of Anglesey, Gwynedd, Denbighshire, Pembrokeshire and Carmarthenshire; all with a result of 8%.

Road Traffic Accidents

- 3.36 The Community profiles produced by the Wales Centre for Health in 2006 used data on the death rate from Road Traffic Accidents (RTA) between 1999-2003. During this time, the average death rate from RTAs was 5.9 per 100,000 people with some variation at the Local Authority Level. In particular, Pembrokeshire exhibited a rate almost twice the national average, although this is considered to be due to the largely rural nature of the area coupled with environmental conditions.
- 3.37 More recent statistics indicate that by 2007, overall, death and serious injury from RTAs have decreased by 25% since 1998, and that fatal and serious RTAs in Wales are significantly lower than GB trends.

Mental Health

- 3.38 The Welsh Health Survey (2003/4) included a series of questions that led to the development of the Mental Component Summary Score (MCS) and a national average of 49.9. However there remains a similar pattern of poor health in the southern areas where Merthyr Tydfil and Blaenau Gwent exhibit significantly lower scores than the national average (47.8 and 48.1 respectively) and a stark contrast to more central yet neighbouring Local Authorities such as Powys (51.8).

Body Mass Index

- 3.39 The 2005/2007 Welsh Health Survey indicates that the level of obesity in Wales has increased from previous surveys, where the national average percentage of the population who are overweight or obese has increased to 56%.
- 3.40 At the Local Authority Level, there is a similar pattern of poor health clustered to the south, where Rhondda Cynon Taff, Caerphilly and Torfaen express the highest percentage of overweight and obese individuals at 62%, closely followed by Merthyr Tydfil and Blaenau Gwent at 61%.
- 3.41 In contrast, the Local Authorities with rates of overweight and obese individuals below the national trend are largely grouped to the North and include Conwy (50%), closely followed by the Isle of Anglesey, Gwynedd, Wrexham and Monmouthshire (52%).

Smoking

- 3.42 The most recent data (2005/2007 Welsh Health Survey) indicates that smoking in Wales has in general decreased since 2003 from 26.4% to 25%, with the highest rates of smoking located in Blaenau Gwent (31%), Merthyr Tydfil and Denbighshire at 28%.
- 3.43 Both areas are in aforementioned cluster of local authorities which exhibit relative socio-economic and health inequalities.

Housing

- 3.44 The Welsh House Condition Survey (WHCS) concluded that Welsh housing stock has steadily improved in terms of its state of repair, amenities, density of occupation and suitability for habitation since 1998. However, there remains a significant percentage of properties at the Local Authority level that are below the national trend of 8.5% properties unfit for residence.
- 3.45 In particular 12.5% of properties in Merthyr Tydfil are considered unfit for residence, followed by Rhondda Cynon Taff (11.4%), and Torfaen (11.3%). In contrast, housing in the Isle of

Anglesey, Conwy, Flintshire and Caerphilly all express lower levels of unfit housing (with a respective 4.4%, 4.4%, 4.8% and 5.9%).

Deprivation

Welsh Index of Multiple Deprivation

- 3.46 The revised Welsh Index of Multiple Deprivation (WIMD, 2005) provides a useful summary on key socio-economic health indicators and provides a means to identify potential inequality and relative community sensitivity to specific health pathways, including: income; employment; education; housing and health throughout Wales.
- 3.47 The WIMD concurs with this community profile and demonstrates that levels of deprivation are generally consistent with existing burdens of poor health in South Wales, and in particular Merthyr Tydfil and Blaenau Gwent.

Community Profile Summary

- 3.48 In general, communities throughout Wales have experienced significant improvements in health and are currently experiencing a significant population increase as a consequence of natural growth and a net increase in migration.
- 3.49 However, there is a consistent trend of poor health within specific Local Authorities in South Wales that exhibit a higher burden of morbidity and mortality, score lower in terms of income, employment and education, have expressed a relative decline in population and a higher rate of poor quality housing.
- 3.50 In particular, the burden of poor health in Wales appears to be closely associated with relative socio-economic deprivation and lifestyle. Such trends also demonstrate the relative health inequality between neighbouring local Authorities and the stark contrast between South and North Wales.
- 3.51 Although health is generally improving throughout Wales, the rate of such improvements is not uniform at the Local Authority level, resulting in the widening of health inequalities.
- 3.52 In terms of the Draft Strategy, the community profile indicates that positive natural population growth coupled with a net increase of inward migration throughout Wales reinforces the justification behind the Draft Strategy, in that a 'business as usual approach' is no longer sustainable, and that a more effective approach to waste minimisation is required to simply keep up with increased demand.

3.53 In addition, the community profile demonstrates relative community sensitivity to certain pathways, and in particular the requirement to consider environmental impacts that may exacerbate existing health conditions within sensitive communities, including:

- Merthyr Tydfil;
- Blaenau Gwent;
- Rhondda Cynon Taff;
- Neath Port Talbot;
- Bridgend; and
- Caerphilly.

3.54 The community profile also indicates the same Local Authorities are potentially sensitive to socio-economic pathways, where an adverse impact upon income and employment could again exacerbate existing health conditions or compound relative socio-economic deprivation. Equally, it is important to consider that the same communities are also sensitive to health benefits brought about by potential income and employment opportunities.

4 Assessment

Introduction

- 4.1 The following assessment section separates the core health pathways to be investigated to the potential environmental and health effect of the waste-resource management options currently under consideration, and the potential socio-economic health effect of the proposed policies and actions.

Environment and Health Effect from the Waste Resource Options Currently Under Consideration

- 4.2 Being a strategic document, the Draft Strategy does not detail the type, number, location or likely change in emissions concentration exposure of the waste management options currently under consideration. As such, the following assessment is based upon the available evidence base (Appendices A), considers likely changes in environmental conditions as a consequence of the individual waste options and the relative health burden in Wales.

Bio-organic Waste Treatment

- 4.3 Bio-organic waste treatment involves the biological degradation of organic waste through processes such as composting or anaerobic digestion. The key health pathway associated with this particular waste management option is the potential exposure to bio-aerosols, although nuisance related to odour, dust and pest have also been recorded.
- 4.4 The weight of available evidence generally indicates that exposure to bio-aerosols from biological treatment facilities is not of a level likely to cause respiratory ill health in residents close to such facilities. However some cases have indicated, based on relative risk data, that there may be a link between the occurrence of respiratory and irritative symptoms in people and living in close proximity to commercial scale composting facilities. The likely impact seems to be strongly related to the scale and type of facility in terms of design and operational procedures in addition to the effect of the local topography and meteorological conditions of the area.
- 4.5 There are a number of uncertainties in relation to exposure and risk from bio-aerosols. For instance, to date, a clear exposure response relationship has not been identified due to the complex mixture of infective, irritative and allergic components, confounded by varying allergic sensitivity at the individual level. Also there are a number of uncertainties relating to the estimation of releases from the different processes and the resulting concentrations with distance.

- 4.6 As outlined in the evidence base section, the Environment Agency has a clear position on the location of new bio-organic waste treatment facilities, requiring a site-specific health risk assessment for any application where the boundary is within 250 metres of a workplace or the boundary of a dwelling.
- 4.7 The current evidence base indicates that 250 meters in some cases (i.e. for large open windrow facilities) may not be sufficient for the dispersion of bio-aerosols to normal background levels. Although it is important to note that this does not necessarily constitute a risk to community health. However, to further alleviate community concern it is recommended to consider amending the requirement for site specific risk assessments for large scale open facilities (to demonstrate that bio-aerosol levels will not result in a significant increase over background levels) and to further develop bio-aerosol risk assessment methods to consider both the viable and non viable components of bio-aerosols.
- 4.8 Furthermore, community exposure to bio-aerosols from such facilities can be managed through appropriate mitigation measures. Indoor, controlled processes can reduce emissions to atmosphere through the installation of appropriate pollution arrestment technology such as bio-filters and wet scrubbers. By adopting such measures potential risk of bio-aerosol exposure will largely be occupational in nature, and can be further managed through safe working practice and personal protection equipment.
- 4.9 Given the current planning and regulatory requirements for new bio-organic waste treatment facilities, new facilities compliant with current environmental standards and subject to bio-aerosol risk assessment are not considered to pose a significant risk of community bio-aerosol exposure or subsequent risk to health.
- 4.10 It is also important to consider how the Draft Strategy will increase rates and types of composting at the residential level. Although levels of bio-aerosol emission are likely to be lower, there remains the potential for exposure through incorrect or inappropriate composting practice (e.g. inappropriate waste entering the process). Furthermore, it is also important to consider relative sensitivity to bio-aerosols, where a proportion of the Welsh population may demonstrate an allergic sensitivity to certain bio-aerosols. Home composting therefore presents a less significant source of bio-aerosols, but a potentially higher level of community exposure (due to increased proximity).
- 4.11 As such, there is a requirement to provide clear instructions on the proper use of composting bins, suitable composting materials, pest control and maintenance (e.g. cleaning and storage of gloves), but to also provide information that some people can be more sensitive to an allergic reaction, and how to prevent or address this.

Mechanical Waste Treatment

- 4.12 Mechanical waste treatment may be combined with biological or thermal treatment and therefore can be divided into two main categories. These include Mechanical Biological Treatment MBT or Mechanical Heat Treatment MHT.
- 4.13 MBT is usually an integrated system combining several processes including different combinations of mechanical sorting to separate out the non-biodegradable fraction followed by drying and biological treatment of the organic fraction. The organic component may also be fed into an aerobic digester. Some systems may screen the waste to produce a compostable material appropriate for in-vessel composting processes.
- 4.14 As demonstrated in (Appendix A), although MBTs present a potential to contribute to background levels of bio-aerosols, they are considered to be low risk activities. Generally, it can be said that health impacts from such facilities are similar to those described for material recycling and biological treatment plants. Health impacts from recycling facilities are typically occupational in nature with limited opportunity for community exposure or risk.
- 4.15 Mechanical Heat treatment is an increasingly applied process to pre-treat MSW and when applied is typically the first stage of an MBT system. The process can include either a steam treatment process to sterilise particular waste streams (most notably clinical waste), but is now more frequently associated with the drying of MSW in combination with a mechanical action (i.e. a rotating heated drum) to remove water, aid in further separating the organic portion of the waste into a more homogenous material and to further remove recyclable materials. The final homogenous dry organic material (often in a pellet form) can then be applied as a cleaner and more effective renewable fuel source than untreated MSW.
- 4.16 There is currently little research undertaken on the potential health impacts of mechanical heat treatment (limited to autoclaving). Further research is therefore required on the potential health pathways associated with the drying process (i.e. emissions to air and water) and the potential for release beyond the facility boundary (i.e. potential community exposure).
- 4.17 However, it is important to note that all new facilities will require an Environmental Permit from the Environment Agency, which will include a risk based environmental assessment to ensure they do not constitute a significant risk to the environment or community health. Larger facilities will also be subject to Environmental Impact Assessment (EIA)

Thermal Treatment Processes

- 4.18 Thermal treatment includes all processes that involve the use of heat to break down waste. All thermal waste treatment facilities including incineration, gasification and pyrolysis are required to comply with the Waste Incineration Directive emissions limits to control hazardous

emissions, to prevent a significant impact upon ambient air quality and to protect the health of communities.

- 4.19 The majority of published studies concentrate on the effects of exposure to emissions from the older generation of incinerators which were phased out in the UK after the introduction of stricter emission controls implemented through the Integrated Pollution Control (IPC) regime.
- 4.20 Most studies of communities living near incinerators have assessed exposure using some measure of distance from the site or an estimate of areas at most risk from emissions. Little evidence has been found for an association between modern waste incinerators and reproductive or developmental effects. In addition there is little evidence of increased prevalence of respiratory illness near incinerators using either self-reported symptoms or physiological measures.
- 4.21 A series of studies in the UK compared observed cancer incidence rates in bands of increasing distance from a number of incinerators. Although a significant decline in risk with distance from the incinerators was initially reported for all cancers, a failure to sufficiently consider socio-economic confounders was considered to be responsible for these results. Although the possibility of an association between residential proximity to MSW incinerators and incidence of cancer could not be completely discounted, confounding from deprivation appears to be the most likely explanation for the excess.
- 4.22 The Department of Health's Committee on Carcinogenicity published a statement in March 2000 evaluating the evidence linking cancer with proximity to municipal solid waste incinerators in the UK. The committee specifically examined the results of these studies and concluded that: 'any potential risk of cancer due to residency (for periods in excess of ten year) near to municipal solid waste incinerators was exceedingly low and probably not measurable by the most modern techniques'.
- 4.23 Applying the available evidence base, the Environment Agency (EA 2008), the UK Health Protection Agency (HPA) and the Chartered Institute for Water and Environmental Management (CIWEM) have produced formal position papers on the health effect of energy from waste facilities (Appendix B). Here it is concluded that well managed and regulated waste incineration processes contribute little to the concentrations of monitored pollutants in ambient air and that the emissions from such plants have little effect on health.

Materials Recycling Facilities, Civic Amenity Sites and Waste Transfer Stations

- 4.24 These facilities allow materials to be processed (separated/segregated) or stored temporarily. Such facilities include Materials Recycling Facilities (MRF), Civic Amenity Sites and Waste Transfer Sites.

- 4.25 A MRF is related to the process defined as a central operation where source segregated; dry recyclable materials are sorted mechanically or manually to market specifications for processing into secondary materials (clean MRF). However some limited UK MRFs are still receiving and processing non separated waste (dirty MRFs).
- 4.26 Civic amenities are convenience sites where the general public can take bulky waste goods or hazardous household products such as fridges, paints, batteries and electrical equipment for eventual safe reuse, recycling and disposal.
- 4.27 Waste transfer stations are sites where municipal waste from industry, commerce and the general public is received. The waste is then bulked and compacted before being transported to other waste treatment facilities.
- 4.28 The available evidence indicates that the core health risks associated with such facilities are occupational in nature although potential influences on community health and wellbeing include:
- potential exposure to odour, noise, dust and bio-aerosols;
 - potential risk from vermin; and
 - potential changes in risk from vehicle movements (local increase versus net decrease in traffic movements from segregating, compacting and transfer to vehicles with larger carrying capacity).
- 4.29 Assuming good practice, such risks are not considered to be significant, managed largely through planning and the requirement to comply with Environmental Permitting Regulations set to protect the environment and community health at the project level.

Waste Collection

- 4.30 As the name suggests, waste collection includes the collection of waste from residential and commercial areas as well as kerbside collection points.
- 4.31 The key health risk from the collection of waste is occupational in nature, where staff have the potential to be exposed to a range of bio-aerosols and VOCs as well as potential risk from sharps (needles, glass and metal) and physical strain. However, such exposure can be managed through appropriate management and compliance with the requirements of the health and safety procedures and control measures such as the use appropriate protection equipment.
- 4.32 During the literature review, no epidemiological studies could be found indicating a significant risk to community health as a consequence of the storage and collection of waste. However, a number of studies indicated that inappropriate waste storage in unsanitary conditions has the

potential to increase vermin proliferation and potential exposure to microbial agents. As such, it is important to consider relative circumstance, where housing, socio-economic status, education and existing level of health may limit the ability to store waste prior to collection appropriately. There is therefore a requirement to consider how the Draft Strategy may influence the segregation and storage of waste in households, and measures to influence and support appropriate and sanitary waste collection.

- 4.33 As discussed during the HIA Steering Group meeting, there is also concern that kerbside collection schemes present a potential occupational health risk hazard of road traffic accidents as workers collect and deposit municipal waste and recycles onto collection vehicles. Although there is currently no available evidence to indicate a significant risk from well managed collection activities, it is recommended that occupational health and safety procedures are revised, to consider how an increase in waste segregation at homes might result in changes in occupational health risk.

Landfill

- 4.34 Landfilling is a term used to describe the deposition of waste in a specially designated pre constructed area, commonly without pre-treatment.
- 4.35 As shown in Appendix A, there have been many studies of populations living near landfill sites, frequently carried out near one specific site in response to public concern. These studies have varied in design and include cross-sectional, case-control, retrospective follow-up and geographical comparison studies. Several large studies were also reported to be carried out to investigate health outcome near hundreds of sites. Also there have been several comprehensive reviews of epidemiological studies.
- 4.36 Some of these studies concluded, that a small association found between certain birth outcome and residence in proximity to a landfill cannot be stated with certainty to be causal, but provide the best currently available estimate of relative risk. However, such findings were disputed and further investigation was recommended based on that low and very low birth weight, in particular, could be related to inequalities or ethnic factors that have not been considered in these studies
- 4.37 Furthermore, no evidence was found to confirm that living close to landfill sites increases the chance of cancer. However, an increase in the risk of non-chromosomal anomalies for residents living close to hazardous was reported by some studies.
- 4.38 The available evidence base indicates that potential health risks associated with landfill are largely defined by the type of wastes accepted, the technology in place to capture emissions (gas leachate), bio-aerosols and to control dust, noise odour and vermin.

- 4.39 Although a number of community health issues have been researched, the primary community complaint is that of odour. The potential impact of odours on health is largely psychological, where the perception of odour may result in increased annoyance, anxiety and changes in social behaviour. Health risks associated with proximity to landfill and potential association between congenital abnormalities and low birth weight require further research to separate socio-economic confounding and establish a causal link.
- 4.40 Landfill sites are subject to Environmental Permitting and with good site and landfill gas management, odour emissions can be controlled to reduce community health impacts associated with chronic anxiety. However, potential health risks, mounting landfill costs coupled with limited viable sites in Wales is further driving the requirement to reduce waste generation and divert waste-resources away from landfill.

Waste Electrical and Electronic Equipment

- 4.41 Separating, treating and safe recycling and disposal of electrical and electronic equipment may present a particular health risk from the release and potential occupational exposure to heavy metals, polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs).
- 4.42 The available evidence base indicates that occupational exposure levels that may result in toxicological effects from certain processes, dictate the requirement for mandatory personal protection equipment and improved emissions control. However there is insufficient evidence to indicate a potential risk to community health.

End of Life Vehicles (ELV) Directive

- 4.43 The available evidence base indicates that potential health risks associated with the dismantling, segregation and treatment of vehicle components (i.e. de-polluting and removal of explosive components such as air bags) is mostly occupational in nature. For open air treatment facilities there are viable pathways for community exposure, but these are likely to be spatially limited.
- 4.44 General community concern from this type of facility is commonly associated with noise, dust and vapour generated by the shredding and dismantling operations. However, such concerns and potential risk will be largely addressed during the planning and Environmental Permitting stage to prevent significant environmental impacts or community health impacts.

Hazardous Waste Treatment Processes

- 4.45 There is a need to ensure that hazardous waste is carefully controlled. As an example APC residue from incineration plants is transferred from storage silo to tanker by pneumatic transfer in a closed process for onwards disposal.

- 4.46 The relative health risk associated with the bulking, transportation and treatment of hazardous waste is dependant upon the composition of the waste and process. There is currently no available study on community level health impacts associated with the bulking of hazardous waste. However, potential risk to health is addressed on a project level basis compliant with the Hazardous Waste Directive (HWD).

Summary of the Available Scientific Evidence Base

- 4.47 Potential adverse health effects and higher rates of certain diseases resulting from residing close to waste storage and treatment facilities has been the subject of a large number of national and international studies over a period of many years.
- 4.48 It has been identified by many researchers (EA, 2005, Schrenk, 2006; Rushton, 2003; Sykes, 2007; Defra, 2004;) that a major drawback of most of these studies is that they provide medical/epidemiological data but usually fail to analyse or provide evidence for the dose-response and identity of substances/chemicals which could eventually be responsible for the observed health problems. Consequently, they are limited to investigating potential associations between health effect and some measure such as proximity to a waste facility, without providing any evidence of a causal link or mechanism, by which the facility is shown to be the cause of the observed effect. Many studies are limited to an investigation of the effect on workers at the facility who will be subject to substantially higher exposure than the general public.
- 4.49 A number of studies investigating possible health effects related to waste sites have been criticised due to a number of scientific weaknesses. One of these major weaknesses is the presumption that populations living in the vicinity are considered to be 'potentially exposed' to any substance that is processed or released within these facilities. The flaw in such an approach could be seriously misleading since the presence of a hazard (chemical, biological, physical) on a site may or may not result or even be related to a level of exposure, especially when the level of exposure itself is not defined.
- 4.50 It is critically important in considering potential health effects to distinguish between hazard and risk. Where a material/process is considered to have the potential to be a hazard (has a property that in particular circumstances could lead to harm), this does not necessarily dictate the presence of elevated risk, as exposure does not necessarily occur. Pathways of exposure need to be present for the hazard to cause a risk. Such pathways are significantly dependent on the configuration of the facility, its controls and its surroundings. A process or a release that has been the cause of a risk and impact on health in a certain setting may not generate the same level of risk and impact within different surroundings. Therefore a generic statement in terms of potential health impact from certain type of processes or facilities cannot be applied without prejudice.

- 4.51 One other area of weakness is related to the collection of health data. These are commonly collected from public databases, investigations with local physicians or questionnaires conducted with the local population. A frequent bias in this procedure is that people living in the vicinity of an unwanted waste management site show a tendency to blame any health effects on these sites. Another problem with such studies is the selection of an appropriate control group. In particular the impact of the socio-economic status on health is important. Furthermore, the socio-economic status in areas where the waste treatment site is located often differs significantly from that of the control group.
- 4.52 In many instances the frequency of certain disease or health defects is low and shows a significant rate of fluctuation over time. In addition the prevalence of estimated 'potential exposure' being also low makes the risk estimates highly imprecise. In such circumstance, powerful statistical techniques with carefully controlled studies are required to distinguish any evidence of elevated risk from the underlying data.
- 4.53 It can be concluded that potential health impact from waste management facilities is dependent not only on the type of facility and its emission but more related to available pathways of exposure and base line conditions. These include environmental, transport, socio-economic and current health burden in addition to the perception of risk.

EA Risk Procedure

- 4.54 It is of paramount importance to bear in mind that modern waste management facilities are subject to stringent environmental regulations, policies, strategies and guidance set to protect health and the environment. The requirement of these regulatory controls may include limits on the level of emission, set specific distances to separate the operational areas from the public or stipulate certain procedures and control measures to be adopted.
- 4.55 For any waste management facility to operate it is necessary to gain not only a planning permission but also an Environmental Permit from the Environment Agency, subject to the requirement of Integrated Pollution Prevention and Control. The Environmental Permit will require that each facility is compliant with all other applicable environmental and health regulations (i.e., the Waste Incineration Directive, the Animal By-Products Regulations, etc). Under these regulatory controls, any such facility is required to demonstrate by means of risk assessment that there are no adverse impacts on human health during their operation, taking into consideration the local factors.
- 4.56 Ultimately, risk is relative, and there is no zero risk situation for the management of waste, although it is generally the case that enclosed management solutions, subject to modern standards of control are likely to offer better control of risk for the local community than the more traditional methods such as landfill. Even for landfill however, modern standards of

design and management represent a significant improvement over even relatively recent practice.

Potential Socio-Economic Health Effect of the Proposed Policies and Actions

- 4.57 Potential socio-economic health pathways associated with the Draft Strategy include:
- the initial cost to industry and retail sectors and a subsequent risk to employment and income during the transition to more responsible and sustainable waste-resource management practice;
 - the waste and waste-resource sector employment; and
 - potential community health outcomes.

Transition to Sustainable Waste-Resource Management Practice

- 4.58 Employment and income are potentially the most significant determinants of long-term health, influencing a range of factors including the quality of housing, education, diet, lifestyle, coping skills, access to services and social networks. As a consequence, poor economic circumstances can influence health throughout life, where communities subject to socio-economic deprivation are more likely to suffer from morbidity, injury, suffer from mental anxiety, depression and tend to exhibit higher rates of premature death than those less deprived. ^{(16) (17) (18)}
- 4.59 Although it is anticipated that in the long term, the Draft Strategy will improve sector efficiency and reduce unnecessary costs passed on to the consumer, there is an initial risk that redesigning and re-sourcing products and packaging will increase cost, impacting upon sector profitability and subsequent cost to the consumer. There is also a risk that non-uniform compliance with the Draft Strategy within Wales may result in a skewed market, where non-compliant and potentially cheaper products may be more appealing to consumers, reducing the market demand and profitability of compliant products. Although such an issue could be managed through a balance of financial incentive and disincentive within Wales, this will not fully address foreign market competition and runs the risk of increasing foreign import demand, or potentially increasing the cost of living in Wales. There is also a potential risk that the Draft Strategy may initially increase the cost of domestic export, and reduce the competitiveness of Welsh products with a subsequent knock on effect to income and employment.
- 4.60 However, the Draft Strategy recognises the potential socio-economic risks during the initial transition period, where policies and actions are specifically designed to:

- provide industry and retail with support through the transition period, but to also recognise and maximise long term economic benefits;
- level the economic playing field between compliant and non-compliant products in Wales with fiscal benefits placed on more responsible waste-resource behaviour;
- support national market demand for compliant products through Public Sector Procurement, Public Sector Grants and through the support of financial institutes (i.e. driven by business lending criteria);

4.61 The Draft Strategy also recognises the potential socio-economic risk to domestic export, and the requirement to work with the UK and European Governments on the development of economic, fiscal and legislative measures to support the Wales Draft Strategy.

4.62 As such, the Draft Strategy provides a joined up approach to facilitate a Zero Waste culture in Wales that accounts for potential socio-economic impacts during the transition stage and facilitates the realisation of benefits at the industrial, retail and community level.

Waste and Waste-Resource Sector Employment

4.63 In addition to more responsible waste-resource attitudes, the Draft Strategy seeks to support the development of the waste-resource management sector and to retain the socio-economic benefits within Wales. The transition from waste management to waste-resource management is not anticipated to result in significant job losses, where skills and experience are transferable.

4.64 Furthermore, through higher value recylates and improved waste-resource segregation, the Draft Strategy seeks to expand the waste-resource management sector with subsequent income and employment opportunities throughout Wales. Being a strategic document, it is currently not possible to quantify the type and number of employment opportunities or subsequent benefit to health (10% rise in income can reduce the relative risk of mortality by 0.0035 in men and 0.03 in women).⁽¹⁶⁾

4.65 However, in qualitative terms the potential for long-term, stable employment with opportunities for promotion and advancement through training and experience will contribute in improving health and wellbeing of socio-economically deprived communities. It is important to note, however, that increasing employment and income opportunities alone will not maximise health benefits. Increased support, training and community involvement is required in order to link and develop skills to employment and reduce the risk of inequality.

Potential Community Level Health Outcomes

- 4.66 The potential socio-economic health pathways with the opportunity to influence community health include:
- potential increase in cost of living during the initial transition period;
 - potential reduction in employment through loss of jobs;
 - potential reduction in the cost of living as product and packaging cost savings are passed onto consumers; and
 - potential increased income and employment through the development and expansion of the waste-resource management sector (from the waste management sector).
- 4.67 As previously discussed, there is a potential risk that as industry and retail re-design and source compliant products and packaging, the cost of products and services dependant upon such products may increase for the short term. The potential health outcome is complex, where a reduction in disposable income has the potential to impact a wide range of health determinants (social, behavioural, recreational, diet, housing etc). As indicated in the community profile, communities in Southern Wales are particularly sensitive to socio-economic impacts.
- 4.68 However, the Draft Strategy recognises such risks and aims to support industry, retail and communities during the transition period and to enhance the uptake of long-term socio-economic benefits as products and services redeem savings from more cost effective waste-resource management.
- 4.69 Finally, as previously discussed, the Draft Strategy seeks to expand the waste-resource management sector with significant income and employment opportunities to construct, operate and return marketable resources to industry and retail. Please note that the Draft Strategy is not anticipated to result in increased unemployment in the current waste sector, as expertise and skills base is transferable to the waste-resource management sector. It is understood that the assessment of direct, indirect and induced income and employment opportunities directly associated with the Draft Strategy is currently being investigated through a parallel socio-economic assessment.

5 Conclusions

Introduction

- 5.1 The Draft Wales Waste Strategy has a number of features that might be considered to have implications for the health of communities throughout Wales. This HIA has examined the extent of these implications in a manner that considers local circumstance and the best-available scientific evidence.
- 5.2 The following section provides a summary as to the significance and potential distribution of health effects.

Assessment Conclusion

- 5.3 Understandably, the provision of new waste management facilities engenders a number of perceived health impacts and associated community concerns. However, in reality the actual risks to health are minimal, and where they do exist, they are not necessarily in line with community priorities or perceptions.

Waste-Resource Management Options

- 5.4 The waste-resource management options currently under consideration include a wide range of technologies with varying processes and activities with the opportunity to influence health. The available evidence base indicates that such risks are largely occupational in nature, where wider community health risks are managed at the project level through design and planning, together with specific Waste and Environmental Permitting Regulations.
- 5.5 However, it is recognised that for relatively new waste-resource management options and technologies, additional project level HIA will be necessary to further inform site selection, planning and Environmental Permitting, and to address and alleviate community concerns.

Potential Socio-Economic Health Effect of the Proposed Policies and Actions

- 5.6 The Draft Wales Waste Strategy constitutes a more joined up approach to waste management that seeks to influence a behavioural change that will streamline industry and retail, reduce costs to consumers, protect the environment and replace the concept of the waste stream, with the waste-resource cycle.
- 5.7 The Draft Strategy is impressive, is wide ranging and recognises that multidisciplinary input is needed to achieve a more sustainable and environmentally responsible attitude to waste generation and management throughout Wales. The Draft Strategy also considers barriers

that may limit the effectiveness of the proposed policies at a national and international level, identifies and seeks to manage potential socio-economic knock on effects with the potential to influence consumer behaviour and the vitality of the Welsh economy, and recognises overlap and opportunities to support wider strategic plans to the benefit of Wales' people, economy and environment.

5.8 Although the concept of zero waste is not new, the environmental health and economic benefits to be achieved are significant and will aid in improving the vitality and economic strength within Wales. However, what is new is the holistic approach the Assembly is seeking to employ to manage risks, facilitate change and enhance benefits at the industry, retail and consumer level throughout Wales.

5.9 This active, holistic and targeted approach to waste-resource management is essential to delivering the goal of the Draft Wales Waste Strategy, incorporating an appropriate consideration of likely health consequences, including potential benefits.

5.10 It is clear that a paradigm shift in waste management practice is required to deliver the solutions required for the 21st century and that this will lead to a wide variety of facilities being developed across Wales over the coming decades. Effective communication of the relative health risks will be an important component of the Wales Waste Strategy required to achieve better waste management in Wales not only for residual waste, but also for recycling and recovery processes.

6 Health Management Plan

Introduction

- 6.1 The following sections provides a series of recommendations geared to further support the development and delivery of the Draft Strategy, to aid in managing potential community and occupational health risks, enhance the uptake of benefits and to address relative inequality at the national, regional and project level throughout Wales.
- 6.2 Being a strategic document intended to inform decision making through Wales, this takes the form of a framework within which to consider health outcomes as a wider programme of work.

National Level Recommendations

- 6.3 National level recommendations are required to establish a uniform approach to regional and project level initiatives throughout Wales and to develop broad awareness programmes for industry, retail and for the general public.

Overarching National Policy

- 6.4 As outlined in the Draft Strategy, there is a requirement to apply a multidisciplinary and multisectoral approach to the minimisation of waste and to encourage more responsible and sustainable waste-resource management throughout Wales.
- 6.5 In this context, it is recommended that the Welsh Assembly Government review existing and emerging policies, subordinate legislation (e.g. regulations and statutory guidance) and Assembly Measures (Welsh laws) to support the delivery of the Draft Waste Strategy consistently at the national, regional and project level throughout Wales.
- 6.6 In particular it is recommended to review Technical Guidance Notes and Planning Policy Guidance in order to build in more effective and user friendly urban waste-resource segregation systems that further reduce both community and occupational health risks. Such guidance is necessary to provide a clear and consistent message that will filter down to the regional level and be applied by Local Planning Authorities to encourage more waste-resource conscious planning. However, please note that for this to be effective, Local Authorities will be required to provide clear guidance on waste items to be segregated, collection methods and the frequency of collection.
- 6.7 Equally, it is recommended that the Assembly encourage more effective waste-resource management through the requirement to comply with Sustainability Codes which relate to buildings. As an example, more responsible and sustainable waste-resource management

can be driven through the requirement to comply with the Building Research Establishment Environmental Assessment Method (BREEAM), including codes for sustainable:

- Homes;
- Industry;
- Retail;
- Offices;
- Schools;
- Healthcare; and
- Courts and Prisons.

6.8 By driving the requirement for waste-resource management as a key planning/sustainability issue, this will encourage planners in creating innovative solutions to comply with best practice and differentiate themselves from competing plans.

6.9 The review of overarching National policy is therefore required to identify opportunities in which to further drive the reduction and management of waste-resources as a planning and sustainability topic, influencing regional decision making and encouraging more responsible and sustainable behaviour throughout Wales.

National Waste-Resource Feasibility Studies

6.10 It is recommended that the Welsh Assembly Government research and review the feasibility of emerging waste segregation and collection systems that could be implemented alongside planned infrastructure developments. As an example, emerging technologies such as Envac, provide underground automated waste collection systems for the transportation of municipal and commercial waste.

6.11 Such a system provides a means to segregate and rapidly deliver key waste streams from homes and public areas to waste-resource management facilities while significantly reducing the level of waste transported via roads. In addition, such systems are anticipated to significantly reduce the storage time of waste in homes and associated growth of microbial agents, reducing both community and occupational exposure.

National Information and Awareness Programmes

6.12 The Draft Strategy recognises that information and awareness programmes will be essential to facilitate more sustainable waste-resource behaviour at the industrial, retail and community

level. It is therefore recommended that national information and awareness programmes include the following information.

Industry Awareness and Engagement Programmes

- 6.13 It is recommended that broad information be provided to industry highlighting the objectives of the Draft Strategy and how waste-resource management will be implemented as a key sustainability issue throughout Wales over the next four decades.
- 6.14 Following initial briefing information it is recommended to engage with industry to identify and encourage best practice to discuss potential barriers to compliance, any potential socio-economic knock on effects and to identify and prepare industry for more responsible waste-resource consumer behaviour. In particular it is recommended to encourage industry and manufacturers to design out mixed waste from packaging and products to increase the value of waste-resources (i.e. utilise materials with a higher recycling efficiency and prevent mixing materials that reduce their value).
- 6.15 In so doing, it will be possible to refine the delivery of the Draft Strategy to address common issues, to facilitate economic benefits and to support industry during the transition stage.

Retail Awareness and Engagement Programmes

- 6.16 Similar to the industry awareness and engagement programme, it is important to both raise awareness as to the changes the Draft Strategy will bring, but also identify the potential barriers and challenges that may need further support to overcome. Equally, it is important to consider how the Draft Strategy may influence the product supply chain and the potential socio-economic knock on effect to small to medium sized industries in Wales.
- 6.17 Such awareness and engagement will further aid in investigating potential barriers that may impede the objectives of the Draft Strategy and aid in further refining delivery mechanisms to manage and address difficulties during the transition period.

Community Information and Awareness Programmes

Environmental, Economic and Health Benefits

- 6.18 Community information and awareness programmes are recommended to demonstrate the environmental, economic and health benefits of reducing waste and more responsible waste-resource behaviour throughout Wales. Where possible, this should demonstrate how much is spent on waste collection and management each year coupled with future management and environmental remediation costs. In addition, this should where possible, provide comparative figures the general public can relate to (i.e. the level or volume of packaging, food waste

generated each year). By explaining why change is necessary at the individual level and the benefits it will bring throughout Wales this will improve community support and aid in the delivery of the Draft Strategy.

- 6.19 In particular, it is recommended to highlight that in reality, it is the average person who pays to make, transport and ultimately pays for the treatment and disposal of, in many cases needless packaging and waste, with consequent environmental costs.

Recycling

- 6.20 It is recognised that a key barrier to recycling is limited awareness on what can be recycled. It is therefore recommended that a broad information programme be established to improve general public awareness of the recycling labelling system and aid consumers in more informed and responsible purchasing behaviour (i.e. in part, selecting products for their minimal waste profile or recycling efficiency).
- 6.21 The mode of such programmes may include public information via TV and/or available on line, posters and handouts in retail/public areas and community centres and possibly include raised awareness programmes at schools and adult education centres.
- 6.22 By driving such a programme with the general public, this will also increase pressure on industry and retail to comply with anticipated market demand for such products and to differentiate their products to increase consumer appeal.

Waste Segregation at Home

- 6.23 We recommend the Assembly provide information on the segregation and storage of waste-resource materials in homes to help address and manage common community concerns (hygiene, vermin etc), increase the recycling of viable materials and reduce occupational hazards associated with incorrect or inappropriate recycling of materials. It is also recommended to raise awareness as to the proper disposal of specific products including electronic equipment and batteries.
- 6.24 The mode of such information can follow that listed for recycling and may possibly include information affixed to recycle bins and kerbside collection facilities.

Waste Management at Home

- 6.25 It is understood that where appropriate, the Draft Strategy is seeking to encourage the management of specific bio-degradable wastes through composting at the household level. In this instance it is recommended that the Assembly raise awareness as to the benefits of home composting in terms of both the benefit to individuals (i.e. development of a rich compost

fertiliser for garden use to enrich soils) and the wider environmental and economic benefit associated with reducing the volume of organic waste currently sent to landfill or incineration.

6.26 Equally, it is important to raise awareness as to correct composting practice, where information is required to:

- determine if such a process is suitable for specific households;
- raise awareness as to the equipment and support the Local Authorities will provide;
- locate such composting bins in gardens to best manage pests and encourage optimal composting conditions;
- clearly establish the types of waste suitable for composting;
- clearly establish the time required before compost is suitable for use; and
- general maintenance information.

6.27 Please note that such information is generally required to increase the uptake of residential composting, but to also minimise inappropriate or incorrect composting practice and to maximise the quality of the fertiliser.

6.28 It is also important to note that, home composting presents a potential increase in community exposure to bio-aerosols, where individuals may present an allergic response (dependant upon relative sensitivity). To date, there is no evidence to suggest a significant health risk from bio-aerosols sourced from residential composting. However, considering the Draft Strategy seeks to increase such practice, it is recommended to perform further assessment on the types and concentration of bio-aerosol exposure directly attributable to residential compost bins. Depending on the conclusions of the study, additional public information may be required to raise awareness as to the significance of potential bio-aerosol exposure (set in contrast to other gardening activities).

Reuse

6.29 It is recommended that the Assembly investigate and encourage services and products that promote viable reuse programmes (e.g. reuse of milk bottles). Where appropriate, it is also recommended that the Assembly support or raise awareness as to companies and charities that seek to reuse suitable products (compliant with standards) to increase their lifespan and delay premature introduction to the waste stream (e.g. furniture, televisions, mobile phones etc).

Community Engagement

- 6.30 In addition to information programmes, it is recommended that targeted community consultation is performed to identify common concerns and barriers that may limit more responsible waste-resource behaviour. In doing so the Assembly will be able to further refine and enhance the delivery of the Draft Strategy tailored to community requirements.

Further Research into Waste Management and Health

- 6.31 During the development of the evidence base (Appendix A), and through consultation with the HIA Steering Group, it was acknowledged that there are a number of uncertainties and apparent knowledge gaps in potential health impacts from some waste management options (in particular for new and emerging waste management technologies). Addressing such uncertainties by further research would aid in addressing a number of common community concerns and support decision making at the regional and project level. Below are some of the identified uncertainties that may require further consideration:

- Characterisation of the source term from the different treatment processes. The evidence base review has identified apparent limitation in the available evidence regarding releases from waste management processes in general and specific processes in particular. For example releases of bio-aerosols and volatile organic carbons (VOCs) from biological treatment facilities and types and rates of emissions from ELV and WEEE plants are still associated with much uncertainty. Uncertainties are also sometimes associated with more well-defined sources such as those related to thermal treatment options. Currently emissions from conventional thermal treatment plants are specified by the WID limits for a list of relevant substances. However emissions of some other relevant substances from the process such as releases of PAHs and PCBs are still not well defined. For some of the options, such required characterisation may include not only the rates of emissions but also the types of emission too.
- Identification of a clear dose-response relationship for releases where such knowledge is currently unavailable with the aim of using such information to drive appropriate environmental criteria to be used in the risk assessment.
- Understanding the mechanisms of fugitive and controlled emission and dispersion of releases into the atmosphere. This may entail the need for further work on the physical and chemical properties of the different types of sources and substances released from these sources (such as the effect of wind speed on erosion related emissions and the effect of agglomeration and particle size distribution on the dispersion of solid particles)
- The difference between acute and chronic exposures.
- The difference between occupational and community exposures

6.32 The review has also identified the need for the following:

- Provision of standard guidance on appropriate mitigation and control measures for the different processes to reduce potential risks to the health of operatives and the community.
- Provision of good practice guides on best methods for assessing potential risks from the different treatment processes and recommending a standard format for risk assessment at project level for any facility being developed to assist in its delivery. Where such guidance is currently existing, regular update is recommended to consider the most recent knowledge. For example, the effect of the currently overlooked effects of the non-viable fractions of bio-aerosol and the applicability of the 250m rules to large scale open windrows and other types of open facilities may need further consideration in light of the findings from recent works.
- Where appropriate, conducting well designed epidemiological studies of modern facilities to inform the commonly inconclusive findings of older studies that were based on older generation facilities. Such studies should carefully consider the socio-economic confounding factors that were often ignored in the past.

Health Impact Assessment

6.33 It is recommended that the Assembly reinforce the requirement for HIA at the regional and local level to support site and technology selection and inform decision making during specific applications and environmental permitting.

6.34 In particular, it is recommended that the Assembly highlight the role and capability of the Welsh Health Impact Assessment Support Unit (WHIASU) to provide guidance on how to best integrate HIA into regulatory processes (to avoid unnecessary repetition of effort), to scope objective focussed HIA and to identify suitable HIA consultants.

6.35 In so doing, the Assembly will aid in addressing relative community circumstance and inequality at the regional and local level enabling more informed planning, more effective mitigation and initiatives to improve the health and wellbeing of communities throughout Wales.

The Management of Perceived Risk

6.36 It is the case that there are a number of commonly perceived risks associated with specific waste-resource management facilities that can lead to needless community fear and anxiety. Addressing such perceptions at the national level can only be addressed by raising awareness as to how community health is implicitly considered through design, and through stringent environmental regulations and standards set to protect health at both the planning and permitting stage.

- 6.37 It is therefore recommended that the Assembly in conjunction with the Environment Agency, the National Public Health Service for Wales (NPHS) and the Health Protection Agency (HPA) develop a formal position on each of the waste-resource management options currently under consideration within the Draft Strategy. Such position papers should draw from the available evidence base, highlight how community health is considered at the regional and local level (SEA, EIA, HIA Environmental Permitting), and where appropriate seek peer review from leading experts.

Local Authority Level

Targeted Community Information and Awareness Programmes

- 6.38 As indicated in the community profile, there are significant variations in relative socio-economic status, education, housing and health throughout Wales that may prove a barrier to the delivery of the Draft Strategy. In addition to a broad national information and awareness programme, it is therefore recommended that Local Authorities tailor information and awareness programmes to local circumstance and requirements.

Health Impact Assessment

- 6.39 It is recommended that HIA is commissioned at the project level to further inform waste-resource management site and technology selection.
- 6.40 Core objectives of the HIA will be to supplement and support a wider body of work including Strategic Environmental Assessments and Sustainability Appraisals to:
- define existing burdens of poor health, inequality and relative community sensitivity;
 - define potential exposure scenarios and subsequent risk to community health (drawing from the Assembly and EA position papers); and
 - identify and address perceived community risks.
- 6.41 In so doing, Local Authorities will be able to further demonstrate how health is implicitly considered from the onset of a project, will be able to more effectively address community concerns and reduce project delay.

The Management of Perceived Risk

- 6.42 As previously discussed, there is a requirement to investigate and address perceived community health risks to prevent needless anxiety and fear during strategic decision making.

- 6.43 It is therefore recommended that Local Authorities catalogue regional community concerns and utilise the Assembly/EA position papers to respond in a rapid and transparent manner. Equally, it is recommended Local Authorities develop a frequently asked questions section for specific projects to not only indicate that they are aware of community concerns, but to demonstrate how they are being addressed iteratively.

Project Level

Health Impact Assessment

- 6.44 It is recommended that where possible, HIA are scoped and commissioned parallel to or as part of Environmental Impact Assessment (EIA). In particular, it is recommended that the National Public Health Service (NPHS) and the Welsh Health Impact Assessment Support Unit (WHIASU) are included as statutory consultees during the EIA scoping exercise, to determine if a HIA is necessary and what it is to entail.
- 6.45 However, it is strongly recommended that any HIA commissioned utilise the technical outputs of the Environmental Statement (ES) and integrate into planned EIA community and stakeholder engagement. Such an approach avoids needless repetition of effort, prevents consultation fatigue and ensures the HIA is based upon realistic changes in environmental and socio-economic conditions directly attributed to the proposed development.
- 6.46 The objective of such HIA will be to expand upon the regulatory assessments to define the potential, distribution, likelihood and significance of potential health outcomes (both adverse and beneficial) during construction and operation.
- 6.47 Key deliverables include:
- provision of HIAs suitable for submission during the planning application stage;
 - that HIAs contain a robust assessment of potential health outcomes directly attributed to that particular development; and
 - a Health Management Plan intended to further mitigate potential community disruption during construction and operation, to address local circumstance, facilitate health benefit uptake and address community concerns.
- 6.48 In addition, it is recommended to reinforce that the aim and objectives of HIA are consistent with those of the Wales Spatial Plan, and HIA can be applied to further facilitate the delivery of more integrated and effective approaches to achieving a healthy, vibrant and sustainable Wales.

The Management of Perceived Risk

- 6.49 The management of perceived risks at the project level initially requires raising awareness as to how health has been implicitly considered at the national and regional level and will be investigated in further detail through planning, EIA, HIA and finally through Environmental Permitting to protect the environment and health.
- 6.50 It is at this stage that it is recommended to engage with communities to identify local concerns and scope such issues into any HIA commissioned. In so doing, it will be possible for the HIA to investigate and separate perceived from actual risk, developing information to further alleviate community concern and anxiety iteratively and through the Health Management Plan.

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Appendices

Appendix A

Health and Waste Management Evidence Base

Waste Resource Management Evidence Base

Introduction

The following section presents the available health evidence base on each of the waste-resource management options currently under consideration in the Draft Strategy, including:

- Bio-organic waste treatment;
- Mechanical waste treatment;
- Thermal Treatment Processes;
- Materials Recycling Facilities, Civic Amenity Sites and Waste Transfer Stations;
- Landfill;
- Waste Electrical and Electronic Equipment;
- End of Life Vehicles (ELV) Directive; and
- Hazardous waste treatment processes.

Common health pathways associated with the construction of facilities and the transportation of staff and materials by road are not considered on an individual basis.

Bio-organic Waste Treatment

Bio-organic waste treatment involves the biological degradation of organic waste through processes such as composting or anaerobic digestion. Each treatment process and potential health risk is discussed below.

Composting

Composting is a complex aerobic microbiological process by which the organic fractions of organic wastes are converted into compost products. Organic wastes contain lipids, carbohydrates, proteins and lignin. A diverse range of bacteria, actinomycetes and fungi act upon these substrates in the presence of air and water and decompose them (EA, 2005). Composting may be undertaken for commercial or residential purposes. Most materials require processing prior to composting by shredding, mixing, screening and controlling moisture content in the feedstock. The level of process control is dictated by the type of facility, the nature of the feedstock and the intended use of the final product (Swan et al, 2003). The different available systems for composting of waste can be divided into three main categories as described below.

Open Composting

The simplest and oldest method historically used for composting of green waste is by placing them into long piles called windrows. The process involves the regular turning of the piles to promote aeration, releasing trapped heat and exhaust gases with degradation of the processed material into compost.

Due to the Animal By-Product Regulations, this type of process cannot accept all food waste and is limited to 'green waste' such as hedge trimmings and grass cuttings and food wastes such as vegetables and biodegradable industrial wastes.

Aerated Piles

These are more advanced composting systems that are equipped with active aeration mechanisms based on either positive or negative air control, with the air from the latter system commonly collected and passed through a cleaning system including scrubbers and biofilters. At certain stages in the process, the windrows can be wrapped in plastic materials, which increase throughput rates and reduce nuisances (DDWS, 2007).

Due to the Animal By-Product Regulations, this process cannot accept all food waste and is limited to acceptance of green waste.

In-vessel Composting

In vessel composting is a term used to describe systems within which the composting processes are contained in enclosed vessels. There are several types of available enclosed systems including tunnels, drums, agitated bays, containers, towers and simple enclosed halls. In-vessel composting requires control of both temperature and moisture to process the material.

Materials handled include organic waste from kitchen, catering and garden waste including animal by-product waste. The process usually takes between 7 and 21 days, followed by a maturation period of between 4 and 10 weeks in windrows (DDWS, 2007).

Other Composting Systems

Other types of composting systems include those use semi-permeable laminate covers for optimisation of open windrow composting by the use of membrane covers to improve the decomposition process and the emission. These systems are usually combined with pressure aeration.

Hybrid systems that utilise a combination of any of the above at the different stages of the composting process are also available. Other processes such as vermi-composting, where selected species of earthworms are used to help compost organic wastes have also been reported (Swan et al, 2003).

Potential Health Pathways Associated with Composting

According to research by Canfield University, operating a composting facility should be a low risk activity. However composting does have the potential to cause pollution, harm to health and nuisance through odours, leachate, fires, dust, vermin and potentially harmful Volatile Organic Compounds (VOC) and bio-aerosols, if not operated properly (Taha et al., 2006). Bio-aerosols are airborne micro-organisms and their components. These include viruses, bacteria, actinomycetes, fungal spores, fragments of insects, mites and plant cells, proteins from plants and animals, endotoxins from Gram-negative bacteria and mycotoxins and glucans from fungi.

An Environmental Permit from the Environment Agency is usually required to operate a composting facility in accordance with the Environmental Permitting (England and Wales) Regulations 2007. Exemption may be available to small-scale operations.

Conditions can be set to control nuisance. The EA also provides standard rules within the permitting regime to minimise adverse impact to health and the environment.

Health Impacts Associated with Composting

It has been reported (Taha et al., 2006) that bio-aerosols are generally <10 µm in size and are not filtered out by the hairs and specialised cells that line the nose. Prolonged occupational exposure has been associated allergic lung disease such as Farmer's Lung Disease and Mushroom Worker's Lung Disease. However it was reported that although the link between bio-aerosols and these symptoms and diseases has been shown, clear dose-response relationship have not been defined and that this remains a principal constraint to characterising the significance of the risks to community health.

Reports (Defra, 2004 and Harrison, 2007) have reviewed multiple studies of health effects associated with composting facilities. Many of these studies have assessed the health effects for workers on composting facilities from bio-aerosols and dust (e.g. Bungler et al 2006, Muller et al 2006, Ivens et al 1997 and Douwes et al 2000). They suggested strong evidence amongst these studies of adverse health effects for workers, which include skin conditions, gastric infections and acute and chronic respiratory conditions. However, caution in interpreting the results of studies of worker's health was advised due to an effect known as the "healthy worker effect" in which a workforce becomes a self-selecting population.

The Health and Safety Laboratory and the Composting Association (Swan et al, 2003) have carried out an intensive review of occupational and environmental exposure to bio-aerosols.

They reported effects of exposure to organic waste containing bio-aerosol on respiratory health to include allergic rhinitis and asthma, chronic bronchitis and chronic obstructive pulmonary disease, extrinsic allergic alveolitis and granulomatous pneumonitis and toxic pneumonitis.

They also reported that workers at compost sites are regularly exposed to bio-aerosols between 10 and 1,000 times greater in concentration than may be expected normally in ambient air. The conclusion of this report was that "There is no published evidence that exposure to bio-aerosols from compost facilities cause respiratory ill health in residents or workers at nearby locations, or that slightly greater than background bio-aerosol levels represent a significant excess risk".

There are fewer reported health studies of the general public living near composting facilities. The Defra review (Defra, 2004) made reference to studies (e.g. Cobb et al 1995, Browne et al 2001) that found no significant adverse health effects on populations living near to composting facilities. They also made reference to other studies that have found links with ill health e.g. Herr, 2003 who found that residents living near one of the composting sites where concentrations of micro-organisms were high, experienced adverse health symptoms including respiratory conditions.

In this cross sectional study, doctors collected 356 questionnaires from residents near a large scale composting site and from unexposed controls in 1997. Self reported prevalence of health complaints, doctor's diagnoses, residential odour annoyance and microbiological pollution were measured simultaneously for the duration of one year. The study used the distance between home and the composting site as well as the number of colony-forming units of bio-aerosol as exposure measures. The results of the study showed a significantly elevated risk for a number of health complaints including bronchitis, frequency of colds and measures of eye irritation and general health. The critical review of this study (Defra, 2004) identified that although the use of self-reported symptoms frequently leads to bias in epidemiological studies, the authors tested this possibility through including odour annoyance as a question in their doctor-administered questionnaire. The results showed that odour annoyance, which might be expected to be a strong bias on self-reported complaints, had no influence on the reporting of irritative airway complaints and therefore did not appear to be a confounder.

The Defra review (Defra, 2004) could not identify any exposure-response function in any of the published research on occupational exposure. They suggested that the work by Herr et al, 2003 provides relative risk data, which can be used to develop effects estimates. From that the review suggested that there might be a link between commercial scale composting facilities and the occurrence of respiratory and irritative symptoms in people living very close to

the facilities. It should be noted that this conclusion was based on the finding of a study related to large scale open windrow facilities; as such caution should be exercised in applying such a conclusion to all sites. Further research is therefore required to address gaps in the current evidence on such issues.

The Environment Agency (EA, 2005) stated that the risk to health, for an individual exposed to bio-aerosol from composting operations depends upon the concentrations in air of different components of the bio-aerosol as well as personal exposure and prior health status. There is evidence from occupational health and individual case reports which demonstrates the potential for health risks in uncontrolled settings though there is little published evidence of serious / chronic disease in compost workers. They emphasised the need to consider health effects from all various components of bio-aerosols with the potential to damage human health including viable and non-viable fractions (EA, 2005). In their report, health effects were found to be also associated with exposure to the non-viable fractions, especially endotoxins, mycotoxins and glucans. Similarly, it was suggested by (Sykes et al, 2007) that the assessment of viable organisms alone provide a considerable under-estimation of personal exposure considering that dead microorganisms, cell debris and microbial components may too have toxic and/or allergenic properties.

The EA 2005 report also discussed the importance of including both the chronic and acute exposure in estimating the likely risk to health. The report suggested it is more appropriate to consider estimating the concentrations at receptors under the most unfavourable conditions and demonstrate that these should not be sufficient to give rise to acute effects. They concluded that the potential for acute health effects is greatest when the seasonal background concentrations of bio-aerosol are greatest.

It was also reported that there is a potential for the release of Volatile Organic Compounds (VOCs) from composting facilities, generated by many sources including micro-organisms. A review of studies (Defra 2004) measuring concentrations of VOCs at composting facilities has found differing results. They reported that studies such as Eitzer (1995) found considerably high concentrations from some species while Wheeler et al (2001) found no appreciably elevated concentrations. Assessment studies of health effects relating to exposure from VOCs is however limited. The Composting Association and Health and Safety Laboratory for the Health and Safety Executive (Swan et al, 2003 considered that:

“there is insufficient evidence available on exposure to microbial VOCs at composting sites to enable full assessment of potential health risks, although the limited data suggests they are not likely to be a major risk”.

It is therefore recommended that further research is considered to address this area of uncertainty.

Noise is a potential problem, particularly at open composting sites. Particularly loud noise emissions are associated with shredding, turning and screening operations such that nuisance levels may be experienced in the order of 300m from any site if no mitigation is put in place (Defra, 2004).

Both odour and dust, especially the former can be problems at composting operations. Odour emissions derived from the delivery of feedstock (especially if it has been stored for long periods), shredding, exhaust air from enclosed systems, the development of anaerobic conditions, dirty areas and untreated pools of leachate could be significant. Dust may also be a problem for sensitive receptors in close proximity to operations (Defra, 2004).

The Environment Agency has a clear position on the location of new (windrow or in-vessel) composting facilities, where EA policy 405_07 requires a site-specific risk assessment for any application for a composting facility where the boundary is within 250 metres of a workplace or the boundary of a dwelling. Such a risk assessment needs to demonstrate that bio-aerosol levels can be maintained at appropriate levels at the dwelling or workplace.

It should however be noted that despite the number of studies demonstrating the reduction of bio-aerosol concentration to background level within 250m, this may not necessarily be the case for sites and facilities. The Health and Safety Laboratory and the Composting Association (Swan et al, 2003) report states that:

“under certain atmospheric stability classes modelled, representing infrequently encountered worst-case conditions, bio-aerosol concentrations would not be reduced to the background value within 250m.”

Other studies (EA 2001) also reported greater distances required to achieve background levels. However, it should be noted that most of the studies that indicated the need for more than 250m are associated with large scale open windrows type of facilities with no or minimum mechanisms of control over the composting processes.

The cross sectional study by Herr et al, 2003 which was referenced and considered by Defra to provide the relative risk data that can be used to develop effects estimates, (discussed above) have also reported greater distances than 250m. The study reported that in the outdoor air of the residential area 200m from the plant, concentrations of up to $>10^5$ CFU/m³ air were recorded for total bacteria, moulds and thermophilic actinomycetes. Even 320 m from the site differences in concentration of total bacteria and moulds which were 100 times background levels (10^3 - 10^4 CFU/m³ air) were detected. Furthermore, the site characteristic thermophilic actinomycetes which were not found in upwind-background measurements were still detectable 550m downwind from the site at a concentration of $<10^3$ CFU/m³ air.

The EA report (EA, 2005) suggested that the distance from the source, at which concentrations of specific components are reduced to background levels, should be determined, in part by the quantity of emission.

It should be noted that the quantity of emission is determined by several factors including the type of activity and site practice, properties of the compost such as the age, moisture contents, type and particle size of the feedstock and the wind conditions. Taha et al., 2007 found that active emissions related to processes such as turning, screening and shredding are significantly greater than passive emissions from static windows. It should also be noted that following emission the final ground level concentration is also affected by local factors such as the local terrain and meteorological conditions.

Uncertainty in appropriately defining and determining the emission term were discussed by Sykes et al., 2007 as one of the barriers to progress in achieving waste diversion and composting targets in Wales and the rest of the UK. Other knowledge gaps relating to development of dose-response data and accurately modelling the dispersion of bio-aerosols were identified as factors hindering the development of reliable risk estimates to inform the management of these potential risks.

It should be noted that most of the discussed potential health impacts are related to open windrows, being the most common form of composting

The Health and Safety Laboratory and the Composting Association (Swan et al, 2003) also reviewed and discussed emissions from in-vessel composting facilities. Most of these studies demonstrated reduced downwind concentrations from these types of facilities in comparison to open systems. They concluded that enclosed and in-vessel composting systems may increasingly be used in the UK, which would reduce dispersed emissions.

A shift towards large scale in-vessel and mechanical biological treatment plants in mainland Europe and to a lesser extent in the UK was reported by Sykes et al., 2007. This was attributed to the fact that indoor, controlled processes have the ability to maintain optimum temperature and moisture content which facilitate the composting process and can minimise emissions to atmosphere by the installation of appropriate pollution arrestment technologies such as bio-filters and wet scrubbers.

Summary

Although some studies (Swan et al., 2003) suggested that there is no evidence that exposure to bio-aerosols disseminated from compost facilities cause respiratory ill health in residents or workers at nearby locations, others (Defra 2004) suggested, based on some relative risk data, that there might be a link between commercial scale composting facilities and the occurrence of respiratory and irritative symptoms in people living very close to the facilities.

The risk to health, for an individual exposed to bio-aerosol from composting operations was reported by the Environment Agency (EA 2005) to depend upon the concentrations in air of different components of the bio-aerosol as well as personal exposure and prior health status.

A safe distance of 250m was referenced by the Environment Agency position statement on composting as the distance where the concentration of bio-aerosol reduces to the background concentration. However, the EA 2005 report suggested that the distance from the source, at which concentrations of specific components are reduced to background levels, should be determined in part by the quantity of emission.

Furthermore it was suggested (Sykes et al, 2007) that the assessment of viable organisms alone provide a considerable under-estimation of personal exposure considering that dead microorganisms, cell debris and microbial components may too have toxic and/or allergenic properties.

The importance of including both the chronic and acute exposure in estimating the likely risk and the contribution of background concentrations are recognised as of considerable relevance in assessing the risk.

Health risks can be minimised by the employment of appropriate mitigation measures. Indoor, controlled processes may minimise emissions to atmosphere by the installation of appropriate pollution arrestment technology such as biofilters and wet scrubbers.

Anaerobic Digestion

Anaerobic digestion is the biological treatment of organic waste in the absence of oxygen, using microbial activity to break down the waste in a controlled environment. The process takes place within a digester, which is a warm, sealed, airless container and results in the production of biogas, which is a mixture of methane and carbon dioxide. Biogas can be used to generate heat/electricity, or upgraded to replace transport fuel (although upgrading will require additional energy inputs). The process also produces fibre which can be used as a nutrient rich soil conditioner and liquor, which can be used as liquid fertiliser (DDWS, 2007).

Anaerobic digestion is commonly used for treating biodegradable waste, including household waste (garden and kitchen waste), the mechanically separated organic rich fraction of mixed waste from Mechanical Biological Treatment (MBT), agricultural and industrial waste and sewage sludge. With the appropriate feedstock combination almost any organic material can be processed.

There are two types of AD process:

- Mesophilic digestion. The digester is heated to 30 - 35°C and the feedstock remains in the digester typically for 15 – 30 days.

- Thermophilic digestion. The digester is heated to 55°C and the residence time is typically 12 – 20 days.

Potential Health Pathways Associated with Anaerobic Digestion

Potential impacts on human health are mainly related to a) direct emissions of dust, bio-aerosols and other gaseous emissions from the process and b) indirect emissions related to potential exposure to the solid digestate residue and liquid residue.

The main risks to health relating to the handling of feedstock are occupational in nature and include:

- potential exposure to pathogenic micro-organisms and bio-aerosols;
- potential exposure to parasites; and
- potential exposure to fumes and inhalation of slurry gases.

Feedstock will contain varying amounts of plant or animal pathogens (such as Salmonella) and parasites (such as Cryptosporidium) dependant upon the material. Neither mesophilic nor thermophilic digestion will totally eliminate the pathogens within the feedstock and may therefore have the potential to cause adverse health effects for those working with the feedstock before and after treatment, and for those who may come into contact with the treated feedstock.

Biogas produced by the digester is primarily composed of methane and carbon dioxide with traces of hydrogen sulphide. Hydrogen sulphide may be released during fuel gas production, from stored feedstock and in the mixing pits or conveying plant. Methane is an asphyxiant and the remaining gases are toxic. In addition there is also a risk of fire and explosion.

Bio-aerosols may also be released from the anaerobic digestion process, mainly from feedstock reception and the eventual aeration of the digestate (solid material remaining after anaerobic digestion and separation), which have the potential to cause respiratory complaints via inhalation (SEPA, 2006).

Gaseous emissions from the energy utilisation plant are another source of emissions that have the potential to affect health.

An Environmental Permit or an exemption from the Environment Agency is required to operate AD plants in accordance with the Environmental Permitting (England and Wales) Regulations 2007.

Conditions can be set to control nuisance. The EA also provides standard rules within the permitting regime to prevent or control adverse impacts to health and the environment.

Health Impacts Associated with Anaerobic Digestion

There is little evidence of health impacts from AD plants. The Defra comparison of potential health impact related to air emission of classical pollutants (PM10, sulphur oxides and oxides of nitrogen) per tonne of waste demonstrated that using AD biogas for generation of energy has slightly lower potential health risk when compared to other type of thermal processing facilities (Defra 2004). It should be noted however that data quality for AD plants was variable. Emission of oxides of nitrogen from anaerobic digestion is reported to be similar to those from power generation.

A search carried out for Defra 2004 yielded no references describing epidemiological studies of the impact that AD has on human health.

Noise is emitted from anaerobic digestion plants primarily in relation to vehicle movements but also from pumps, compressors, power plant etc.

Odours may be released from anaerobic digestion plants primarily from feedstock and digestate handling. Dust is not known to be associated with anaerobic digestion plants (Ref. Defra 2004).

In conclusion AD produces certain emissions to air, land and water that have the potential to adversely affect human health, especially within an occupational context. The likely magnitude of risk and impact on health seems to be dependant on the level of control and management of the process and the health and safety measures adopted on the site.

No epidemiological studies were identified for this process and there is little evidence of impacts from AD plants on health, if managed properly.

Mechanical Waste Treatment

Mechanical Biological Treatment (MBT)

This is usually an integrated system combining several processes including different combinations of mechanical sorting to separate out the non-biodegradables, which are mostly bulked up and sent for recycling or landfill followed by drying and biological treatment of the organic fraction. The organic component may also be fed into an aerobic digester. Some systems may screen the waste to produce a compostable stream appropriate for in-vessel composting processes.

MBT plants are commonly designed to sort out mixed waste into different fractions using mechanical means and extract materials for recycling followed by biologically processing the segregated organic rich components. Through biological treatment a dry stable product is usually created. The stabilised residue may undergo further screening or sorting depending

on the ultimate application of the residue. This application may be in the form of landfill cover, restoration or for soil conditioning applications if processed to a sufficient quality (Defra 2004). However the process may be used to produce a segregated higher calorific value waste to feed to an appropriate thermal process as a Refuse Derived Fuel (RDF).

Primarily materials handled are for mixed municipal solid waste but other wastes with bio-degradable elements may be treated.

Potential Health Pathways Associated with MBT

These are commonly considered to be low risk activities. However the different processes have the potential to cause pollution, harm to health and nuisance through odours, leachate, fires, dust, vermin and potentially harmful bio-aerosols, if not operated properly.

An Environmental Permit from the Environment Agency is required to operate an MBT in accordance with the Environmental Permitting (England and Wales) Regulations 2007.

Conditions can be set to control nuisance. The EA also provides standard rules within the permitting regime to minimise adverse impacts to health and the environment.

Health Impacts Associated with Mechanical Biological Treatment

Due to the variable nature of the processes that can be carried out within MBT plants, it is not possible to identify likely emissions and health impacts related to such emissions. However, it can be said that health impacts from such facilities are similar to those described for material recycling and biological treatment plants. If the MBT plant resulted in the production of a RDF, the combustion of the RDF would result in emission of combustion gases. However this is unlikely to take place at the same facility and will be subject to strict controls to protect environment and health.

The EA (2005) stated that a small number of published references have examined the health impact of RDF, but only in relation to production workers. It reported that the surface of RDF pellets can have elevated microbial concentrations if the production temperature is not sufficiently high. This report also made reference to other studies where workers in the production of RDF reported symptoms of sinus trouble, headaches, nose irritation and diarrhoea. Workers employed for more than seven years had significant reduction in Forced Vital Capacity (FVC) and Forced Expiratory Volume (FEV). A similar US study was referenced to conclude no decrease in FEV and FVC but an increase in self reported symptoms such as headaches, rashes and hay fever.

The aerobic decomposition of waste may result, depending on the configurations of the system, in emission of bio-aerosols, dust, VOCs and odour. These emissions can be treated by means of a bio-filter or a thermal oxidizer. For biological treatment processes site specific

risk assessment is required to demonstrate that bio-aerosols levels at receptors are either at background concentration or below the Environment Agency health criteria.

According to Defra (2004), health impacts related to air emission of classic pollutants (PM₁₀, sulphur oxides and oxides of nitrogen) per tonne of waste from MBTs are generally lower in comparison to most other types of facilities. However this conclusion was based on very limited data. Emission of sulphur dioxide from MBT was lower than other waste management facilities except AD. Nitrogen oxides emission was much lower for MBT than other facilities. It was noted that the air emission from an MBT plant should be quantified in relation to the solid residues only and not the overall waste input. A further source of emissions to air from MBT systems would a rise from any combustion of residues in an RDF system.

Generally there is little current evidence of health effects of MBT, though adverse effects from handling and sorting wastes are possible.

Noise, dust and odour may be potential issues at MBTs as described in similar processes.

In conclusion, due to the variable nature of the processes that can be carried out within MBT plants, it is not possible to identify likely emissions and health impacts related to such emissions. However, it can be said that health impacts from such facilities are similar to those described for material recycling and biological treatment facilities. Health impacts from recycling facilities are usually occupational in nature with limited opportunity for community exposure or risk. Aerobic biological treatment of waste was demonstrated to have the potential to present health risk to the community. As such mitigation and control measures required for these facilities may apply to MBT plants.

Mechanical Heat Treatment

Mechanical Heat Treatment (MHT) is a process applied to further segregate recyclable materials and to process biomass materials into a homogenous product to facilitate more effective and efficient use as a renewable fuel source. The technology is typically part of a waste separation facility and can include shredding, blending, drying and pelletising.

Autoclaving

Autoclaving is a well proven process for the treatment of clinical waste and for the sterilisation of laboratory/operating theatre equipment. However its application to treatment of municipal waste is relatively new. In the treatment of clinical waste, the main purpose of autoclaving is to sterilise the waste material or equipment so as to destroy pathogens and other biological contaminants. This is quite different to the application of autoclaving for MSW treatment where the principal aim is to condition the material to aid downstream separation into constituent materials, although the sterilisation that occurs also aids this process of separation.

Autoclaving can accept a wide variety of waste input that requires no pre-sorting, however it should not be considered as a replacement to source-segregated recycling. It has been reported to maximise the recovery of organic material as sterilised fibre and the recovery of premium quality recyclables. The produced fibre is used either as a fuel for the generation of energy or to feed into an AD system.

When used for treatment of MSW, autoclaving is utilised as a pre-treatment technology, which normally comprises the first stage of an MBT system. It is essentially a steam treatment process, however some processes include mechanical action during the treatment to break open bags and break down the organic portion of the waste into a fibrous material.

The process involves treating waste with steam at 160°C, and elevated pressure, in rotating vessels. The process sterilises waste and reduces its volume by about 60%. After going through the vessels, the material is mechanically sorted to produce 20% recyclables and 60% organic fibre, the remaining 20% is stabilised waste suitable for landfill.

The fibre can be biologically treated, used as fuel, or used as a raw material in industry. It has been reported that most pollutants from the process are removed in the wastewater.

Potential Health Pathways Associated with Mechanical Thermal Treatment

The main potential exposures and impact on health are related to gaseous emissions, waste water and the solid residues. Odour, noise, heat stress, fires and explosions are also of potential concern.

Mechanical Heat Treatment

Being a relatively new process there is limited emissions data and no available epidemiological studies.

Autoclaving

It was reported (EBPHCF, 2003), that at the end of the autoclave cycle, the autoclave uses a vacuum to remove steam, which usually exits through a condenser. Uncondensed steam vapour, and possibly pollutants vaporised during the autoclave cycle, exit from the emission vent. Some of these vents contain high efficiency filters or a water spray scrubber. Opening the autoclave chamber may release additional vapour.

Potential Health Impacts from Mechanical Heat Treatment

There is little research undertaken on the potential health impacts of mechanical heat treatment. No reference to epidemiological studies has been found in relation to MHT or

autoclaving of waste. Generally reference is made to occupational health and safety from autoclaving of medical waste.

Autoclaving of medical waste has been reported to have the potential to expose workers to infectious materials, hazardous or radioactive pollutants (as a consequence of the feed stock), heat stress and noise. It is also reported that, available data suggest that most hazardous pollutants released from autoclave come from improperly disposed material like solvents or mercury-containing equipment. Materials in ordinary regulated medical waste can, however, release embedded pollutants during autoclaving. Examples given include red bag waste potentially containing cadmium and Polyvinyl chloride (PVC) plastic containing plasticizers like diethylhexyl phthalate. However new pollutants are not formed in the process due to the low operating temperatures. Therefore the pollutants released from autoclaving are the same ones that enter the autoclave in the waste. This is the fundamental reason why proper waste segregation is essential to safe autoclaving process.

Although the above relates specifically to medical waste, it indicates that likely releases from such a process is dependent on the type of waste treated. In the absence of data on the quality of air emission from the process, it is not possible to identify likely health impacts.

A 1993 study by the Research Triangle Institute for the USEPA Office of Solid Waste found that for properly operated autoclaves, infectious agents should not be released in quantities capable of causing infection (EBPHCF, 2003).

Most of the emissions from MHT facilities are generally linked to vapours from the release of pressure from the autoclave vessel. The relatively high temperature in the autoclave should be sufficient to eliminate the risks posed by microorganisms. It was also reported that facilities could be designed with no significant releases of VOCs or particulate matter from autoclave vessels by depressurisation into a standby vessel. The combustion of the RDF is the main source of emission.

Odour is a concern at all waste facilities. The thermal treatment of the waste in the process of autoclaving is conducted within an enclosed building and therefore the potential for odour emission will be controlled through the building ventilation and filtration system.

Thermal Treatment Processes

Within the context of this report, thermal treatment covers all processes involving the use of heat to break down waste, including incineration, gasification and pyrolysis (excluding the mechanical heat treatment previously discussed).

Waste Incinerators and Energy from Waste

Waste incineration usually involves the combustion of MSW with no or minimal treatment to the incoming feedstock. To allow the combustion to take place a sufficient quantity of air is required to fully oxidise the fuel, a proportion of which is generally drawn from waste storage areas to reduce odour emissions beyond the facility.

Waste is a highly heterogeneous material, consisting of organic substances (including paper, plastics, green and food waste materials) minerals, metals and water. During incineration, flue-gases are created that contain the majority of the available fuel energy as heat. All today's municipal waste incinerators recover energy, either in the form of steam for local industrial use or district heating or for conversion into electricity via a steam turbine. Some recover both heat and power. It should be noted that district heating scheme, carry a premium in terms of cost, depending on the site specific demand characteristics, and requires careful planning.

There are a number of different types of incinerators depending on the furnace technology used:

- Grate incinerators: widely applied for the incineration of mixed municipal wastes (at large scale). In addition grate incinerators can also treat commercial and industrial non hazardous wastes, sewage sludges and certain clinical wastes.
- Rotary kilns: widely applied for the incineration of hazardous wastes and also commonly used for clinical waste, although only used at the small scale (oscillating kiln) in the UK. They are very robust and almost any waste, regardless of type and composition, can be incinerated.
- Fluidised bed: widely applied to the incineration of finely separated wastes like RDF and sewage sludge. It has been used for decades, mainly for the combustion of homogeneous fuels like coal, although there are only two examples operating on MSW in the UK. Fluidised bed requires an additional process to prepare the fuel for combustion and is not considered to be as robust as the moving grate technology for use with current UK MSW streams.

All waste incinerators are subject to specific emission limits set by the EC Waste Incineration Directive (WID). Key pollutants regulated under the Waste Incineration Directive include:

- Nitrogen Dioxide (NO_x);
- Sulphur Dioxide (SO₂);
- Total Dust (including PM₁₀ that constitutes the PM_{2.5} fraction);
- Carbon Monoxide (CO);

- Total Organic Carbon (TOC);
- Hydrogen Fluoride (HF) and Hydrogen Chloride (HCl);
- Cadmium (Cd) & Thallium (TI);
- Mercury (Hg);
- the sum of Antimony (Sb), Arsenic (As), Lead (Pb), Chromium (Cr), Cobalt (Co), Copper (Cu), Manganese (Mn), Nickel (Ni) and Vanadium (V); and
- Dioxins / Furans (PCDD / PCDFs).

Common Community Concerns

Emissions that commonly elicit community concern include Dioxin and Furans and Particulate Matter (PM₁₀ and PM_{2.5}).

Dioxin, Furans and Heavy Metals

All new thermal waste treatment facilities require both detailed air quality dispersion modelling and Human Health Risk Assessment to assess the worst case change in exposure to specific pollutants (including dioxins, furans and heavy metals) and the risk to health from inhalation, ingestion and absorption through skin. Such an assessment factors in prevailing meteorological conditions and is inherently conservative, normally assuming that local receptors spend approximately 70 years consuming only food grown/reared in the location of highest emission concentration. Only if a proposed facility can confirm that it does not present a risk to health will it gain planning consent and an Environmental Permit to operate.

As such, regulatory requirements are in place at the project level to ensure such facilities do not constitute a significant risk to community health from exposure to dioxins, furans and heavy metals.

Particulate Matter

There is robust scientific evidence to support the quantification of potential changes in morbidity and mortality from changes in exposure to particulate matter. The UK Department of Health's Committee on the Medical Effects of Air Pollutants (COMEAP) has established that:

- there is a 0.75% increased risk in the background rate of all cause mortality per 10 µg.m⁻³ increase in PM₁₀ per 100,000 individuals exposed;
- there is a 6% increased risk in the background rate of all cause mortality per 10 µg.m⁻³ increase in PM_{2.5} per 100,000 individuals exposed; and

- there is a 0.8% increased risk in respiratory and cardiovascular hospital admissions per $10 \mu\text{g.m}^{-3}$ increase in PM_{10} per 100,000 individuals exposed.

Such potential health outcomes are primarily dependant upon the level of community exposure and their existing burden of poor health. However:

- modern thermal waste treatment facility emissions are not of a level to result in a significant impact upon ambient air quality;
- particulate matter emissions are typically orders of magnitude lower than the $10 \mu\text{g.m}^{-3}$ increase required to quantify a meaningful change in health outcome; and
- community exposure is typically far lower than the 100,000 population exposure used as the basis to quantify a meaningful health outcome.

As such, potential changes in community exposure to particulate matter from such facilities are generally not sufficient to quantify any meaningful change in health outcome.

To illustrate this point, applying the highest all cause mortality rate by Local Authority in Wales (Blaenau Gwent 831.8 per 100,000), and assuming a hypothetical situation, where the entire population (approximately 70,000 residents) is subject to an annual average increase of $1 \mu\text{g.m}^{-3}$ of PM_{10} would result in approximately 0.4 of a Death Brought Forward (DBF) per year.

However, it is important to note that an increased risk of mortality and morbidity due to elevated particulate matter exposure is small and limited to that part of a population which is already in poor health. As such, the term DBF does not constitute new/additional deaths but a reduction in life expectancy for those whose health is already seriously compromised.

In order to convert DBF into changes in life expectancy, the COMEAP ⁽¹⁰⁾ provided an estimate of an average two to six month loss of life expectancy per DBF. Applying the previously outlined scenario, 0.4 of a DBF equates to a hypothetical 30 to 90 seconds loss of life expectancy for those individuals whose health is already seriously compromised.

The previous calculation is based upon the highest all cause mortality rate in Wales, using an unrealistic community exposure scenario from such facilities. Regulatory processes are in place to prevent a significant impact upon the environment and subsequent community health. Based upon the available evidence base, it is concluded that such facilities do not pose a significant risk to health from exposure to particulate matter. This conclusion is consistent with the Position Statements issued by the Environment Agency, UK Health Protection Agency and the Chartered Institute of Water and Environmental Management.

Residual Waste Management

- 6.51 Ferrous and non ferrous metals can be recovered from the furnace bottom ash which can itself be used as a secondary aggregate substitute.
- 6.52 Due principally to alkalinity associated with unspent reagents for acid gas neutralisation, Air pollution Control (APC) residues are classified as a hazardous waste, and as per regulatory requirement are subject to stringent measures for handling and transfer. A duty of care is applied for all aspects of the waste management process including the transportation and reuse of such materials.

Transportation

- 6.53 Such facilities are likely to result in an increase in local transport movements due to staff and the transportation of waste, with the potential to increase community severance, risk from road traffic accidents, and changes in air quality and noise. However, such impacts are largely managed through the planning process by the appropriate choice of location and provision of good access. Residual effects can be managed through the development of a Traffic Management Plan.
- 6.54 However, it is also important to consider that such facilities should facilitate a net reduction in vehicle movements and associated health benefits through a reduction in the volume of waste sent to landfill.

Potential Health Pathways Associated with Incineration

Exposure in relation to gaseous emissions and residual waste are the main areas of concern in relation to human health. Noise, odour, bio-aerosols, fire and explosions are of less potential concern than with other technologies. In contrast, community anxiety is often higher.

Although public concern is generally focused on health impacts associated with changes in air quality, for many pollutants including some of the trace metals and potentially carcinogenic organic compounds (such as dioxins and furans), the major route of exposure is through the food chain.

Health Impacts Associated with Incineration

Like other combustion processes, including steel and coal, the by-products of the combustion process may contain hazardous pollutants and emissions that will add to background pollution levels. There is often considerable public concern over the possible health effects of living near to incinerators processing hazardous, clinical or municipal waste (EA, 2005).

Historically, incinerators were relatively poorly controlled compared with modern facilities, which must comply with the requirement of the WID. The public is generally not well informed about the improvement in controls (including pollution abatement technology) that have taken place for EfW incineration, and there is a need to ensure good dissemination of information during the planning process.

Air pollution (from all sources) can have an adverse effect on the health of susceptible people (including the young, the elderly and infirm). The Air Quality Strategy (July 2007) notes that both short term and long-term exposure to ambient levels of pollution (particularly Particulate Matter) is consistently associated with respiratory and cardiovascular illness and mortality as well as other ill-health effects (the largest source of particulate matter emission in the UK is traffic).

The Committee on the Medical Effects of Air Pollutants (COMEAP) has reported that evidence regarding the effect of long-term exposure to air pollution points strongly to an association between long-term exposure to particulate air pollution and effects on mortality, while studies on health effects from other combustion gases such as nitrogen dioxide and sulphur dioxide were found to be less consistent. Epidemiological evidence for increased risk at environmental levels of exposure to metals was reported to be scarce or equivocal. High levels of dioxins exposure (generally in occupational settings) was reported to have caused increase in cardiovascular disease and increased risk from some cancers, although the results vary depending on the specific substance (Rushton 2003).

However, extrapolating health effects associated with exposure to these pollutants to the relatively small additional exposure from incinerators could be dangerously misleading.

The Defra review concluded that whilst incinerators generate a considerable amount of public concern it was not possible to identify any peer-reviewed study showing that modern incinerators release hazardous substances at a level causing harm to the people in the vicinity.

Cancer

Several epidemiological studies have suggested a possible association between incinerator emissions and variety of cancers including stomach, colorectal and liver cancers; larynx and lung cancers; childhood cancers and soft tissue sarcomas and non-Hodgkin's lymphomas. However, the review carried out by Defra 2004 concluded that there is no consistent or convincing evidence of a link between cancer and incineration. In the UK, the large epidemiological studies from the Small Area Health Statistics Unit (SAHSU) examined an aggregate population of 14 million people living within 7.5 km of 72 municipal solid waste incinerators. This included all incineration plants irrespective of age up to 1987. Despite the

inclusion of incinerators with emissions much higher than would occur from modern incinerators, both studies were unable to convincingly demonstrate an excess of cancers.

Following these studies, the Department of Health's Committee on Carcinogenicity published a statement in March 2000 evaluating the evidence linking cancer with proximity to municipal solid waste incinerators in the UK. The committee specifically examined the results of these studies and concluded that:

'any potential risk of cancer due to residency (for periods in excess of ten year) near to municipal solid waste incinerators was exceedingly low and probably not measurable by the most modern techniques'.

Noting that emissions from modern incinerators are orders of magnitude lower than from older incinerators, it may be concluded with some confidence that any impact on cancer rates in local people are small or non-existent and unlikely to be quantified through epidemiology (Defra 2004).

Respiratory Function and Disease

Available studies have typically examined respiratory health around the older generation of incinerators. Overall, there is little evidence to suggest that waste incinerators are associated with increased prevalence of respiratory symptoms in the surrounding population.

This is consistent with emissions and ambient air quality monitoring in the vicinity of incinerators, which indicate that modern, well managed incinerators make a very small contribution to background levels of air pollutants and are not a significant contributor to local air pollution.

The Defra Study concluded that modern incinerator facilities simply do not generate sufficient concentrations of emissions to quantify any meaningful change in health effect (Defra 2004). In the absence of any exposure response coefficient specific to incinerators, the current approach is to use known exposure response coefficients derived from more significant emission sources (e.g. road emissions) to quantify the magnitude and distribution of health outcome.

Congenital Abnormalities

High exposure to environmental pollutants is known to adversely affect the reproductive system of animal test subjects. However, epidemiological studies fail to establish any convincing links between incinerator emissions and congenital abnormality (Defra 2004).

Infant Mortality

Risk of increased infant mortality as a consequence of emissions from incinerators is a frequently raised issue by concerned communities. However, there is no evidence publicised in the scientific literature to suggest that modern incinerators increase the risk of infant mortality.

There are a number of web sites that publish material relating to excess infant mortality near incinerators. This material does not however appear in peer reviewed scientific literature and can not be accepted as credible without further clarification of the evidence applied.

The majority of published studies concentrate on the effects of exposure to emissions from the older generation of incinerators which were phased out in the UK after the introduction of stricter emission controls implemented through the Environmental Permitting regime (and the former Integrated Pollution Control (IPC) and Integrated Pollution Prevention and Control (IPPC) regulatory systems).

Most studies of communities living near incinerators have assessed exposure using some measure of distance from the site or an estimate of areas at most risk from emissions. Little evidence has been found for an association between modern waste incinerators and reproductive or developmental effects (HPA 2005, Defra 2005). In addition there is little evidence of increased prevalence of respiratory illness near incinerators using either self-reported symptoms or physiological measures. A series of studies in the UK of multiple sites compared observed cancer incidence rates in bands of increasing distance from each incinerator with rates based on national data.

Although a significant decline in risk with distance from the incinerators was initially reported for all cancers combined and particular types, incomplete control for socio-economic confounders were considered to be responsible for these results. Although the possibility of an association between residential proximity to MSW incinerators and incidence of cancer could not be completely discounted, confounding from deprivation appears to be the most likely explanation for the excess. It was concluded that even if such a link could be established, the excess relates to historical exposure patterns around older incinerators and not current or future incinerators.

No evidence of an increasing risk of lung or laryngeal cancer was found with proximity to incinerators used for the disposal of solvents and oils. Although additional studies (Rushton, 2003) have indicated a statistical increase of cancer with increasing proximity of residence to MSW incinerators, such studies have been criticised for lack of adequate measurements on internal or external exposure and for potential confounders (Schrenk, 2006).

The evaluation of potential health effects of the large number of pollutants which can be produced by waste incineration, by assessing the effects of individual pollutants or through

more general studies of community residents and incinerator workers was discussed by the MRC Institute for Environment and Health (Rushton 2003). It was suggested that from the health aspects, the most important pollutants associated with incineration are particles, acidic gases and aerosols, metals and certain organic compounds. It concluded that available exposure data and associated acute and chronic health effects may be available for certain pollutants such as particles but are still scarce for other pollutants.

The Environment Agency (EA, 2005) concluded that there are only a small number of epidemiological studies on populations around incinerators and the results of these are typically inconsistent and inconclusive. Based on current epidemiological evidence, it is difficult to establish causality, particularly once confounding factors such as socio-economic variables, exposure to other emissions, population variables and spatial/temporal issues are taken into account.

In reality, most data on the possible health effects of incinerator emissions are derived from risk assessments, which are routinely used to evaluate both direct and indirect carcinogenic and non-carcinogenic risks.

Despite uncertainties identified by the Environment Agency in terms of the ability of risk assessment to predict accurately the degree and consequences of exposure, especially from indirect routes, site specific risk assessments that relies on actual or expected site specific conditions was recommended to be used to estimate likely risks. In order to place the risk assessment from incineration emissions in a more appropriate context, such an assessment should address the issue of background exposures, since for some contaminants it is necessary to account for existing body burdens and intakes from other sources.

Applying the available evidence base, the Environment Agency (EA 2008), the UK Health Protection Agency (HPA) and the Chartered Institute for Water and Environmental Management (CIWEM) have produced formal position papers on the health effect of energy from waste facilities. Here it is concluded that well managed and regulated waste incineration processes contribute little to the concentrations of monitored pollutants in ambient air and that the emissions from such plants have little effect on health.

Pyrolysis and Gasification

Pyrolysis is the thermal degradation of a substance in the absence of oxygen to produce a carbonaceous char, oil and combustible gases. How much of each product is produced is dependant on the process conditions, particularly temperature and heating rate. Waste materials are heated at temperatures of between 300-850°C.

The synthetic gas (syngas) is a mixture of combustible gases such as carbon monoxide, hydrogen, methane and a range of VOCs. Energy can then be generated from either

combusting the gas and feeding the hot gases into a heat exchanger where steam is produced and used to generate energy in a steam turbine or the gas is refined to a quality suitable for use in a gas engine. The solid fraction may be used as the feed material for a gasification process.

Gasification is a partial oxidation of organic substances to produce gases than can be used as a feedstock or as a fuel. There are several different gasification processes available, which are in principle suited for the treatment of municipal waste, certain hazardous waste and dried sewage sludge (EC, 2006). Gasification involves a large number of reactions, from initial devolatilisation and char formation through heterogeneous reactions involving the formed species and the oxidising media (which is most commonly air, pure oxygen or steam).

For utilisation in entrained flow, fluidised bed or cyclone gasifiers, the feeding material must be finely granulated. Therefore pre-treatment is necessary, especially for municipal wastes. However, due to the homogeneous characteristics of some hazardous wastes, they may be gasified directly if they are liquid or finely granulated (EC, 2006).

This process generally requires a consistent waste stream such as tyres or plastics to produce a usable fuel product, and is therefore better suited to commercial and industrial waste streams. However, it is proposed as a viable alternative for dealing with residual fractions of municipal waste. These systems are reported to be less robust for dealing with raw municipal waste than conventional incinerators and require further front-end treatment and/or segregation prior to processing in pyrolysis and gasification plants (Defra 2004). These systems have also been promoted for use in processing RDF and residues from MBTs which are more homogeneous than raw MSW. Under current UK conditions these types of technology are appropriate for consideration for specific fractions of segregated residual MSW streams as a component of an integrated solution.

Some modern developments in thermo-chemical processing of waste have utilised both pyrolysis and gasification in combined technologies, which may then involve a further combustion step to combust the gases produced in the first two stages. Such pyrolysis/gasification/combustion technologies are in effect equivalent to the incineration process, where each step of the process is separated into a separate temperature and pressure-controlled reactor rather than in an incinerator where the thermal degradation steps are combined in a one-step grate combustion system. The decoupling of the thermal degradation steps has the advantage of flexibility in determining which targeted end product is best suited to each application, and can result in slightly improved efficiency of energy recovery in the form of electricity per tonne of waste produced.

Similar to incinerators, pyrolysis and gasification plants must comply with the Waste Incineration Directive emission limits.

Potential Health Pathways Associated with Pyrolysis and Gasification

Potential health pathways are the same as conventional incinerators.

Health Impacts Associated with Pyrolysis and Gasification

There is a dearth of specific evidence on the potential health impacts of pyrolysis and gasification facilities. Research that does exist suggests that emissions are comparable with other forms of thermal treatment, although this will depend on the management or disposal of the char and oil streams. The Waste Incineration Directive emission limits from the stack are applicable to emissions from these types of facilities and as such health impacts are considered to be similar to those associated with traditional thermal treatment of waste.

Material Handling and Recycling Facilities

Materials Recycling Facilities (MRF) allow materials to be processed (separated/segreated) or stored temporarily. Such facilities include Materials Recycling Facilities, Civic Amenity Sites and Waste Transfer Sites.

Materials Recycling Facilities

There are several types of MRFs, but they can generally be divided into those that sort and process construction and demolition waste and those that sort and process source segregated household and commercial waste. A MRF is related to the process defined as a central operation where source segregated; dry recyclable materials are sorted mechanically or manually to market specifications for processing into secondary materials (RS.C, 2002). MRFs may be attached to, or incorporated within transfer stations or other waste facilities or may be separate dedicated facilities dealing purely with the recyclable fraction of collected municipal waste. Waste material entering a materials recycling facility has normally been subject to some pre-segregation by the householder, but further mechanical or manual sorting is required. These are commonly called clean MRFs (as opposed to dirty MRFs which accept non separated waste).

Dirty Materials Recovery Facilities is a term used to define housed facilities which combine a number of screening/sorting techniques to divide residual municipal waste into a recyclable material stream and a non-recyclable residual waste stream disposed to landfill. The research undertaken for Defra, 2004, reported that, due to market acceptability of recyclates and operational experience over the last ten years in the UK, it is unlikely that MRFs processing organic waste or, dirty MRFs, will find any significant future application in the UK.

More advanced plant may be used to produce a third stream comprising either a primarily biodegradable waste stream which can be sent for Anaerobic Digestion or In-vessel

composting, or a relatively high calorific value stream for conversion to RDF (the Mechanical Biological Treatment Web Site). However, this type of application will classify the plant as an MBT.

Potential Health Pathways Associated with MRFs

There is the potential for MRFs to generate odour, dust and litter. However MRFs are typically enclosed and fitted with appropriate ventilation and filter systems. Noise would be primarily produced by vehicle movements and from the mechanical processing and ventilation systems. There is also a potential for occupational exposure of bio-aerosols, depending on the type of MRF. Contaminated sharps from domestic sources are also encountered in many MRFs in the UK (RS.C, 2002). Contaminated sharp edges refer to glass or metal and needles that may lead to infection or disease, of particular interest are tetanus, hepatitis or less likely HIV.

Health Impacts Associated with MRFs

In the Defra study no epidemiological studies were identified for populations living near MRFs. In their review of potential health associated with MRFs, and in order to enable the potential health effects in local populations to be assessed, Defra (2004) examined studies that assessed adverse health effects associated with plant workers. The highest risk from these facilities was found to be related to bio-aerosols, similar in nature to that associated with composting plants, although likely to be of lower magnitude, if mainly dry recyclable are handled in clean MRFs. In addition to bio-aerosols, significant chemical hazards including exposure to vapour and particles that may extend outside the plant was also reported (dirty MRFs).

A number of studies have reported workers to experience adverse health effects including skin and eye irritation, fatigue, asthma and other symptoms. However, most of these studies were unclear on the exact nature of the materials being processed, or the resulting emissions.

In a large American study (EPA, 1995), emissions of trace metals and silica were considered to be very low or undetectable and lower than the occupational standard in six American MRFs which covered a range of manual and mechanical segregated waste sorting techniques. Measurements of metals in downwind communities as well as PCBs and pesticides showed little evidence of elevation. The study concluded that there was no significant impact by a MRF on the surrounding community from these parameters. Some elevation in the total occupational suspended particulates was reported in this same study.

A study of eleven MRFs handling a mixture of household and commercial waste materials in England and Wales is discussed in several references (EA 2005, RS.C 2002, Defra, 2004). Measurements of dust and bio-aerosols, including endotoxin and glucan, VOCs, electromagnetic field, cadmium and mercury were conducted in this study. Cross sectional

questionnaires were also given as a personal interview to each operative working within nine of these MRFs. The results of this study indicate that exposure to dust, endotoxins and glucans for workers in a MRF environment show a dose-response relationship in terms of exposure and respiratory and gastrointestinal effects. The results illustrated that total dust exposure is mainly related to diarrhoea and skin problems, although upper respiratory nose and throat irritations were also apparent. The situation with endotoxin was found to be more complex. Workers exposed to higher levels of glucan were reported to be potentially more prone to developing a range of health symptoms. The reported symptoms were not considered unusual for workers in the waste industry. Also measured in this study were VOCs, electromagnetic field, total and viable microorganisms, cadmium and mercury. In common with similar studies, these results did not show any significant amounts in the MRFs. Lead was also detected in the air of one facility and was found in very small amounts in settled dust in all of the MRFs measured. It was concluded that these metals are not expected to significantly affect MRF workers. This study concluded that workers exposed to higher levels of total dust, endotoxins and glucan at their work sites exhibited various work related symptoms primarily respiratory and gastrointestinal effects.

A detailed review of health problems by Poulsen et al., 1995 from sorting and recycling was referred to in the EA 2005 report and concluded that workers handling the source segregated paper or cardboard fraction do not appear to have an elevated risk of occupational health problems related to bio-aerosols exposure.

From the available evidence base potential health impacts are occupational in nature and that potential adverse health impact to local communities is unlikely to be significant. Bio-aerosols, especially endotoxins and glucan were demonstrated to potentially affect worker's health. Note however, that in clean MRFs, potential emission of bio-aerosols is expected to be very limited due to the nature of handled waste. Facilities that treat organic waste may be expected to have similar bio-aerosol emissions and similar occupational health risks to manage as organic treatment facilities.

Civic Amenity Sites

Civic amenity sites provide the facility for the general public to take bulky waste goods or hazardous household products such as fridges, paints, batteries and electrical equipment for eventual safe reuse, recycling and disposal.

Potential Health Pathways Associated with Civic Amenity Sites

There is the potential for civic amenity sites to generate dust, limited gaseous emission and litter. Noise would be primarily produced by vehicle movements and skip handling. There is also the potential for accidents and injuries caused by vehicle movements.

Health Impacts Associated with Civic Amenity Sites

There is very limited data related to exposure and health impacts from civic amenity facilities and no epidemiological studies have been identified. Chemical hazards from material recycling facilities that receive hazardous household waste such as those described above were reported by R.S.C (2002). These include vapour fumes and residue from the waste, (e.g. garden chemicals, wood preservative, paints, cleaning materials etc). Heavy metals are included in this category due to the possibility of exposure to cadmium and mercury (e.g. batteries in household hazardous waste). R.S.C referenced an investigation in Denmark (Sigsgaard et al., 1969) that investigated waste-handling workers and showed that the presence of mercury and lead were within the normal ranges with only minor differences in trace metals such as iron, zinc and copper. However, cadmium levels were significantly increased in all workers, attributed to batteries in the waste, but this was not thought harmful to health. Cadmium was also raised with smokers in all groups. The study concluded that there might be areas of concern to workers from exposure to metals.

No other reference was found in relation to potential health impact on the local communities.

Based on the limited evidence available, the level of exposure and resulting health impact is likely to be occupational in nature and the evidence for potential effect on the health of the local community from civic amenity facilities is limited.

Waste Transfer Stations

Waste transfer stations handle municipal waste from industry, commerce and the general public. The waste is bulked and compacted before being transported to other waste treatment facilities. Handling and sorting of waste within these facilities is the main cause of worker's exposure. These sites are commonly used to reduce the number of waste transport vehicle trips by transferring the waste from smaller vehicles to larger ones.

Wastes handled at a transfer station may include municipal solid waste, green waste, household hazardous waste and recyclables.

Potential Health Pathways Associated with Waste Transfer Stations

There is the potential for Waste Transfer Stations to generate bio-aerosols, dust and gases. Odour, noise and litter are also common problems with these type of facilities. Noise would be primarily produced by vehicle movements. There is also the potential for accidents and injuries caused by vehicle movements as well as slips, trips and falls especially around the tipping floor.

Health Impacts Associated with Transfer Stations

The EA 2005 report discussed the limited published research on transfer or sorting sites and the common focus by these studies on occupational health.

The report also discussed a variety of published studies that monitored the internal air quality at transfer stations and the overall conclusion of elevated microbial concentrations. Elevated concentrations of ammonia, carbon dioxide, hydrogen sulphide and VOCs such as chlorinated hydrocarbons, aliphatic, cyclic and aromatic hydrocarbons were also reported. However, most of these studies noted that outdoor air quality downwind was unaffected by the operations in terms of both bio-aerosol and gases.

A wide range of studies was reported to consider occupational health problems and possible causes from sorting and recycling domestic waste. Some of these studies found significant association between exposure to organic dust and a fall in Forced Expiratory Volume (FEV). Others reported asthma, a decrease in lung function and possible allergic sensitisation, frequent symptoms of Organic Dust Toxin Syndrome, some cases of severe pulmonary disease, gastro intestinal symptoms, and irritation of eyes and skin. Some studies reported high cadmium blood concentration among the waste handlers that was related to exposure to electrical batteries in the waste.

If poorly managed, such facilities can be a source for odour, noise, and dust which may pose nuisance to the neighbouring premises.

From the available evidence base, potential health risk is occupational in nature with limited evidence to suggest a potential risk to local communities.

Waste Collection

This section will consider the potential health pathways associated with the collection of residential including curbside collection.

Potential Exposure Pathways Associated with Waste Collection

The storage and collection of waste presents a number of potential health pathways at both the community and occupational level. Community level health pathways generally include the storage of waste, where incorrect or unsanitary practice has the potential to increase vermin and exposure to potentially harmful microbial agents. Wider community level health pathways include physical strain putting waste out for collection and the potential risk from road vehicles at kerbside collection schemes. However, it is important to note that potential risk is relative to an individual's circumstance, where the type of housing (i.e. flats, terraced housing etc), the number of residents and level of education and existing health may influence how waste is stored and segregated for collection.

From an occupational health perspective, the collection of waste presents a number of activities with the opportunity to increase exposure to bio-aerosols, vehicles fuel exhaust and VOCs. Physical strain is one of the major health problems associated with waste collecting operators. Sharp objects such as glass and metals in refuse, particularly in bags may lead to cuts and infections. Noise would be primarily produced by vehicle movements. There is also the potential for accidents and injuries caused by vehicle movements.

Health Impacts Associated with Waste Collection

There is very limited data related to health impacts from waste collection and no epidemiological studies have been identified. Most of the available evidence is related to occupational health, although a number of HIA have been commissioned to investigate the potential health risk associated with changing from a weekly to fortnightly waste collection service (Shanom et al), (Spencer 2005). In these studies it was concluded that 'no evidence that alternative week waste collection will cause any significant health impacts for residents, or that any health impacts are likely to be significantly greater than those associated with weekly collections'.

In EA Science report P6-011/1/SR1, they reviewed a number of studies on health effects from collection of waste from properties. Workers were reported to have been monitored by personal samples for airborne contaminants to identify the level of exposure to bio-aerosols for the different segregated waste collections. The conclusion was that workers collecting garden waste were more heavily exposed to bio-aerosols than workers collecting other wastes with the main exposure being related to fungi and actinomycetes. Spring season resulted in heavier exposure and collection in bins or sacks made little difference. A review of a number of other studies confirmed this finding on garden waste and concluded that exposures were lower in the winter and were reduced by top-loaded vehicles, where the emissions were 3m above ground. Other studies concluded that sack collection resulted in lower exposure compared with bin collection, where one operator continually loaded the vehicle. The review also concluded that waste collectors are generally exposed to fewer bio-aerosols than workers inside waste transfer stations or incinerators with landfills and composting plants giving higher worker exposures. In terms of the public exposure the review suggested an order of magnitude reduction in micro-organisms at a distance of only 2-3 m from refuse collection vehicles based on a French study.

The EA review made reference to a Danish Study (Ivens et al., 1999) that found an exposure-response relationship between nausea and endotoxin exposure and between diarrhoea and exposure to both endotoxins and viable fungi. Another study was reported to have found no positive trend between high exposures to bio-aerosols and gastrointestinal (GI) symptoms, but found an association between exposure to fungal spores and self reported diarrhoea. However the symptoms were thought to be caused by exposure to volatile organic compounds

(VOCs) which is usually released from waste with a high microbial activity based on the findings of other studies that have linked such symptoms with elevated VOCs in transfer stations.

The HSE good practice guidance for green waste collection stated that research suggested that the health risks of breathing in bio-aerosols from handling green waste are no greater than those from handling any other mixed household waste. This guidance provided a number of recommendations in terms of systems of work such as the use of compostable green bags and avoiding of double tipping to control the risk of exposure to bio-aerosols. It also made recommendations in relation to working practices and use of Personal Protection Equipment (PPE) to minimise the dust and bio-aerosols entering the lungs.

The Health and Safety Laboratory (HSL/2006/25) investigated risks for Musculoskeletal disorders (MSDs) to waste recycling collectors engaged in kerbside collection of recyclables to provide authoritative guidance on control measures to limit risk within existing systems. The work focused specifically on the risks associated with the collection of recyclables in boxes and the sorting of the recyclables on or alongside the vehicle studying receptacle and handle design, load, vehicle design and influence on posture, lifting frequency and techniques, carry distance, environmental factors and work organisation. A range of control measures to reduce the risks of MSDs was identified from the investigation.

A similar study was carried out by the Health and Safety Laboratory (HSL/2002/21) investigated risks for Musculoskeletal disorders (MSDs) in general refuse collectors including collection of recyclable waste in wheeled bins and non-recyclable waste in bags and wheeled bins. The investigation recommended a number of measures to protect the health of operators including the use of effective PPE for the hands and legs to help reduce the risk of lacerations, infections and diseases and to enable gripping, holding and carrying refuse in optimal ways to support better body posture.

The Health and Safety Executive HSE research report 240, 2004 investigated performance of waste industry with the aim of mapping the health and safety standards in the UK waste industry. They concluded that accidents in this industry predominantly occur during refuse collection, with significant numbers also occurring during loading/unloading and on site transfer activities. Handling and sprain injuries resulting from refuse workers handling refuse during collection was found to account for the largest proportion of the 3-day incidents. The 3-day injury incidents accounted for around 85% of the total number of accidents. The study concluded that of the factors that have direct influence on health and safety in waste collection, competence, team working, communication and compliance are the most significant factors. On the organisational levels, training, management/supervision and communications are judged to be the most significant factors influencing the health and safety of the collection workers followed by procedures, planning and health and safety culture.

The Centre for Health and Environment Research and Expertise (CHERE) and Wales Community Recycling Network (Cylch) has collaborated on a joint project to explore the issues surrounding health and safety and occupational health within the Welsh recycling sector. Working with nine organisations throughout Wales, the project looked at collection systems and the tasks involved in these to provide an evidence base that would be used to make recommendations for improving health and safety. The study focused on the collection of recyclable using boxes and bags, with organisations operating their collection rounds using either a co-mingled or source separated process. This study failed to identify any significant risks within kerbside recycling operations using boxes and bags that could not be effectively managed and controlled. The risks identified included twists and strains, which were most obvious with certain rear-loading vehicles where operatives found it necessary to adopt unsafe postures in order to load the vehicles. The risk of traffic accidents was also found to be greater with this type of vehicles. Side loading or purpose built rear loading vehicles appeared to present significantly less risks including the traffic accident risks. It was also found that plastic boxes appeared, from observation to present a lower risk than bags due to the association of ergonomics of manual handling and sharps injuries with the latter.

Due to the type of these activities exposure is occupational in nature and of no great significance to the general public. Such exposure could be controlled and managed by proper management of the activity and compliance with the requirements of the health and safety procedures and control measures such as the use of appropriate personal protection equipment

Landfills

Landfilling is a term used to describe the deposition of waste on land, in a specially designated pre-constructed area, normally in the form of cells, filled with waste materials in compacted layers which are progressively covered then sealed with a permanent cap. Landfilling may be done either on the surface of the land or in deep excavations. Due to the degradable nature of the waste in municipal waste, and since much of the waste is not processed prior to disposal, this results in decomposition, settling and the release of landfill gas from non-hazardous landfills. Landfill gas comprises mainly methane (a potent greenhouse gas) and carbon dioxide and is increasingly collected for combustion and energy conversion.

Three types of landfill currently exist (inert, non hazardous and hazardous). Hazardous waste is defined by the Environment Agency as waste that is explosive, oxidising, flammable, irritant, corrosive, harmful, toxic, carcinogenic, infectious, toxic for reproduction, mutagenic, ecotoxic, produces toxic gases in contact with water, air or acid, or is capable of producing another toxic substance after disposal.

Waste is considered inert if:

- 1) It is categorised as non hazardous;
- 2) It does not undergo any significant physical, chemical or biological transformations after deposit;
- 3) It does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health; and
- 4) Its total leachability and pollutant content and the ecotoxicity of its leachate are insignificant and, in particular, do not endanger the quality of any surface water or groundwater.

The Landfill Directive requires that non-hazardous and hazardous wastes are not subject to co-disposal after 2004. The reporting of annual emissions from most landfills is necessary under the Pollution Prevention and Control (England and Wales) Regulations 2000. The Landfill Directive also sets out new standards for the design and operation of landfills. These include appropriate liners, leachate and gas management systems and capping.

An Environmental Permit from the Environment Agency is required to operate a landfilling facility in accordance with the Environmental Permitting (England and Wales) Regulations 2007. The EA also provides standard rules within the permitting regime to minimise adverse impact to health and the environment, and operational conditions can be set to control nuisance.

Waste Management Paper No. 27 requires that where development is proposed within 250 metres of a landfill site, whether operational, awaiting restoration or restored, the developer will need to take account of the proximity of the proposed development to the landfill and investigate the geology and topography of the area.

Potential Health Pathways Associated with Landfills

Emissions from landfills include those to air, water and soil. Emissions to air may include dust, biological agents, gases including raw landfill gases and combustion products if flaring or energy recovery were utilised. Deposition on the ground and leaching into water resources of organic and inorganic compounds are other potential pathways of exposure to landfill emissions. Occupational exposure may include in addition to the above, contaminated sharps, potential for accidents and injuries as well as slips, trips and falls. Landfills are also associated with odour, noise, pests and vermin, fire and explosion risks.

Health Impacts Associated with Landfills

The MRC Institute for Environmental Health (Rushton, 2003) reported that there have been a large number of studies of populations living near landfill sites, many in response to public concern. These studies have varied in design and include cross-sectional, case-control, retrospective follow-up and geographical comparison studies. Several large studies were also reported to be carried out to investigate health outcome near hundreds of sites. Also there have been several comprehensive reviews of epidemiological studies.

Defra, (2004) reported that the majority of published research on the human health effects of landfill relates to landfill sites which accepted either hazardous waste or co-disposal of municipal and hazardous waste.

Birth Defects and Reproductive Disorders

Defra, 2004, EA, 2005 and Rushton, 2003, reviewed research studies related to birth defects and reproductive disorder associated with landfill sites. They reported that reproductive effects associated with landfill sites have been extensively researched, including low birth weight, foetal and infant mortality, spontaneous abortion and the occurrence of birth defects.

Rushton, 2003 reported that several of the single site studies found increased incidence of low birth weight in populations near landfill sites, and that trends in low birth weight and neonatal deaths were found to correspond closely with time and quantities of dumping of waste on these sites. She noted, however, that exposed areas were defined according to the number of odour complaints rather than any more objective measure. The results from these single site studies for low birth weight were also found to contrast with results from two large multiple site case-control studies in the USA. These studies used residence as an exposure measure and found no association with low birth weight.

A reference was made in these reviews to the geographical study of adverse birth outcomes associated with living within 2km of a landfill site between 1982 and 1997 in Great Britain. This study found a statistically significant increased risk during operation or after closure compared with the risk before opening. The study attempted to control for socio-economic confounding for people living close to landfill sites. It was noted by Rushton however that one of the interesting findings of this study was that 80% of the population in Great Britain live within 2 km of an operating or closed landfill.

In terms of congenital malformation, the Rushton review stated that the results of studies of birth defects are less convincing than those of birth weight.

Statistically significant risks for congenital defects were reported in the SAHSU study. Similar findings were reported in the analysis of congenital malformation rates among the populations living near the Welsh landfill of Nant-y-Gwyddon (RS.C 2002; Defra 2004; Rushton 2003).

A study of 21 European hazardous waste sites found that residence within 3 km of a site was associated with a significantly raised risk of congenital anomaly, with a fairly consistent decrease in risk with distance away from the sites (Dolk et al., 1998).

However, the results from the two large multiple site case-control studies in the US using residence as an exposure measure were considered to be less convincing (Rushton, 2003). One found a small increase (1.5-fold) in heart and circulatory malformation but no increased risk for other malformation while the other found no association. The latter study was criticised for the poor response to the questionnaire used to collect the data.

The review by Defra (2004) concluded, based on the SAHSU study, that a small association found between certain birth outcomes and residence in proximity to a landfill cannot be stated with certainty to be causal, but provides the best currently available estimate of relative risk.

This conclusion was criticised by the Royal Society in their peer review of the Defra report. They expressed concern about the extrapolation of the results from the Great Britain study to quantify the health outcome when the Department of Health's Committee on Toxicity (Ref. COT, 2001) concluded that it was inappropriate to draw firm conclusions on the health effects of landfill sites from this study, and that the results merited further investigation.

The key concern was that because a study of this kind assumes that the population being measured is exposed to emissions from the landfill sites, it cannot demonstrate that the effects might be caused by other factors. Low and very low birth weight, in particular, could be related to inequalities or ethnic factors that have not been considered. It also highlighted the incomplete register of the congenital malformation used in the study.

Cancer

Several geographical comparison studies have investigated cancer mortality and incidence around waste sites. Increased frequency of cancers in counties containing hazardous waste sites was found in two US studies, particularly for gastrointestinal, oesophageal, stomach, colon and rectal cancer. These studies are, however, limited by a lack of chemical release data. Other studies failed to find an increase in cancer rates or the frequency of chromosome changes although positively identified low birth weight impacts (Rushton, 2003).

A collaborative European study (EUROHAZCON) examined the association of non-chromosomal congenital anomalies with 21 hazardous waste landfill sites. A 33% increase in the risk of non-chromosomal anomalies for residents living within 3 km of the sites was reported (Dolk et al 1998).

Based on extensive research, Defra (2004) found "no evidence that living close to landfill sites increases the chance of cancer".

Odour is one of the primary impacts of landfilling operations and, in some circumstances, can result in complaint from distances of up to 500m away. Any effect, however, will depend on the nature of the wastes being deposited, the landfill design, the degree of landfill gas collection, weather conditions and the proximity/orientation of sensitive receptors. As collection and combustion of landfill gas becomes more widespread throughout the landfill industry, odour impacts from landfill may be expected to decrease (Defra 2004).

The review by Defra concluded that a small association found between certain birth outcome and residence in proximity to a landfill cannot be stated with certainty to be causal, but provide the best currently available estimate of relative risk.

However, the Department of Health's Committee on Toxicity (COT, 2001) argued that low and very low birth weight, in particular, could be related to inequalities or ethnic factors not considered in the study which led to Defra's conclusion and therefore further investigation was required.

Defra (2004) has also concluded that 'no evidence that living close to landfill sites increases the chance of cancer'. However an increase in the risk of non-chromosomal anomalies for residents living close to hazardous was reported.

WEEE Directive Processes

The Waste Electrical and Electronic Equipment (WEEE) Directive aims to minimise the impact on the environment of electrical and electronic goods. It deals with best available treatment, recovery and recycling of EEE. The Directive on Restrictions of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS) bans the use of certain substances in electrical and electronic equipment products after July 2006. Substances restricted by RoHS are cadmium, lead, mercury, hexavalent chromium, polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs).

Wastes covered by this directive include large domestic devices such as refrigerators, washing machines, microwaves; small domestic devices such as vacuum cleaners, irons, hair dryers; remote communication devices; consumer devices including radios, TVs, videos, audio; power tools, toys; medical devices; measure and controllers and vending machines.

Potential Health Pathways Associated with the Recycling of WEEE

Emission of heavy metals, polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs) from WEEE recycling facilities, into air, soil or water could result in adverse health effects for the exposed population.

Health Impacts Associated with the Recycling of WEEE

E-waste contains a number of toxic substances, including heavy metals (lead, mercury, cadmium and hexavalent chromium) and brominated flame retardants including PBB and PBDEs).

Cadmium

Cadmium bioaccumulates in the human body and especially in the kidneys, bones and blood, thereby reinforcing its inherent toxicity. It has an elimination half-life of 10-30 years. The main reported health effects are renal dysfunction, growth disturbances, skeletal damage and reproductive deficiencies. Cadmium is also suspected to cause liver, lung and prostate cancer. The International Agency for Research on Cancer (IARC) has classified cadmium as a human carcinogen (category I under IARC).

Lead

Lead is a cumulative general poison, with pregnant women, the foetus, infants, and children up to 6 years of age being the most susceptible subgroups to adverse health effects (WHO 1995, WHO 1996). Lead can cause damage to both the central and peripheral nervous systems of humans. Effects on the endocrine system have also been observed. Lead can have negative effects on several systems in the human body, especially the nervous system, blood system and kidneys. Furthermore, lead is a probable human carcinogen based on evidence from experiments on animals.

The opinion of the Scientific Committee on Toxicity, Ecotoxicity and the Environment (CSTEE) is that there is inadequate scientific data to demonstrate conclusively what is a safe blood level for lead.

Mercury

In humans mercury may affect the brain, such as those parts that control sight, co-ordination and balance. It has been shown that in pregnant women, methylated mercury can be transmitted through the placenta to the embryo, whereby serious foetal exposure can lead to brain injuries and mental disability.

PBB and PBDE

The lower brominated PBDE compounds show effects above all on the liver but also on thyroid hormone and affect the behaviour of experimental animals. They occur widely in the environment, in human blood and in mother's milk. The highly brominated compounds included in technical octa-BDE and deca-BDE are persistent, have effects on reproduction and

can cause tumour formation in the liver. There are scientific data, which support the assumption that these compounds can be transformed into lower-brominated compounds.

Lower brominated PBB compounds are toxic and produce effects resembling those of chlorinated dioxins and PCB. Just as with PBDEs, there are grounds to believe that deca-BB can be transformed into lower-brominated biphenyls, which are equally toxic. It has been demonstrated that PBDEs may also act as endocrine disrupters.

Hazardous emissions to the air may result from the recycling of WEEE containing heavy metals, such as lead, mercury and cadmium, in steelworks and lead-copper smelters. Contaminated metal scrap increases significantly the emissions of these heavy metals, particularly highly volatiles mercury and cadmium (CEC, 2000 website).

Health risks have been associated with the extrusion of plastics containing PBB and PBDE. Both dioxins and furans are generated as a consequence of recycling the metal content of WEEE, which also contain halogenated plastics (CEC, 2000 website). Various studies suggest that the risk of generation of dioxins is a reason for the complete lack of recycling of plastics containing brominated flame retardants (CEC, 2000 website).

It has been demonstrated that personnel at an electronics-dismantling plant showed significantly higher levels of all PBDE congeners in their serum compared to a control group. The results of a Swedish study showed that deca-BDE is bio-available and that occupational exposure to high levels of PBDEs occurs at the electronics-dismantling plant (Directive of the European Parliament and the Council on the restriction of use of certain hazardous substances in electrical and electronic equipment) (EC Directive 2002/95/EC). It was however argued that special protective measures could be implemented in order to address these occupational health problems (EC Directive 2002/95/EC).

It was also reported that cadmium and chromium VI have the potential to pose risk to assembly and recycling/reprocessing workers associated with assembly and disassembly of EEE (Horne & Gertsakis, 2006).

No further reference was found in relation to potential health impact or epidemiological studies on local communities.

Occupational exposure may result in risk to WEEE recycling workers. Although, it should be possible to provide appropriate protection measures to protect workers. No reference or evidence has been found in relation to potential risk to the community.

ELV Processes

The EC ELV Directive aims to promote the collection, reuse and recycling of ELV components to protect the environment and reduce the amount of waste from vehicles (cars and vans)

when they are finally scrapped. The UK has transposed the Directive through its ELV Regulations 2003 and 2005.

The UK 2003 Regulations put in place most of the requirements of the Directive, including the improved standards for vehicle treatment sites, some new technical standards that apply to new vehicles and the establishment of a Certificate of Destruction (CoD) system.

The Directive is aimed at certain classes of motor vehicles, essentially cars and light goods vehicles. However, the pollution potential of a heavy goods vehicle is probably greater than from its smaller counterpart. Therefore the government has decided that the same environmental protection standards will apply in respect of all end-of-life (i.e. waste) motor vehicles, irrespective of their class.

Processing for ELVs include the dismantling, segregation of different parts, depolluting of parts by removal and separate collection and storage of all fluids unless these are necessary for the re-use of the part, neutralisation of explosive components, shredding and removal of metal components by media separation plant. Tyres and large plastic components are usually segregated in the shredding process and recycled. Glass components are usually removed prior to the shredding process.

Potential Health Pathways Associated with Processes for the Dismantling, Treatment of End of Life Vehicles and their Components

Vehicles that have not been fully depolluted have many pollutants associated with them and are classified as hazardous waste. If a vehicle has been depolluted in accordance with government guidance, any pollution risk will be significantly reduced and it will no longer be classified as hazardous waste.

The main risk associated with these facilities is related to the exposure of workers to oils, including motor oil, transmission oil, gear box oil, hydraulic oil; fuels, acids, and other fluids such as cooling liquids, anti freeze, brake fluids, air conditioning system fluids, lead batteries, mercury containing components, liquefied gas and PCB/PCT containing condensers. Many of these components are hazardous and have the potential to cause adverse health effects in workers.

Other hazards include those associated with the neutralisation of explosive components such as air bags and belt pre-tensioners. The impact of noise and vibration from these may also be significant.

Health Impacts Associated with Processes for the Dismantling, Treatment of End of Life Vehicles and their Components

Studies on health impact or epidemiological studies on these types of facilities are not available. However, general public concern is commonly associated with dust and vapour generated by shredding and dismantling operations. Noise and vibration complaints are also very common from local communities in the vicinity of such operations.

Hazardous Waste Treatment Options

Processes for the bulking of hazardous waste for onward shipment for treatment / disposal and / or the onsite treatment of these materials

The Hazardous Waste Directive (HWD) defines hazardous waste as wastes featuring on a list drawn up by the European Commission, because they possess one or more of the hazardous properties set out in the HWD.

Health impacts associated with the bulking of hazardous waste

There are no available studies on the health impacts associated with the bulking of hazardous waste. Any health impacts would be highly dependant upon the composition of the waste. Hazardous waste is defined on the basis of a list of wide ranging hazardous properties and therefore the potential for adverse health effects would be wide ranging and any impact assessment would have to be site specific.

Available Health and Waste-Resource Management Position Papers



Environment and Health

Key Issues

There are close links between the environment and people's health. A high quality environment enables people to live longer in good health. Environmental problems such as pollution and flooding can pose significant risks to our health if not properly assessed and managed.

The Government is increasingly focusing its health policy on preventing illness and tackling the range of factors that can contribute to ill-health. The Environment Agency has a role to play here and can make a significant contribution through its work to reduce pollution and increase public access to a high quality environment.

A major challenge is making people aware of the health risks associated with pollution and how to place these in the context of other risks. This is particularly difficult when there is a level of uncertainty in the scientific knowledge underpinning regulatory decisions.

It takes a wide range of skills, knowledge and information to effectively communicate on health issues to the public. Those organisations with roles and responsibilities for public health protection need to work closely together in dealing with environment and health issues.

The relationships between pollution, the environment and health are often complex. A greater understanding of the links between exposure to pollution and the effect it has on health, as well as the impacts on health of mixtures of chemicals, microbes or physical changes in the environment is needed. This information will help us to develop policies that will benefit both the environment and health.

The Environment Agency's Role

The Environment Agency has a statutory regulatory duty to protect human health and the environment. We can't remove all risk of harm to health from the industries we regulate because it would make them uneconomic and deprive society of the goods they produce and the services they provide.

We are working closely with public health bodies in England and Wales to make sure that roles and responsibilities are clear and that we deal with public health issues related to pollution in a co-ordinated way. We have a Memorandum of Understanding (MoU) with the Department of Health (DoH), the Department for Environment, Food and Rural Affairs (Defra) and the National Assembly for Wales (NAW). We have a working agreement with the Health Protection Agency and are developing a working agreement with the National Public Health Service for Wales.

To safeguard human health we will: -

- Seek advice and help from health professionals whenever needed as we are not medical experts.
- Make sure that we can act effectively on advice and information provided by health professionals in making decisions on the risks to health from the industries we regulate.

- Assess and control potential health issues using existing health criteria and standards where available.
- Promote a process for developing criteria and standards for substances of concern where they do not already exist.
- Use existing health impact information to inform our regulatory work.
- Apply a precautionary approach and work with others to improve knowledge about the impact of environmental factors on health.
- Share information with public health professionals, local authorities and the public.

Improving quality of life by encouraging people to use our rivers for recreation is one of our priorities. This can have positive health benefits.

Solutions we call for:

- Government to recognise the close links between the environment and health and to provide co-ordinated, strong policies in this area. We also want them to promote close working between government departments on this issue.
- Government should promote the positive health effects of access to a good quality environment and recognise the negative health effects that may result from poor environmental quality. This should be reflected in the Public Health White Paper.
- Joint working between government and the health profession to protect the public from the harmful effects of environmental incidents and emergencies including natural environmental events such as flooding. We will work to include the Health Protection Agency (HPA) and the National Public Health Service for Wales (NPHS) in the Memorandum of Understanding we have developed with Department of Health (DH), the Department for Environment, Food and Rural Affairs (Defra) and the National Assembly of Wales (NAW).
- Joint working between ourselves and the health profession to integrate the use of environment and health data in providing reliable information to address health issues.
- Primary Care Trusts (PCTs) in England and Local Health Boards (LHBs) in Wales to consistently fulfil their role as statutory consultees under the Pollution Prevention and Control Regulations in line with guidance provided by the Health Protection Agency.
- Government to provide more resources to enable the Health Protection Agency, Primary Care Trusts/Local Health Boards and the National Public Health Service for Wales to increase their effectiveness in addressing the health issues related to pollution.
- An integrated training programme to be developed by ourselves and the Health Protection Agency for public health professionals and environmental regulators.
- Industry to play a role in providing better information on the health risks of chemicals. The Environment Agency supports the development of initiatives such as the European Commission's proposals for the Registration, Evaluation and Authorisation of Chemicals (REACH).
- More health based standards which we can use to ensure that people are protected from pollutants released to the environment from processes that we and others regulate. We are keen to work with the Department of Health, Defra and Government expert panels to develop these standards, and are currently in the process of doing this for halides. In the meantime, we will seek backing from Government and its expert committees to use existing evaluation procedures to provide rapid initial assessments.

- Clear communication on the health risks of pollution. We will work with health professionals to communicate clearly about environmental risks to health. This will enable the public to make up their own mind about the impact of the environment on their health, and make choices to improve their own health.
- More research to improve our knowledge of the effects of chemicals on health, particularly for low-level exposures over a lifetime. We support the EC Environment and Health Action Plan, and its prioritisation of research into diseases of concern such as allergies and asthma, and for substances of concern. We will prioritise our own research, co-ordinating with and making the best use of research by health professionals nationally and internationally.

Background

- Every year the short-term effects of air pollution may lead to the premature deaths of up to 24,000 people who are already in poor health (Committee on the Medical Effects of Air Pollution (COMEAP), 1998). COMEAP advises that air pollution can worsen the condition of those with lung or heart disease and can aggravate asthma.
- In 2001, a study by the Small Area Health Statistics Unit, found a slight increased rate of birth defects in populations living with 2 km of landfill sites in England and Wales. This study did not demonstrate a causal link between this health impact and landfill sites. In May 2004, Defra published an independent review of the environmental and health effects of household waste management which concluded that well managed and regulated sites present only very small risks to human health and the environment.
- Some chemicals are intrinsically hazardous and may represent a risk to health if they are used in a way that makes environmental exposure likely. This would include chemical groups which are persistent in the environment; accumulate in people; are toxic; cancer-causing or interfere with peoples hormone messengers (known as endocrine disrupters). At the Johannesburg World Summit on Sustainable Development, held in 2002, the UK signed up to a commitment to be met by 2020, that chemicals are used and produced in ways that lead to the minimisation of significant adverse effects on human health and the environment.
- The recently published EU Environment and Health Strategy focuses on illness and disorders such as childhood cancer, childhood respiratory disorders, asthma and allergies and neuro-developmental disorders. It also covers endocrine disrupting effects and environmental pollutants such as heavy metals, dioxins and PCBs which could be contributing to these health effects.
- A recent study has revealed a four-fold increase in the risk of psychological distress following flooding.
- Physical inactivity is currently estimated to cost around £8.2 billion a year, and a 10 per cent increase in adult physical activity would save at least £500m a year.

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Waste Management

Introduction

The Chartered Institution of Water and Environmental Management (CIWEM) is an independent professional body representing over 12,000 managers, and other professionals, in all sectors, who are responsible for the stewardship of environmental assets. CIWEM's agreed purpose is to develop and promote better and integrated management of the environment; to foster a deeper understanding of water and environmental issues and to enhance the quality of people's lives. This is achieved through CIWEM's Royal Charter; education, training and professional development; dissemination of information; conferences and events; research and publications; contact with Government, agencies and other bodies; partnerships with other organisations; and the publication of Policy Position Statements (PPS).

Purpose

The purpose of this Policy Position Statement is to outline the main issues with respect to the Government's waste strategy for England and Wales, the potential for achieving this and to indicate the implications for and role of CIWEM.

CIWEM's Position on Waste Management:

Key issues

Of particular concern to CIWEM are the following issues:

- CIWEM endorses the development of waste strategies that do not harm the environment.
- CIWEM encourages the development of waste options that improve recycling rates in a manner that is economically viable, meets legislation and reduces resource use.
- CIWEM stresses the importance of waste strategies that are integrated at a national and local level to resolve conflicts in order to enable greater recycling to take place.

CIWEM's aims and objectives relating to waste management are to:

- Ensure that waste management plans and contracts are sustainable in terms of financial viability, protection of the environment and resources consumed.
- Ensure that protection of the environment and public health is undertaken at every stage of design, development and operation of waste management facilities.
- Ensure that the Government develops coherent and integrated strategies for waste management at local, national and European levels.
- Promote the equal implementation of European Directives throughout both the UK and Europe in order to afford due consideration to the interests of the UK waste industry.

Conclusions

The problem of waste, regardless of whether it is on a local, regional or national scale, requires solutions and the commitment of governments. Leadership and example are required if public support is to be generated and converted into practical actions which lead to an increase in recycling, improved environment, improved quality of life and sustainable waste management practices.

CIWEM welcomes the commitment of the Government to provide funding and work more closely with Local Authorities and agencies in educating and supporting the general public, communities and industry in good waste management practice. The Institution also urges environment and waste professionals to develop and use a language and terminology which the public will understand and which will help them apply good waste management practices in their everyday lives.

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- Yes
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Background:

Context

Each year we as individuals and as a nation increase the waste we produce by an average of 3%. This waste must be disposed of in a manner which meets European and domestic regulations and causes minimal harm to the natural environment. The majority of domestic waste produced in England and Wales is either sent to landfill or for thermal treatment. These methods are seen as either being unsustainable, such as the filling of landfill void or are unpopular with the public, such as incineration. Neither method can really be classed as a recycling operation. As a consequence of the introduction of recycling targets, limited landfill void and negative public perception towards thermal treatment the Government produced a document entitled 'A Way With Waste', which set out to achieve greater levels of recycling of domestic waste in England and Wales.

Legislation for waste management is becoming increasingly stringent and more focused towards sustainability at both a European and national level. As a consequence waste management is becoming an ever more important issue at both a national and local level. The Government is committed to sustainable development in which environmental, economic and social objectives are integrated. As part of this commitment the Government published its waste strategy for England and Wales in 2000. This document set out ideas and goals for changing current practices for waste management in England and Wales. The document introduced the waste hierarchy of Reduce, Reuse and Recycle. The hierarchy along with the aims of the document was developed to try to increase sustainability of waste management and reduce the potential for damage to the environment.

Further European legislation, such as the Landfill Directive, the increase in landfill tax and the setting of statutory recycling targets for Local Authorities in England and Wales, now means that it is time to deliver on the commitment to improve waste management and develop more sustainable methods of treating and disposing of domestic waste.

Current situation

Statutory recycling targets for each Local Authority have been set and the Landfill Directive is in the process of implementation which is leading to the reduction of organic waste, including much domestic waste that was previously disposed of in landfill. Progressive targets for reduction of waste to landfill with deadlines have been set. It is up to each individual Local Authority how they achieve the reduction to landfill and increase recycling rates to meet their targets.

To date little real progress has been made to develop and implement waste strategies that achieve significantly greater recycling rates. A number of important issues including financial viability, regulatory control and public perception have prevented Local Authorities from taking significant steps forward to increase recycling.

Financial viability has been one of the main issues facing Local Authorities with regard to developing and implementing more sustainable waste strategies that achieve greater recycling. The collection, processing and treatment of waste to achieve recycling are generally greater in cost than the traditional method of landfill disposal. As a consequence Local Authorities have had to try and source additional funding for these schemes. Until the announcement of the £140 million DEFRA fund in 2002 there had been little financial support provided to increase recycling. The creation of this fund and the gradual rise in the level of landfill tax is helping to improve the financial viability of many recycling schemes and is enabling Local Authorities to finally be able to develop and implement schemes that make a significant difference to recycling rates.

Problems have also risen with the regulatory framework. For example, the planning process for new waste management facilities consists of conflicts at both a national and local level. These conflicts include authorities being unsure of responsibilities, increased levels of administration and a lengthy disjointed process meaning that it can take many years for permission to be granted to construct a new facility. Increasingly stringent legislation is also hindering development. Another example where legislation is preventing steps from being taken is the Animal By-Products Order relating to the composting of catering waste. This is having a large impact on the composting industry and the construction and operation of new composting facilities.

At the same time public awareness has increased substantially with respect to environmental and waste issues, leading to the public having a powerful influence on new waste management facilities. For example, energy from waste or incineration was seen as one of the most viable methods to help increase recycling rates and reduce waste to landfill. However, increasing public concerns over the safety of these facilities and negative publicity through the media and environmental pressure groups now means that it has become increasingly difficult and time consuming to get permission to construct a new plant. This type of public pressure is now being felt in other sectors of the waste management industry including composting and recycling.

This situation is resulting in increasing time and resources being required to design, plan and construct new waste management facilities which is slowing the achievement of mandatory recycling targets and diversion from landfill disposal.

March 2003

Note:- CIWEM Policy Position Statements (PPS) represent the Institution's views on issues at a particular point in time. It is accepted that situations change as research provides new evidence. It should be understood, therefore, that CIWEM PPS's are under constant review, that previously held views may alter and lead to revised PPS's

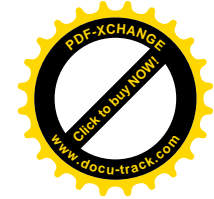
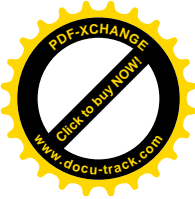
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Developments in UK Policy on Anaerobic Digestion

This paper is for information and discussion. It updates RCCF members on the development of UK policy on anaerobic digestion; outlines, for comment, our current thinking on possible measures to support an increased uptake of the technology; and summarises international work currently underway.

ANAEROBIC DIGESTION

1. The Government sees anaerobic digestion as a technology with significant potential to contribute to our climate change and wider environmental objectives. It is an effective source of renewable energy that can reduce greenhouse gas emissions through the processing of organic materials such as manures and slurries, food waste and sewage sludge. We are keen to see a much greater uptake of this technology by local authorities, businesses and farmers.

2. Defra will shortly be publishing the UK Biomass Strategy. This will include details of how we propose to work with stakeholders to drive faster growth in the use of this technology. In parallel, the national Waste Strategy, which is also to be published shortly, will set out the important contribution which anaerobic digestion can make to achieving our waste management goals. Policy measures under consideration are outlined below. These seek to stimulate and develop the markets for anaerobic digestion and its products, and address the administrative and technical challenges which may hamper their development.

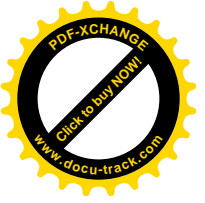
3. The main rationale for Government support for anaerobic digestion is that it provides a range of environmental benefits including important carbon savings. However the value of these is not reflected in the market price. This causes investment in anaerobic digestion to be less than would be economically efficient if climate change and other externalities were fully taken into account. A system in which the impact of all greenhouse gas emissions (including carbon dioxide, methane and nitrous oxide) was reflected in a single carbon price would, in the longer term, help to overcome this problem. The work to examine a market mechanism for reducing greenhouse gas emissions from agriculture, forestry and land management (see paper RCCF 07/02) is relevant in this context.

Stimulating and Developing Markets for Anaerobic Digestion and Its Products

4. We are looking at how and whether economic or fiscal instruments can facilitate the adoption of anaerobic digestion technology. In particular, three complementary areas of work are:

- with DTI we are looking at the contribution that Renewable Obligation Certificates (ROCs) can make to encouraging anaerobic digestion on the demand side (renewable electricity – but not renewable heat – is currently eligible for ROCs);
- Defra and DTI have recently commissioned a study to review the business case for supporting renewable heat, and to examine prospective mechanisms for longer-term support for renewable heat; and
- with HMT we are exploring possible means to support the development of local infrastructure and supply chains.

5. The digestate (treated liquid) from anaerobic digestion contains useful nutrients and can be used as a fertiliser and soil conditioner. Its sale is a potential additional source of revenue for the operators of anaerobic digestion plants. It can also replace mineral fertiliser,



the production of which requires significant energy input. To facilitate the development of the market for digestate:

- the Environment Agency will undertake work to develop a standard for digestate in 2007/08 in order to bring certainty to when this material is fully recovered (a priority for many stakeholders); and
- WRAP will support the development of the market for digestate alongside its work to establish markets for waste-derived compost.

Addressing Administrative and Technical Challenges

6. Anyone wishing to set up and operate an anaerobic digestion plant faces a range of administrative and technical challenges. For example, as with any industrial facility, anaerobic digestion plants are subject to regulations designed to protect the environment and human health. Also, in order to fully realise the environment benefits of anaerobic digestion, it is important that the system is operated well and that the digestate is correctly applied to land so that the nutrients can be used effectively. We therefore propose:

- in line with our better regulation agenda, to work with regulators and other stakeholders to tackle any administrative hurdles which may hamper the more rapid development of anaerobic digestion in the UK, while ensuring that the important objectives of protecting the environment and human health are not compromised;
- to build on our existing research to improve the contribution of anaerobic digestion technology to reducing greenhouse gas emissions and delivering other environmental benefits;
- to encourage and facilitate communication between interested parties in industry, regulators, government delivery bodies and non-governmental bodies; and
- to work with stakeholders to develop and disseminate guidelines on best practice and technology for the use of anaerobic digestion in agriculture in a way that is both cost effective and beneficial to the environment.

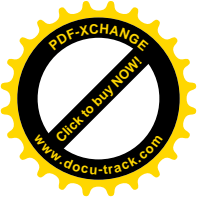
International Dimension

7. The UK is taking the leading role in driving forward thinking about the role of anaerobic digestion internationally. The UK hosted an international workshop about anaerobic digestion in agriculture on 29-30 November under the auspices of the Agriculture Sub-Committee of the G8 inspired international Methane to Markets (M2M) Partnership, which we co-chair with Argentina. The objective of the workshop was to “identify the policies needed to grow markets for anaerobic digestion to reduce global levels of agricultural methane emissions”.

8. The workshop was attended by 63 delegates from 12 countries, including Argentina, Canada, China, Germany, India and USA. These included leading policy, technical and finance experts and business partners. (The executive summary of the workshop report is annexed.) The UK was well represented. A number of businesses which are either developing or interested in developing anaerobic digestion plants in the UK took part. They will now become members of the M2M Project Network. This will help keep them in touch with policy and technology developments and business partners.

9. Following on from the workshop, key actions that we will be taking forward with the Partnership include:

- holding a workshop in Argentina in May 2007 to showcase anaerobic digestion technology used successfully in cold climates;

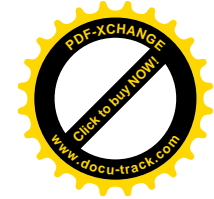
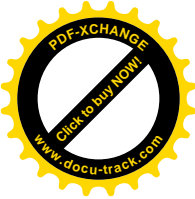


- organising a high profile Partnership Expo in Beijing, China in October 2007 to highlight the work of the Partnership, showcase projects and so enhance funding opportunities;
- designing a common accounting framework for the benefits of anaerobic digestion based on the best elements of methodologies in each country; and
- sharing information about the status or standards for digestate in each country.

Coordinating Delivery

10. To coordinate delivery of the above measures within Defra, we have established a cross-cutting project team, involving principally sustainable agriculture, waste strategy and sustainable energy policy leads. A work plan has been agreed with Ministers in order to:

- take forward measures to facilitate a greater uptake of anaerobic digestion; and
- work with stakeholders to identify and address barriers and to maximise the synergies between the different markets for anaerobic digestion.



Annex

Executive Summary of Report by Enviro Consulting Limited of International Methane to Markets Partnership Anaerobic Digestion Workshop, 29-30 November 2006, Berkshire

A two-day Workshop, held in the UK in November 2006, brought many of the key players together from 12 countries of the Methane to Markets Partnership primarily to identify the policies needed to grow markets for AD to reduce global levels of agricultural methane emissions. Presentations and discussions during the Workshop led to substantial knowledge and best practice transfer which can be taken away and used to inform international policy. What is apparent from the proceedings is the huge potential of agricultural AD to assist in meeting many national and international environmental, social and economic objectives. There are many benefits of AD that include increasing fuel security, improving the local environment and therefore reducing risks of infection and disease and providing profits for farmers.

Methane emissions from agriculture worldwide are about 14% of all global methane emissions and the countries involved in the Methane to Markets Partnership are responsible for half of these emissions. Cutting methane emissions would have a greater benefit since methane is 23 times more globally potent than carbon dioxide. If these emissions were reduced by just 4% this is predicted to stabilise the atmosphere, dramatically slowing climate change. A significantly increased AD uptake could facilitate this.

The potential role of AD in agriculture

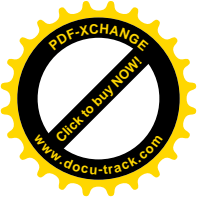
For different countries and different regions within countries the Workshop has shown that there is not one solution for all with regards to types of AD systems and use of AD products. All scales of systems are possible from small-scale on-farm installations to large centralised systems taking in other waste streams, and the scale of system should be chosen based on location, local circumstances and use of the AD products. It has been shown through presentations of case studies that all scales of systems can be made to work.

The potential role of AD in agriculture is vast and from discussions during the Workshop includes:

- Production of biogas for cooking, heating and fuelling vehicles,
- Biogas to produce electricity
- Production of natural digestate for use as fertiliser and compost to replace artificial fertilisers
- Replacing traditional fossil fuel alternatives such as wood-fuel for cooking.

Barriers to accelerated uptake of AD in agriculture

The reasons why AD uptake has historically been relatively low in most countries in comparison to its potential is due to a number of barriers discussed throughout the Workshop. These barriers discussed fall mainly under financial, policy and bureaucracy, environmental, knowledge and awareness, technical and infrastructure. One of the main barriers with knowledge and awareness is that agricultural waste is called 'waste' and not 'resource' and here a change of culture is needed to recognise the benefits agricultural waste presents.



Maximising synergies with other sectors

There are opportunities for the agricultural sector to work with other sectors, such as the food and waste management sectors in increasing AD of agricultural waste. The main opportunities identified are as follows:

- On-farm digestion of imported wastes
- Digestion of farm wastes in off-site facilities
- Co-digestion of carbohydrate rich crops and forages Each of these opportunities presents challenges to be overcome but there were some good examples presented during the Workshop which showed how working with other sectors can be beneficial.

Key policy messages for growing this sector

The main policy messages that can be taken forward for accelerating use of AD in agriculture are to overcome barriers that are preventing the sector meeting its potential. The policy messages are separated into different areas as follows:

1. Direct Policy

Awareness – key decision makers within the broad environmental policy arena (waste management, energy security, rural renaissance, GHG mitigation etc.) should be made aware of the benefits and potential role of agricultural AD

Clear messages - AD developers, like all renewable energy systems, require clear messages of intent. If grants or revenue based support systems are put in place they should be clearly time delimited and not changed regularly.

Incentives – it is clear that in many instances the full benefits of AD will not be harnessed without incentives, such as tax breaks, feed-in tariffs and subsidies, as well as legislation to moderate behaviour.

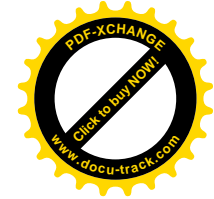
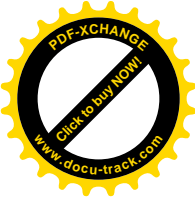
Integration of broader environmental objectives into the policy framework – although there are carbon dioxide reduction targets there are no specific methane reduction targets, even though this gas contributes much more to global warming, per unit, than CO₂.

Consistent and scientifically guided industry regulation – some environmental legislation is acting as a barrier to increased uptake of AD systems and should be reassessed along with the wider environmental policies so that they are consistent in protecting the environment, guided scientifically.

Clear performance guidance and experience sharing – concern was frequently expressed that badly practised anaerobic digestion could add rather than reduce methane emissions. Suggested course of action: International Workshop on fugitive emissions reduction or development of international guidelines.

Easier routes of access to finance and green certificate mechanisms – e.g. CDM could be made less bureaucratic and easier to access finance but need strict assessment controls for additionality and functionality.

Quality standards on AD products – this will increase the value of products and increase positive perception of products.



2. Environmental

Agreement on Life Cycle Analysis methodologies and benchmarks - there were numerous references throughout the Workshop to the need for internationally agreed LCA methodologies and benchmarks.

Joined up thinking and environmental governance – there were numerous references to the lack of continuity between energy and environmental delivery agencies and legislation.

Acknowledgement ‘value-added’ chain - of soil health and public health – A significant opportunity was identified to increase the overall social valuation of AD through consideration of externalities and dispersed social and economic benefits that accrue from its use.

3. Technology

Supplier base – in many instances the lack of a mature supplier base was cited as a reason for slow uptake of AD. Greater knowledge of international market opportunities plus the adoption of country specific measures to stimulate the development of the supplier base, through “Accelerator Programmes” is needed.

Feedstock development – more research is needed on integration on carbohydrate crops into systems and in the production of low input, high yield crops as well as the effect of variation of input material to output quality. Also more information on co-digestion of municipal and agricultural wastes is needed.

Inefficiency of systems – there is a great opportunity for increasing R&D efforts worldwide to produce lower technological solutions that are reliable but affordable which should be reflected in policy.

4. Education

Technology best practice and knowledge transfer – there was a consensus that information sharing between M2M partner countries could yield significant benefits to all countries. Best practice related to technologies, infrastructure, finance, supply chain development, local policy development and market development.

Increased public awareness and perception of agricultural AD – changing public perception of AD systems as being unreliable and harmful to the local environment is a difficult challenge but vital to tackle with use of case studies and demonstrating the positive benefits.

The Workshop identified numerous barriers to increased uptake of agricultural AD systems, many of which may be solved at the policy level. Learnings from AD trials in many different countries must be shared in order to avoid duplication of efforts and further accelerate progress in this sector. Where possible, collaborating with other waste sectors to increase AD of agricultural waste should be undertaken, since these maximise methane yields as well as increasing financial viability of AD. Many of the recommendations, especially in increasing awareness and sharing best practice between countries, that have come out from the Workshop can now be taken forward by the M2M partnership to further their aims to facilitate further uptake of agricultural AD.

Anaerobic Digestion (biogas) – A rough guide

What is Anaerobic Digestion (AD)?

Anaerobic digestion (AD) is the bacterial fermentation of organic material under controlled conditions with minimal oxygen, in a closed digester vessel to produce biogas (methane and CO₂). Biogas can be used for electricity and heat generation and you are also left with an odour free, pathogen reduced digestate, which can be used as a fertiliser. Feedstocks can range from human sewage, animal manures, food by-products, biodegradable domestic refuse, maize or grass and food waste.

The NFU believes that future deployment of AD technology in Britain is likely to involve:

(1) *on-farm digesters* utilising manures and farm-based feedstocks like silage maize, operating without the need for a waste management licence, with income only from sale of energy. These are likely to be around 250-500 kW electrical capacity, producing about enough electricity for several hundred homes or a village. On-farm digesters could be shared between several nearby farms, subject to regulation of movements and landspreading of manures and digestate between farms. Single-farm AD systems have the potential to demonstrate truly low-carbon dairy and livestock production, driven as much by perceived consumer demand for low-carbon products as by government policy measures. Enhanced revenues from electricity sales with double Renewables Obligation Certificates (ROCs), as is proposed from April 2009, are generating much of the interest in AD at present. Capital grants, low-interest finance, or project development support may be nevertheless required to enhance take-up at the smaller on-farm scale. The wider supply chain may also have a role to play in overcoming the capital cost of AD, particularly when it comes to product differentiation.

(2) *larger centralised waste-licensed "merchant" plants (CAD plants)*. Accepting multiple biodegradable wastes (manures, food packing or processing wastes, supermarket waste food, local authority green waste or food wastes), with income from both energy sales and gate fees, these are likely to be around 500 kW-10 MW electrical capacity. Centralised AD plants might be located on rural industrial estates or close to food processing facilities, and could perform a role in localised treatment of municipal wastes, e.g. at the scale of a market town. These could also be located on farm. Centralised AD plants are likely to be more profitable than single-farm plants, although they will have a longer design/planning lead time.

Benefits of Anaerobic Digestion, and why is it important?

- Produces a digestate which can be used as a fertiliser. This fertiliser is slow release and odourless.
- Air quality benefits - Controls odours from waste, and reduced ammonia emissions.
- Allows diversification for farmers, and the wider rural economy.
- Provides a sustainable outlet for on farm residues.
- For energy security – international gas supplies are politically unstable, and we are nearing peak production of oil.
- Greenhouse gas savings – helping us meet our climate change mitigation commitments. This is especially important as methane (emitted from the uncontrolled breakdown of manures) is 25 times more potent than CO₂, making it a greater 'threat' to climate change.

Digestate and Liquor

Between 40-60% of the organic matter in this process is converted to biogas, the rest is left as an odour-free residue which has value as a soil conditioner or fertiliser. The by-product of AD is termed 'digestate', consisting of fibre and liquid. Compared with manures and wastes, digestate

has more predictable properties and is easier to handle, and its reduced odour makes it easier to land spread. A joint Environment Agency and Waste & Resources Action Programme (WRAP) project is developing a digestate standard and a protocol for its use. If followed, such digestate will not be considered 'waste'. This will help markets develop for digestate and ensure greater confidence in its use.

How developed is it in the UK?

To date there has been little development of agricultural AD plants in the UK, in contrast to other European countries (for example Germany has over 3500). We have approximately 15-20 on farm systems, with less than 0.1% of livestock manures are treated by AD in the UK. There are presently 3 centralised systems, with more under development.

NFU Policy View

The NFU believes that the development of AD in UK agriculture needs demonstration, research and support. Key stakeholders in the development of AD include farmers, local authorities/regulators and local communities. Awareness and understanding of the technology are best raised through demonstration installations, local champions and better communication on the role AD can play in tackling climate change. However, there are still barriers to be overcome in public understanding of the technology, not least with local planners.

Research is also a key area of concern. The development and introduction of technical solutions – in the form of simple, low cost units – needs to be encouraged. Greater research and in particular, better evaluation of the cost effectiveness of the technology is needed. Much of the experience from other countries could be a good starting point for this information. This research needs to be integrated at more than just the producer level of the supply chain – we need to ensure that those best placed to carry out the research are used.

There needs to be promotion of the use of digestate and improvement of the ranking of AD in the waste hierarchy. The NFU also believes that there is great potential for co-digestion of animal manures with materials from other industries. These may be significant, further increasing energy generation, waste re-use and fertiliser source opportunities. Income from energy sales can therefore help to fund an integrated package of investments in improved manure management (AD plant together with improved slurry stores, etc).

AD appears to be the most promising mitigation option for reducing net methane emissions from management of agricultural manures and slurries. Technologically, there is no reason why AD should not increase in the UK, as it has in Germany. However, considerable barriers to its uptake remain. Most notably, high capital costs and an uncertain supply chain and market for products gives rise to low uptake. A combination of legislative and fiscal actions involving financial incentives and engagement with farmers and technology suppliers is needed to stimulate the market. The experience from Germany suggests the main route to market for on-farm AD is to set incentives at a level such that it becomes a recognised source of extra income for farmers.

NFU Key AD Policy Recommendations

- Urgently (2008-2010) need to raise awareness of anaerobic digestion across all agricultural sectors and the food chain; also with local government and regulators.
- Government needs to offer a package of incentives for anaerobic digestion: revenue-based (enhanced Renewables Obligation banding); capital grants to encourage project development; development of market infrastructure (electricity network access, sale or disposal of digestate)
- Need to learn from methane mitigation knowledge from other countries, especially work done on-farm in the EU

- Need research on use of digestate from anaerobic digestion as a fertiliser, including its effects on all greenhouse gas emissions, environment impacts, etc.

Sustainable management of biowastes

Composting – maximising the benefits and minimising the environmental impacts

Composting can play a very important role in diverting biodegradable wastes from landfill and in recovering value from them, provided that the process is carried out properly. Composting facilities that have poor quality feed stock, that are not operated correctly or which use unsuitable raw material have the potential to cause environmental pollution, including detriment to local amenities, harm to human health and to produce poor quality compost.

This position statement is aimed at local authorities and the composting industry and sets out the Environment Agency's views on commercial scale composting. It sets out what needs to be done to maximise its benefits whilst minimising the impact on the environment and human health. The statement is not aimed at individuals or institutions carrying out their own small scale composting, for example, householders or schools.

Key issues

We are concerned about the unacceptable impacts caused by composting sites if they are poorly managed and operated. In particular, they can:

- give rise to nuisance odours
- produce immature compost (which is likely to be malodorous), contaminated or otherwise poor quality compost
- catch fire
- expose people nearby to high concentrations of potentially harmful bioaerosols.

The location of sites, their design and their supporting infrastructure are also important factors in minimising the impact on the environment, human health and local amenities. We believe that problems can be exacerbated where there are contracts between local authorities and operators requiring operators to accept all the local authority waste delivered to them. Effective source segregation of waste is an essential part of proper site management. Some facilities get overloaded at certain times and/or have to take waste that is already decomposing and malodorous. Operators may also have to accept waste that is contaminated due to poor segregation. These factors cause problems for local amenities as well as affecting the final quality of output. They affect the public perception of composting and compost in a negative way.

Exempt composting sites have to be registered with us, but are subject to a much lower level of regulation as they are deemed to pose a lower risk. The scale and nature of composting operations covered by the current composting exemption is very wide. Our experience is that this lower level of regulation does not always reflect the impact of some exempt composting facilities.

We already require licence/permit applicants and those wishing to register exemptions to provide us with a site specific bioaerosol risk assessment where the proposed composting facility will be within 250 metres of dwellings or workplaces. These risk assessments need to demonstrate that bioaerosols from the proposed facility will not pose an unacceptable risk to human health. In practice we have found that many are of poor quality or are not sufficiently comprehensive.

Where the proposed facility is further than 250 metres from dwellings or workplaces and provided certain other criteria apply, licence applicants have been able to apply for a fixed licence for composting. This procedure has been simpler and cheaper than that for a site specific, bespoke licence. The fixed licence has a standard set of conditions designed to take into account the generic risks to the environment from such a facility. We have been finding, however, that our fixed licences for composting have not always been providing sufficient control to prevent unacceptable impacts on the environment.

Where the output from a composting process is waste (i.e. where it does not meet the Environment Agency/WRAP [Compost Quality Protocol](#)), its subsequent application to land also needs to be regulated by us, either under an exemption or Environmental Permit (Waste Licence prior to 6th April 2008).

We believe technology choice is a matter for operators, provided it gives adequate protection to health, amenities and the environment. Properly managed windrowing is a well established technology that can be perfectly acceptable for green waste. Where food or animal by-products are involved, in-vessel composting is required, giving good quality control over the initial rapid composting phase. Our experience is that operators are often not composting waste for long enough, leading to odour problems and poor quality outputs.

Our role

Our main role in composting is as the principal regulator for the recovery and disposal of waste. Most larger scale composting facilities require an Environmental Permit¹ before they can operate, whilst the medium and smaller scale ones are exempt from the need for a permit.

Solutions – what we call for:

We want to see an adequate network of composting sites that meet the needs of the locality, particularly in dealing with future demand for treatment capacity for source-segregated municipal wastes.

¹ The Environmental Permitting regime came into force on 6th April 2008, replacing and consolidating the previous regimes covering Waste Management Licences and Pollution Prevention Control permits.

- In supporting the above aim, we want to work with local authorities in their various roles as waste collection, disposal and planning authorities. We will provide guidance on composting, covering aspects such as the location of sites; acceptable waste types; the relationship between contract conditions and permitting requirements and the necessary infrastructure. We expect to have this ready later this year
- We want Environmental Permit and exemption registration applicants (for composting sites within 250 metres of dwellings or workplaces) to produce site specific bioaerosol risk assessments that are fit for purpose. We will be rigorous in rejecting them if they are not. We are improving and streamlining the way we deal with bioaerosol risk assessments and are producing guidance on them for applicants, which should be available later this year
- We would like all those involved in waste composting to see it as a way of producing quality compost rather than as a way of disposing of waste or solely boosting waste performance indicators. We encourage them to adopt the Compost Quality Protocol. We are aware that some operators may wish to partially compost biodegradable waste as a pre-treatment option for landfill. We regard this as biological treatment for disposal rather than composting and will regulate it accordingly
- The acceptance of unsuitable wastes for composting could seriously undermine the markets for quality compost and the efforts of those producing it. We want to work with the composting industry to provide more clarity on what wastes are suitable for composting, and will use the list of wastes in the Quality Protocol as a starting point. We consider that the segregation of municipal waste at source plays an important role in ensuring quality outputs from the composting process
- We expect operators to operate their sites in a way that minimises their impact on the environment and local amenities. The Composting Association has set out benchmark standards and procedures for the management and operation of composting sites² and guidance on ways of operating that prevent or minimise nuisance odours³. We want operators to work to these standards as a minimum. We have also been reviewing the conditions in our fixed licences for composting to ensure they provide appropriate protection for the environment and public health. We are introducing the revised requirements via the new system of standard rules permits from 6 April 2008 to coincide with the introduction of the Environmental Permitting regime
- We want a more proportionate and effective regulatory control system for composting. We have been working with Government on the new Environmental Permitting Regulations and on their current exemption review to produce such a system. We are expecting the exemption review to be implemented in autumn 2009. We want the scope of the new composting exemption to be reduced considerably and would like to see many of the existing exempt facilities subject to standard rules permits in the future.

² [The Composting Industry Code of Practice](#)

³ [Industry guide for the prevention and control of odours at biowaste processing facilities](#)

Background

The disposal of biodegradable wastes to landfill produces carbon dioxide, methane and leachate. Methane is a potent greenhouse gas with 23 times the global warming potential of carbon dioxide. Composting the right biodegradable wastes can produce a quality compost suitable for use as a soil improver and growing medium. Wastes that can be used include green wastes from parks and gardens as well as food wastes. There are two main technologies used in commercial composting, windrow and in-vessel. Both can be used for a range of wastes, but only in-vessel composting can be used when the feed stocks contain catering or other animal by-product wastes. With the proviso that it must be done properly, we support the use of composting as one of the ways of recovering valuable resources. Suitable municipal, commercial and industrial wastes streams can be used, reducing the amount of biodegradable waste going to landfill.

Municipal waste composting has grown over the last few years as many Local Authorities introduced separate green waste and, latterly, food waste collections. Industry has responded by developing new composting facilities, but growth is continuing and there is a demand for more composting capacity throughout England and Wales.

There need to be sufficient facilities available to meet the growing demand, so that the effective operation of existing plants is not undermined. It is also essential that these facilities are located, operated and regulated so that there is minimum impact on the environment and human health.

The use of Mechanical Biological Treatment (MBT) plants for treating un-segregated municipal waste is growing. These use various technologies and plant configurations and can produce a number of different waste stream outputs. One of the main ones is an organic-rich, fine material generically referred to as CLO (Compost-Like Outputs). We have a separate position statement on CLO.

Environment Agency Policy

Our position on composting and potential health effects from bioaerosols

Policy number: 405_07

Policy statement: (please also read the explanatory notes below)

We will take into account the potential effects of bioaerosols^a on human health when authorising new waste composting^b facilities or changes to existing facilities. To do this, applicants will have to provide us with a site-specific bioaerosol risk assessment if there is a workplace^c or dwelling^d within 250 metres of the composting site boundary^e when they apply:

1. for a waste management licence^f or a pollution prevention and control permit^g for a new composting facility
2. to register an exempt composting facility^h
3. to modify a waste management licence or vary a pollution prevention and control permit for an existing composting facility where
 - any relevant control measures in the existing bioaerosol risk assessment will be changed
 - there is no existing bioaerosol risk assessment
 - the existing bioaerosol risk assessment is inadequate
 - the waste types or quantities are to be changed

The assessment must be based on clear scientific evidence and show that bioaerosols can and will be maintained at appropriate levelsⁱ at any workplace or boundary of a dwelling.

Where we consider that such a risk assessment is necessary and it is either missing or inadequate, we may refuse to grant the new licence or permit, vary the existing permit/modify the existing licence or register the facility as exempt.

This policy only covers the risks posed by bioaerosols on human health. Other risk assessments may be needed to cover, for example, the effects of bioaerosols on animal health.

Objectives:

- 1) To meet the relevant objectives as laid down by Article 4 of the Waste Framework Directive¹. This states that: Member States shall take the necessary measures to ensure that waste is disposed of without endangering human health and without harming the environment and, in particular:
 - without risk to water, air, soil and plants and animals,
 - without causing a nuisance through noise or odours
 - without adversely affecting the countryside or places of special interest.
- 2) To impose a level of regulation that is proportionate to the level of risk to the environment associated with that activity.

Primary Contact: Viv Dennis

Policy Author: Mark Okuniewski and Viv Dennis

Policy Sponsor: Liz Parkes

Signature of authorisation by Policy Sponsor (as set out in Schedule B of the NFSoD):



Version: 2

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If any term or acronym used in this document is unfamiliar you might find the definition in the Glossary on Easinet: Information Resources > [Glossary of Terms and Acronyms](#).

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Explanatory Note

Our position on composting and potential health effects from bioaerosols

Policy number: 405_07

Background

This policy replaces the document “Agency Position on Composting and Health Effects”, dated 13 August 2001, which set out our position on permitting waste composting facilities. That document highlighted:

- the need for a site-specific bioaerosol risk assessment to accompany applications for any proposed new or modified composting facilities within 250m of dwellings or workplaces
- that there would be a presumption against permitting (and to object to any planning application) unless this risk assessment showed that bioaerosol levels would be maintained at appropriate levels at the dwelling or workplace

The need for the position statement arose from research published by the then DETR² and us³ which highlighted the potential risk to people’s health of bioaerosols produced during composting.

The original Position Statement referred to further research that would be needed to identify control measures that may allow operations within 250metres of the boundary of a dwelling or workplace. Research has continued since 2001 and we’ve published interim internal guidance on an environmental risk management framework for composting facilities⁴. We intend to publish the research and produce further guidance on risk assessment for external use.

This policy statement does not apply to operators of composting facilities or their staff as their health is covered by Health and Safety legislation. If a the only dwelling within the 250 metres is occupied by the operator then this policy statement will not apply unless the dwelling is visited by members of the public, such as if it is used as a bed and breakfast.

We’ve removed the reference to planning applications in this policy statement.

Definitions

a. Bioaerosols are microscopic, airborne particles including bacteria, fungal spores, protozoa and organic constituents of microbial and fungal origin.

b. Composting means the biological decomposition of organic materials, under conditions that are predominantly aerobic, and that allow the development of thermophilic temperatures as a result of biologically produced heat. It does not include Mechanical Biological Treatment (MBT) processes except where composting activities are also carried out at the same site. For licensing or permitting MBT plants, use the [378_05 Guidance on Environmental Controls for Mechanical Biological Treatment](#).

c. A workplace is defined as where workers would frequently be present. This should be the boundary of land under the ownership of the business unless it is confirmed that any land within that ownership is not, and is never, going to be used by workers except for short periods of time, for example for maintenance work, animal husbandry.

d. Dwelling includes the boundary of the garden of the domestic property. This does not include any land such as a paddock or field in the same ownership of the domestic property.

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e. Composting site boundary. The bioaerosol risk assessment or application should include a plan of the composting facility showing the boundary of the permitted, licensed or exempt area. We will treat this as the composting site boundary unless there is a defined area within this where waste storage, processing and other waste handling operations are to take place. If this is the case, we will treat the boundary of this smaller defined area as the composting site boundary. In all cases, we will expect the composting site boundary to be physically identifiable on the ground once composting operations start.

f. Waste Management Licence as defined in the Environmental Protection Act 1990.

g. Pollution Prevention and Control Permit as defined in the Pollution, Prevention and Control Regulations 2000.

h. Exempt composting facility as specified under paragraph 12 schedule 3 of the Waste Management Licensing Regulations 1994, as amended. This exemption is under review by Defra.

i. Appropriate levels are defined as bioaerosol levels not exceeding:

- i) those before the start of the composting process or
- ii) bioaerosols levels no greater than 1,000 colony forming units (cfu) m⁻³ total bacteria, 1,000 cfu m⁻³ total fungi and 300 cfu m⁻³ gram-negative bacteria

There may be other activities close by that are producing bioaerosols that mean background levels are higher than we'd normally expect. This should not prevent the siting of a composting facility if it doesn't present an increased risk. We can't say at present what levels of bioaerosols present a health risk, so that's why we've adopted the precautionary approach to background levels. Research on dose response is underway.

Desired outcomes




- No new composting sites, or new processes at existing composting sites, that we regulate present a health risk to people living or working nearby.

Audience

- Policy, process and operational staff.
- Government and other bodies responsible for protecting public health.
- Those we regulate, and the general public.

References

- 1) Council Directive on Waste, 2006/12/EC
- 2) Health Effects of Composting - A study of three composting sites and review of past data, AEAT, 2001.
- 3) Monitoring the Environmental Impact of Waste Composting Plants R & D Technical Report P428, 2001.
- 4) [An Environmental Risk Management Framework for Composting Facilities in England and Wales](#); Environment Agency guidance dated October 2004.

Policy Implementation Plan																
Policy number: 405_07 Our position on composting and potential health effects of bioaerosols																
1. Who are the target audiences, and do they require awareness, training or education?	Our staff who process (Pollution Prevention and Control) PPC Permit or Waste Management Licence applications. Officers responsible for registration of exemptions from Waste Management Licensing, specifically para 12, schedule 3, Waste Management Licensing Regulations 1994. Awareness, training or education.															
2. What do they need to know?	Awareness of what the policy says, training and education on bio-aerosols on risk assessment of bio-aerosols.															
3. When do they need to know it?	From when this policy takes effect.															
4. How will they be told?	A targeted training day															
5. Who will tell them?	Process, Policy and expert from Science Group															
6. Monitoring progress Method(s): Success criteria: Date(s) undertaken: Comments:	Audit of permits, licences issued and exemptions registered within 12 months of the implementation date of policy. All permits, licences and exemptions checked have a risk assessment that satisfies the risk assessment guidance.															
7. Authorisation	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;"></td> <td style="text-align: center;">Policy Sponsor</td> <td style="text-align: center;">Chair Approval Body</td> </tr> <tr> <td>Sign:</td> <td style="text-align: center;"></td> <td></td> </tr> <tr> <td>Name:</td> <td colspan="2">Liz Parkes</td> </tr> <tr> <td>Title:</td> <td colspan="2">Head of Waste</td> </tr> <tr> <td>Date:</td> <td colspan="2">23 Oct 2007</td> </tr> </table>		Policy Sponsor	Chair Approval Body	Sign:			Name:	Liz Parkes		Title:	Head of Waste		Date:	23 Oct 2007	
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Sign:																
Name:	Liz Parkes															
Title:	Head of Waste															
Date:	23 Oct 2007															
8. Review Due	01/03/2009															



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CIWEM Poll

Policies

Composting

Purpose

This Policy Position Statement reviews the contribution and role of composting in the management of organic waste and considers the operational, policy and environmental issues relating to this practice.*

CIWEM calls for:

1. A firm regulatory footing for controls on composting treatment and product quality (as is the case for organic material containing kitchen waste).
2. Regulation of composting that is exempt from waste management licensing, to the same standard as for other centralised composting operations.
3. The delivery of agreed microbiological quality standards for composts.
4. Quantitative monitoring at the district scale to determine the effectiveness of home composting at diverting household waste from landfill disposal.
5. The UK Government to make a case to the European Commission for derogation of composted material from the prescribed nitrogen (N) limits of the Nitrate Directive. This would resolve the apparent conflict between improving soil organic matter and restricting N additions to soil from composts, so that the full benefit of composted materials on soil quality can be realised.
6. Further research to develop alternative products from composted biomaterials, that are acceptable to the specialised sector of the horticulture industry, which continues to require peat for use in its growing media.
7. Local authorities to address as a matter of urgency how to tackle segregation of kitchen waste in the context of those living in flats, high-rise apartments and dwellings where home composting is not possible.

The Chartered Institution of Water and Environmental Management (CIWEM) is the leading professional body for the people who plan, protect and care for the environment and its resources, providing educational opportunities, independent information to the public and advice to government. Members in 96 countries include scientists, engineers, ecologists and students.

*This PPS addresses stabilised compost derived from source separated organic wastes. Partially or fully stabilised materials produced, for example, as an output from Mechanical Biological Treatment (MBT) plants are discussed in a separate PPS.

Context

Composting is a well-established natural method for treating, sanitising and stabilising organic materials such as green waste, fruits, vegetables, cardboard and wood found in municipal solid waste (MSW) streams. It is undertaken on both a large and small scale, ranging from home composting bins to centralised sites that compost thousands of tonnes every year. Composting is playing a key role in helping local authorities to achieve targets both on diverting waste from landfill and on recycling.

Composting is generally defined as the controlled biological decomposition of organic material under conditions that are predominantly aerobic and that allow the development of "thermophilic" temperatures because of biologically produced heat. The composting process produces a final product that is sanitised, stabilised, high in humic substances and can be applied to land. Applying compost to land is beneficial as it adds valuable organic matter which improves soil structure, adds valuable macro- and micro-nutrients and adds micro-organisms back to the soil to improve its health.

In order to improve the UK's performance in the management of MSW the Government has imposed a system of recovery and recycling targets on local authorities. With incremental targets based on each local authority's individual performance, it is the

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Government's intention to reach 33% recycling nationally by 2015. Biodegradable materials such as paper can either be removed from the MSW stream and recycled as paper, or turned into a compost along with other organic wastes. Compost is regarded as a recycled product, and therefore counts towards the achievement of the 33% target. At EU level, the Landfill Directive requires the UK to divert biodegradable MSW away from direct landfilling into alternative forms of treatment – 25% diversion (relative to 1995 levels) by 2010, rising to 65% diversion by 2020. This equates to up to 33 million tonnes of biodegradable waste being diverted from landfill.

Currently, over 80% of good quality compost (approximately 500,000 tonnes) is obtained from green waste (plant clippings, grass cuttings etc.) collected from civic amenity sites and from parks and civic gardens. Only 7% of compost is produced from organic waste collected at the kerbside. Tightening recycling and landfill diversion targets will require ever-larger quantities of compost to be produced, turning the organic fraction of waste into an increasingly significant source of compost, since 63% to 68% of MSW is believed to be biodegradable.

Home composting offers a complementary route to civic amenity collection sites and centralised treatment for garden waste. Recent estimates indicate that participating households, on average, may divert 400 kg per year of organic waste from landfill⁽¹⁾.

Composting of sewage sludge with green waste or woody wastes is also practised by a number of water companies to make the sludge safe for application to agricultural land. Methods to improve the management of solid farmyard manures, in order to encourage composting, are also being discussed with respect to controlling microbiological hazards from these livestock-derived organic wastes.

Key Issues

Composting Technologies

Many technologies and systems are commercially available for centralised composting of wastes. Currently the main process type is open-air windrow turning, a lower cost option than other more technologically developed in-vessel methods, or aerated static piles. In 1999, 88% of the waste composted in the UK was by open-air mechanically turned windrow⁽²⁾. However, open windrows are more susceptible to odour complaints than other methods which are enclosed or not mixed during the initial, active, composting phase. In-vessel composting takes place in a sealed container where the environment can be carefully controlled and optimised for stabilisation and sanitisation of the product and allows gas scrubbing to prevent odour emissions. The approximate cost of composting in windrows is £15 per tonne of feedstock and is £30 per tonne by in-vessel systems⁽³⁾.

Quality control

The UK has seen the introduction of BSI PAS 100 standard for composts and the commercially derived Apex standard. In association with European legislation such as the Animal By-Products Order 2003, legal requirements and quality control are playing an increasingly significant role in determining materials to be composted and the methods that can be used.

Declining organic matter in soils – compost as the answer?

The proportion of agricultural soils in England and Wales containing less than 3.6% organic matter has increased from 31% in 1979-81 to 41% in 1995. Declining organic matter status is identified in the Draft Soil Protection Strategy for England⁽⁴⁾ as a key issue for the sustainable management of soil and has important implications for the physical condition of agricultural soils.

Waste-derived composts, as well as other manures and organic materials, can provide a good source of organic matter for soil improvement. The Waste Management Licensing Regulations⁽⁵⁾ stipulate that a maximum application of 250 tonnes per ha of waste-derived compost may be spread on the land in any 12-month period.

Composts provide effective replacements for mineral phosphate and potassium fertilisers for crop production, but are generally poor sources of N as the organic N in the product is not readily released. However, this makes composts ideal substrates for building soil organic matter because the risk of nitrate leaching into groundwater is low. The Code of Good Agricultural Practice for the Protection of Water⁽⁶⁾ for England and Wales sets an application limit of 250 kg N/ha/year from organic wastes and compost (which usually contains 1-2% N). In Nitrate Vulnerable Zones, which represent significant areas of intensively managed agricultural land in England where soil organic matter is in decline, the Nitrates Directive (91/676/EEC) sets a limit of 170 kg/ha/year as total N with the intention of protecting groundwater from nitrate contamination. Unfortunately, these limits restrict the potential benefits to be gained from applying high rates of composts to soil to raise organic matter values. No specific limits on N inputs are stipulated in the Scottish Code of Practice for the Prevention of Environmental Pollution from Agricultural Activity⁽⁷⁾, but the matching of nutrient applications to crop needs is required; CIWEM considers this more pragmatic approach preferable.

A substitute for peat

A further advantage of waste-derived composts is peat substitution and reducing the destruction of unique peatland habitats. Total horticultural peat consumption in the UK is estimated at 3.4 million m³ per year, the majority of which (96%) is used in growing media

formulation⁽⁸⁾. Mindful of the environmental measures introduced by peat producers in the UK and the industry's role as a source of employment, composted biomaterials are accepted as effective alternatives to peat for general soil conditioning purposes and this is likely to be the main outlet for composted wastes in the domestic and commercial landscaping markets. Indeed, significant progress has been made in exploiting alternatives to peat for use as soil conditioners and recent statistics⁽⁸⁾ indicate that peat substitutes already represent 92% of the horticultural market for soil improvers. This indicates that horticultural demand for soil improvers derived from composts is close to saturation. Therefore, market development activities may now be most effectively targeted on the agriculture sector.

With considerable refinement and blending, composted wastes can also replace peat to some extent in growing media, but the variability and limitations of biowaste composts, together with high processing costs, do not favour this.

Land reclamation, brownfield development and urban situations

Compost is an ideal material for soil building in reclamation and brownfield development situations. Self-sustaining soils need to have adequate organic matter to provide a reserve of nutrients, water and biological diversity. The microbial activity that organic matter stimulates can also degrade some of the pollutants found in brownfield situations. Composted materials are also valuable for soil improvement and mulching in urban areas.

Discussion

1. The environmental, operational and regulatory pressures influencing composting are dynamic and finely balanced. Composting is a key way to reduce the amount of organic waste sent to landfill. However, this is balanced by the need to protect the natural environment from pollution when compost is used on land. EU legislative trends are moving in the direction of increased regulation, and cleaner composts derived from source separated waste streams.
2. A key issue is the requirement for controls on composting treatment and product quality. CIWEM considers this should have a firm regulatory footing, as is the case for biosolids and organic material containing kitchen waste, and that standards should be set according to risk.
3. CIWEM recognises that whilst composting undertaken through the use of exemptions (from waste management licensing, under The Waste Management Licensing Regulations 1994) is useful in helping to recycle organic material, these operations need to operate to the same standard as other centralised composting operations.
4. CIWEM recognises that standards are necessary to provide quality assurance for composted materials and supports the efforts of both Government and the commercial sector to develop and implement these. However, effective co-ordination of this effort is required to avoid duplication and confusion.
5. Proposed microbiological quality standards for composts require measurement of numbers of pathogenic and indicator bacteria. This type of analysis is inherently difficult and results from different laboratories are likely to be highly variable because of the lack of standardisation of methods used. Therefore, further work is necessary to develop and validate, through inter-laboratory comparison, agreed standard protocols for detecting and counting specified indicator and pathogenic organisms in composted residuals.
6. Home composting has the potential to divert significant amounts of biodegradable household waste from landfill disposal and fulfils the proximity principle for waste management. Many local authorities in the UK have distributed home compost bins to the public. A continued commitment to promoting home composting is important to expand waste diversion in this way. So far, only qualitative information on the diversion of waste by home composting has been collected based on questionnaire surveys, so there is uncertainty about its actual contribution. Therefore, quantitative monitoring work is needed at the district scale to determine the contribution of home composting to diverting household waste away from landfill disposal.
7. In areas where home composting is not possible or is not desired, food waste disposers⁽⁹⁾ can play a useful role in managing kitchen waste safely and diverting it from the municipal solid waste stream.
8. UK agriculture requires significant inputs of biomaterials to correct the declining organic matter in soil used for food production. Composts provide an ideal substrate for this purpose as they contain significant amounts of organic matter. Their low N availabilities also have the advantage of minimal risk of nitrate leaching to groundwater. Large rates of addition are necessary to increase soil organic matter reserves, but there is a conflict apparent between the need to raise soil organic matter and the current restrictions on N additions via organic manures. CIWEM recommends that these conflicts be resolved so that the full agronomic benefit of these materials on soil quality can be realised.
9. The market for alternatives to peat as horticultural soil conditioners is approaching saturation. Therefore the agricultural sector, land reclamation, soil improvement in urban areas, etc. are likely to be the main outlets for recycling bulk quantities of composted biowastes to land.
10. Considerable progress has occurred in the substitution of peat with alternative biomaterials for general soil conditioning purposes in the domestic and commercial horticultural markets. The main use of peat is now in growing media formulation. CIWEM is fundamentally against the extraction of peat and considers that the UK Government should take a proactive role in promoting wider use of alternatives which are of a consistent standard and acceptable to this specialised sector of the horticulture industry.

References

- (1) Smith, S.R. and Jasim, S. (2002) Small-scale composting of biodegradable household

waste: Process, diversion and end-use. 7th European Biosolids Organic residuals Conference, 17 – 20 November, Wakefield.

(3) Slater, R.A., Frederickson, J. and Gilbert, E.J. (2001) The State of Composting 1999: Results of The Composting Association's Survey of UK Composting Facilities and Collection Systems 1999. The Composting Association, Wellingborough.

(3) Hogg, D. (2002) Costs for Municipal Waste Management in the EU. Final Report to Directorate General Environment, European Commission. Eunomia Research & Consulting, Bristol.

(4) Department of the Environment, Transport and the Regions (2001) The Draft Soil Strategy for England – A Consultation Paper. DETR, London.

(5) UK Statutory Instrument (1994) The Waste Management Licensing Regulations 1994. SI No 1056. The Stationery Office, London.

(6) Ministry of Agriculture, Fisheries and Food/Welsh Office Agriculture Department (1998) Code of Good Agricultural Practice for the Protection of Water. PB 0585. MAFF Publications, London.

(7) The Scottish Office Agriculture, Environment and Fisheries Department (1997) Prevention of Environmental Pollution from Agricultural Activity: A Code of Good Practice. SOAEFD, Edinburgh.

(8) Department of the Environment, Transport and the Regions (1999) Monitoring and Assessment of Products for Growing Media and Soil Improvers in the UK. DETR, London (available on website: <http://www.peatproducers.co.uk/useuk.html>).

(9) CIWEM PPS on Food Waste Disposers

March 2005

Note: CIWEM Policy Position Statements (PPS) represents the Institution's views on issues at a particular point in time. It is accepted that situations change as research provides new evidence. It should be understood, therefore, that CIWEM PPS's are under constant review, that previously held views may alter and lead to revised PPS's.

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Sustainable management of biowastes

Compost-Like Output from Mechanical Biological Treatment of mixed source municipal wastes

This statement sets out our views on the use of Compost-Like Output (CLO) from Mechanical Biological Treatment (MBT) plants accepting mixed source municipal wastes on land. Through it we are providing as much certainty as possible to inform decisions made by central, regional and local government, the waste industry and their consultants and advisors. It should be read in conjunction with our main position statement on biowastes.

Key issues

Relatively small amounts of CLO are produced at the moment. Currently, CLO are landfilled, used as a landfill cover or spread on previously developed land to improve that land. We expect that the growth of MBT will lead to greater pressure to use CLO on other types of land. This will compete with the use of other biowastes on land.

CLO may pose a risk to the environment or human health when spread on land; this is because of the potential for contaminants to have an impact on soil, water or the food chain. The production of CLO is relatively new and our understanding of the risks is limited at present. We are concerned about the risk associated with applying increasing amounts of CLO to land, especially where that land might be brought into future use in food production.

As increasing amounts of CLO are applied to land, we need more evidence from industry about the risks that the activity poses, and evidence that they can be adequately controlled.

Currently, CLO can be used for the reclamation, restoration or improvement of previously developed land under a notifiable exemption in accordance with the Environmental Permitting Regulations. There is another notifiable exemption, which allows certain biowastes to be spread on agricultural land. This does not apply to CLO, which cannot be spread on agricultural land under any exemption.

Defra, WAG and Environment Agency are undertaking a major review of exemptions from environmental permitting. Defra is currently proposing that higher risk exempt activities (i.e. the current notifiable exemptions) will be regulated through Environmental Permits in the future. We are considering our approach to permitting various waste to land recovery operations in the future.

Our role

As a regulator:

- we regulate mechanical, biological treatment plants under the Environmental Permitting Regulations 2007
- we regulate the treated outputs from these plants as controlled wastes in order to prevent pollution of the environment or harm to human health.

As technical specialists and advisors:

- we have produced '[An Environment Agency guide to assist those considering the Mechanical Biological Treatment of waste](#)', which outlines options for outputs from the process. We have also produced [guidance](#) that allows Waste Disposal Authorities to measure and demonstrate the diversion in biodegradable municipal waste achieved by these processes
- our Waste Technology Data Centre has produced [detailed information](#) for operators and decision makers on the use of mechanical, biological treatment techniques, showing the costs and benefits of the technology.

Solutions - what we call for:

Within the context of the review of exemptions, we do not believe that CLO should be applied, under an exemption, to agricultural land used for growing food or fodder crops, or any land that is likely to grow food or fodder crops in the future owing to:

- the potential for chemical contamination from unknown sources within the waste
- the potential for physical contamination such as plastics and glass
- the potential for contaminants to build up in the soil and cause harm to the environment
- variability of quality
- the current lack of knowledge about CLO.

For the same reasons, we do not believe that CLO should be applied, under an Environmental Permit, to agricultural land used for growing food or fodder crops or any land that is likely to grow food or fodder crops in the future.

We believe that CLO may be suitable for application to previously developed land, subject to various restrictions, but recognise that we need to know more about the risks. We therefore support the steps taken by some operators to assess their CLO for a wide range of contaminants on an ongoing basis. We also encourage the work that they are doing to investigate the risk to the environment when CLO are used on land. In this way, knowledge of the likely contaminants and variability in quality of

CLO can be built up. This will enable operators to identify contaminants and reduce them at source. We want all operators wishing to apply CLO to land to do likewise.

The waste management industry and local government should:

- take into account all environmental and logistical considerations for different waste technologies before deciding on mixed waste MBT to reduce wastes going to landfill
- recognise the advantages of segregating waste streams at source, so that waste treatment inputs and contaminant potential are known and the maximum recycling/recovery potential of the wastes can be realised as a quality material
- at an early stage of planning, assess the best environmental options for using all outputs from the MBT process taking into account the waste hierarchy and regulatory constraints
- recognise the limited opportunities for recycling CLO from mixed waste treatment plants to land when making waste investment decisions. Configuring MBT plants to produce outputs which can be used as a fuel may be a more sustainable option. CLO can also be landfilled.

We will review our guidance on the assessment of permits to allow wastes to be used on land for reclamation or restoration. This will be done in preparation for the outcome of the exemptions review and taking into account the Environmental Permitting Regulations. We will consider the results of industry-led research on the nature and effects of these wastes when making revisions to our guidance.

Background

In order to meet their statutory targets for landfill diversion, a number of local authorities use or are planning to use plants which use both mechanical and biological treatment technologies to treat mixed municipal waste. These treatment technologies are commonly known as Mechanical Biological Treatment (MBT). They reduce the amount of waste going to landfill and separate waste for recycling or recovery. Currently, about 615,000 tonnes of municipal waste per year are treated using MBT, but this is expected to increase rapidly (about 3 million tonnes per year input by 2010 and further increases beyond).

Understanding the nature of a waste is fundamental to managing it effectively. Separation at source into identifiable fractions clearly has advantages over allowing wastes to be mixed together. We recognise that source separation of municipal waste is not always practicable, but a lack of separation will limit the options for its reuse.

MBT covers a wide range of technologies and plant configurations and can produce a number of different outputs. The most common fractions are:

- combustible fraction, often used as a fuel to produce electricity

- recyclables, for example metals
- organic material from the biological treatment often called 'Compost-like Output' (CLO).

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0845 988 1188

Sustainable management of biowastes

Sewage sludge and septic tank sludge

This statement sets out our views on the sustainable management of treated sewage sludge (biosolids) and septic tank sludge. It will be of interest to central government, the water industry, some parts of the waste industry, agricultural advisors and farmers. It should be read in conjunction with our main position statement on biowastes.

Key issues

Sewage sludge is an organic material produced in the treatment of domestic waste waters. The amount produced has continued to rise steadily over the last decade.

Treatment of sewage sludge or septic tank sludge followed by use as a soil conditioner can:

- capture methane to produce energy
- stabilise soil
- reduce the need for chemical fertiliser.

Use as a soil conditioner requires controls to avoid detrimental effects from:

- chemical contaminants
- pathogens.

Sewage sludge comes from mixed sources, often including industrial discharges and may contain chemical contaminants which have the potential to damage soil. There is an extensive research base showing the level of risk to the environment or human health when used as a soil conditioner. Because we understand the risks, we are able to effectively control them or identify where additional controls are needed.

It is known that treated sewage sludge can contain pathogens. Where this material is used on agricultural land, there is potential for transport into the food chain. The water industry has invested heavily in controlling this risk through a number of measures including the [Safe Sludge Matrix](#).

Septic tank sludge is handled by non-water industry operators, some of whom still spread it untreated on land with few regulatory or voluntary controls. It is important that this limited practice does not undermine supply-chain confidence in the highly controlled use of treated biosolids from the water industry as a soil conditioner.

Our role

As a regulator:

- we regulate landfills, incinerators and certain sewage and sludge treatment centres through the Environmental Permitting Regulations 2007
- we control the use of sewage sludge and septic tank sludge on agricultural land used to grow food crops through the [Sludge \(Use in Agriculture\) Regulations 1989](#)
- we regulate application of both sewage sludge and septic tank sludge to non-agricultural land and land used for non-food crops. This is usually done under exemption from the Environmental Permitting Regulations.

As technical specialists and advisors:

- we have contributed to a substantial body of research into the treatment and use of sewage sludge in agriculture including work led by Defra and by the water industry
- we advise on improvements to water company assets, including sludge treatment needed as part of the [Asset Management Planning process](#). We also monitor the delivery of improvements
- we have taken results from the Long Term Sludge Experiments and other research to assess the standards in the sewage sludge regulations along with other soil protection guidelines. We will publish the results of this work in our soil standards 'Roadtesting' project in 2008.

Solutions - what we call for:

We recommend that the water industry should act on our advice about treatment technology in our main Sustainable management of biowastes position statement when planning sustainable sludge management strategies.

The water industry has called for even tighter independent scrutiny on their operations to ensure continued consumer confidence. In line with our modern regulatory approach, we would recommend a voluntary accreditation system rather than further statutory controls for pathogens.

We are working with Defra to improve the Sludge Regulations. This process has been ongoing for some years without completion. We wish government to revise the Sludge Regulations, to include:

- controlling the landspreading of septic tank sludge with controls equivalent to those for sewage sludge, including a ban on the spreading of all untreated sludge
- the statutory metal limits for copper and zinc to be in line with those of the current voluntary code of practice for agricultural use of sewage sludge

customer service line

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- a charging scheme which enables us to recover our costs for enforcing these regulations.

We support government plans to use the results of the 'Long term Sludge Experiments' research to influence future changes in European legislation. We encourage them also to consider the outputs of our soil standards 'Roadtesting' project in reviewing national legislation.

In many circumstances, sludge use in agriculture is the best practicable environmental option. Sludge producers should recognise that there are alternative options that may also use sludge as a resource and deliver environmental benefits, provided those options meet appropriate regulation controls. An example would be thermal treatment of sludge to provide combined heat and power.

Background

Approximately 1.3M tonnes (dry solids) of sewage sludge was produced in 2006. The processes treating domestic effluent in septic tanks also produce an organic sludge. For both, the options for use or disposal are mostly restricted to treatment, followed by either:

- use as a soil conditioner (biosolids)
- incineration
- landfill.

Alternative technologies, for example incineration with energy recovery, have improved markedly over the last 10 years. In some circumstances they offer advantages over land spreading such as:

- better control of contaminants
- reduced requirement for transport.

A recent study sponsored by the Defra, UK Water Industry Research, Environment Agency, WAG and the Scottish Government (the '[Long Term Sludge Experiments](#)') has indicated that the current regulatory limits for some metals may not fully protect soil if used over an extended period of time.

Sustainable management of biowastes

This position statement and those linked to it state our views on some of the most pressing issues concerning the developing topic of biowastes. The target audience is principally central, regional and local government, the waste management industry, water industry, farmers and agricultural advisers. It will also be of interest to members of the public.

Biowaste is often taken to mean the organic biodegradable fraction of the municipal waste stream, including garden waste, food waste and other biodegradable material such as paper. We have extended the definition to include similar biodegradable wastes from commercial¹ and industrial sources, together with sewage sludge and agricultural manures and slurries. It does not include clinical bio-hazardous wastes.

We believe that biowastes should be treated and recovered to maximise their benefit as a resource, whilst minimising their impact on the environment.

We want a more coherent and integrated approach to management and disposal of biowastes, linked to waste strategy and land use planning.

Key issues

Understanding the nature of a waste is fundamental to managing it effectively. We prefer to see separation of biowastes at source into identifiable fractions; this clearly has advantages over allowing wastes to be mixed together. We recognise that source separation of municipal waste is not always practicable, but a lack of separation will limit the options for its re-use.

The management of biowaste is changing rapidly. We need to clarify our role and views for government and industry. To support government waste strategies and encourage recovery of biowastes, the right balance of controls and incentives needs to be found in order to encourage beneficial use of biowastes whilst ensuring that land, the wider environment and human health are protected.

New biowastes are being used, or proposed for use as soil conditioners in increasing quantities. There is currently uncertainty about the benefits some of these biowastes provide and the potential detrimental effects that they may have on the environment, in particular on soil. Where more information is needed on those risks, a precautionary approach to regulation may be necessary to avoid detriment to the environment or human health.

As more and new materials are used as soil conditioners, there will be increased demand for land. We are concerned that the supply of organic soil conditioners in

¹ including wastes from the preparation of food and drink in retail, hotel, restaurant sectors etc.

some areas will outstrip demand. Important regulations to protect the environment from over-application, such as the proposed Nitrates Action Programme and the Water Framework Directive (which may limit the amount of soil conditioner that can be used) will undoubtedly increase the demand for suitable land.

Our role

As a regulator:

- we have a modern, risk based approach to regulation. We regulate the treatment and use of biowastes through a range of measures, from deregulation through the BREW Quality Protocols to bespoke permits
- we have been working closely with government on the Environmental Permitting Regulations, and on a major review of the waste exemptions regime, expected to come into effect in 2009.

As experts and advisors:

- we have produced and contributed to research and guidance on biowaste treatment and use. We are a partner in delivering government waste strategies. We have a role in land use planning, providing data at a strategic level and responding to individual planning consultations. We have also produced a [soil strategy](#) which outlines our wider commitment to the protection and management of soils
- we have published separate position statements on the [Use of Waste Incineration in Waste Management Strategies](#) and on [Biomass](#)
- where biowastes are produced from mixed and potentially contaminated sources, they pose special challenges both for the environment and regulation. We have set out our views on sustainable management of Sewage sludge and septic tank sludge and of Compost Like Output from Mechanical and Biological Treatment of mixed source municipal wastes in separate documents. We also have a position statement on Composting.

Solutions - what we call for:

Treatment technologies. There are a number of emerging technologies for treating biowastes as well as a few well established ones. Choosing the right treatment technology for a given situation is complex and will depend on the type of material being treated. Those planning and delivering waste management infrastructure should find the best treatment for their individual situation, taking into account environmental and other relevant considerations.

Those treating biowaste should aim to maximise its benefit as a resource. The value of the waste both as a source of quality material and of energy must be considered. We want to see high quality materials derived from source segregated biowastes finding markets as a resource, rather than low quality materials that need disposal with tight and restrictive regulation.

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Waste planners and developers must consider the availability of local land and relevant regulatory controls for any soil conditioner outputs when making investment decisions on biological waste treatment plants. We support Defra's ALLOWANCE project, which is analysing the availability of land, and hope the results will shortly be available to waste planners.

Use on land. Producers of biowastes should carry out ongoing research into the nature of the materials they produce. When assessing permits or exemptions from permits to spread wastes on land, we will always ask for evidence of:

- what contaminants are in the materials
- details of the soil conditioning benefits and any detrimental effects that the material has
- other requirements set out in the relevant regulations and guidance.

This is especially important for materials produced from:

- process industries
- materials which have not, until recently been widely used as a soil conditioner, such as treated food wastes
- sites where there is uncertainty about the nature of source materials including unsegregated and mixed source wastes.

Farmers and other practitioners should follow good practice when spreading materials on land, including the Defra Codes of Good Agricultural Practice.

Background

The range of names used for biowastes reflects a variety in use, value, quality and impact on the environment. Among them: sludge, slurry, manure, biosolids, organic resources and compost. Some are considered to be wastes, others products, depending on the circumstances.

In total, they represent over 100 million tonnes of material produced in the UK each year.

Biowastes contain carbon. In landfills, much of this carbon is converted to carbon dioxide and methane, a potent greenhouse gas with 23 times the global warming potential of carbon dioxide. Successful biowaste recovery obtains value from the carbon whilst minimising its release to the atmosphere in the form of greenhouse gases. Value can be recovered either by: producing energy; using it as a source of organic carbon in soils; or by a combination of the two.

The way in which biowastes are managed and disposed of by industry, commerce and local government is changing rapidly. Biowaste recovery is increasing and disposal to landfill decreasing, driven by various factors such as the implementation

of the Landfill Directive, governments' waste strategies, landfill tax and local authority targets.

In practice, the options for using or disposing of biowastes are normally limited to use as a soil conditioner/fertiliser, incineration (or other thermal treatment), landfill, or treatment followed by one of those options.

Soils can benefit from the addition of good quality biowastes. Healthy soils, well stocked with organic matter, can help prevent pollutants entering watercourses. They mitigate the effects of extreme weather events that cause floods and droughts - events we expect to see more of as a result of climate change. Use of biowastes as soil conditioners also replaces the need for inorganic fertilisers produced in resource intensive processes. But biowastes can contain physical, biological and chemical contaminants and have the potential to cause pollution or harm to human health if mismanaged. The level and nature of contamination varies between materials, as does our knowledge of the contamination potential.

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Energy from waste

Key issues

- We generate a large amount of municipal waste which must be managed.
- Local authorities collected 30.9 million tonnes of municipal waste in England and Wales in 2006/07. This included 27.5 million tonnes of waste from households, representing around 509 kg per person per year.
- The amount of municipal waste we produces keeps on increasing every year although the rate of increase has declined.
- The main route for municipal waste disposal in the UK has traditionally been landfill. However, to comply with the requirements of the European Landfill Directive, England and Wales must landfill no more than about 12 million tonnes of biodegradable municipal waste by 2009/10, 8 million tonnes by 2012/13 and 5.5 million tonnes by 2019/20.
- We must urgently find affordable ways of managing municipal waste that cannot be recycled and maximise its use as a resource.

Our position on energy from waste

- We believe that we need to create less waste, recycle more and maximise the use of residual waste in a safe and environmentally friendly way.
- We believe that recovering energy from waste can contribute to a balanced energy policy.
- We consider that it may be appropriate for local authorities to include energy from waste in their strategies and plans provided that:
 - it does not undermine preventing or minimising waste, re-use, recycling or composting;
 - it forms part of a properly considered and appraised regional or local strategy.
 - it is consistent with the statutory aim to establish an integrated and adequate network of waste disposal installations and enable waste to be disposed of in one of the nearest appropriate installations.
- We also consider that energy generated by incineration should be recovered as far as practicable, for example using Combined Heat and Power (CHP) schemes, consistent with the requirements of Best Available Techniques (BAT).

Our role

- We will not issue an environmental permit for any industrial site, including energy from waste plants, if we consider they will cause significant pollution to the environment or harm human health.
- We will make sure that the standards used in designing, maintaining and operating energy from waste plants are at least as good as the agreed European standards.
- When we receive an application for an environmental permit to operate an energy from waste plant we consult members of the local community, the local authority and the public health bodies for their views on the potential effect on the environment and public health.
- We regulate the performance of energy from waste plants by:

- Requiring continuous emissions monitors to be used to measure concentrations of pollutants such as sulphur dioxide, oxides of nitrogen, hydrogen chloride, carbon monoxide, total organic compounds and particulate matter;
- Requiring twice yearly monitoring of hydrogen fluoride, heavy metals and dioxins, dioxin like PCBs (polychlorinated biphenyls) and PAHs (polyaromatic hydrocarbons);
- Carrying out check monitoring of pollutants using our own independent contractors, normally once a year or carrying out on-site auditing of operator monitoring;
- Inspecting sites regularly and carrying out unannounced inspections; and,
- Requiring operators to inform us within 24 hours if any of the emission limits set in the environmental permit are exceeded, or if they fail to comply with any of the operating conditions.
- If the energy from waste plant operator does not comply with its environmental permit we will take action in line with our Enforcement and Prosecution Policy.

Strategic Waste Planning

- In England the regional assemblies set out the high-level spatial planning framework for waste in their regional spatial strategies.
- In Wales, Regional Waste Plans determine overall policy for the management of waste in land use terms, including the number and type of the different facilities required. The policy is transposed at a local level into the Local Development Plans for implementation.

Local authority's role

- As the waste disposal authority, local authorities determine how municipal waste should be managed, including whether energy from waste is needed and, if so, how much is needed.
- As the waste planning authority, local authorities decide where energy from waste facility should be built.
- We provide our views on the environmental impact of energy from waste plants through input to draft spatial plans and responding to consultation on planning applications.

Public Health Bodies' role

- We consult the local public health bodies (the Primary Care Trust in England or the Local Health Board in Wales) on an application for an environmental permit for energy from waste plant.
- We ask them to comment on the potential health impacts of the proposed plant and take their views into account when we decide whether to grant a permit.

Background

- The Government's Waste Strategy for England 2007 says that 'recovering energy from waste which cannot sensibly be recycled is an essential component of a well-balanced energy policy.' It expects energy from waste to account for 25 per cent of municipal waste by 2020.
- Wales Waste Strategy "Wise about Waste" is currently under review, although the Welsh Assembly Government have stated that energy from waste is the best method to deal with non-recyclable waste but only where the maximum level of energy from waste required automatically mirrors minimum recycling levels. It currently proposes that the maximum amount of energy from waste should be 30% by 2024/25

- The number of energy from waste plants needed depends on the rates of recycling and composting achieved, the use of other treatment methods, the growth in municipal waste and the size of any proposed energy from waste plants.
- In 2004, Defra published a report entitled "*Review of Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes*". This report concluded that "Published studies of the health of communities living in the vicinity of incinerators have failed to establish any convincing links between incinerator emissions and adverse effects on public health; specifically no impact was demonstrated on the incidence of cancer, respiratory health symptoms or reproductive outcomes."
- The main outlets for residual waste in Europe are shown in the following table (taken from Source publication: [e-Digest of Environmental Statistics](#), published February 2006 Department for Environment, Food and Rural Affairs). This demonstrates that high levels of recycling can be compatible with high levels of incineration.

	landfill	recycled/compost ed (and other)	incineration	municipal waste generated per capita / kg
Greece	91.8	8.2	0.0	428.0
Portugal	74.8	3.5	21.7	452.0
United Kingdom	74.0	18.0	8.0	592.0
Ireland	69.0	31.0	0.0	732.0
Finland	63.3	27.6	9.1	450.0
Italy	61.8	28.9	9.4	523.0
Spain	59.3	34.2	6.6	609.0
France	38.1	28.2	33.7	561.0
Austria	30.0	59.3	10.7	610.0
Luxembourg	22.6	35.7	41.6	658.0
Germany	19.9	57.2	22.9	638.0
Sweden	13.6	41.4	45.0	471.0
Belgium	12.6	51.8	35.7	446.0
Denmark	5.0	41.2	53.8	675.0
Netherlands	2.7	64.4	32.9	599.0
eu 15	44.9	36.4	18.7	577.0



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Policies

Energy Recovery From Waste

Purpose

This Policy Position Statement (PPS) considers the issues surrounding the potential for expansion of energy from waste as a waste management solution and sets out the position of the Chartered Institution of Water and Environmental Management on how best to progress this sensitive issue.

CIWEM's Position on Energy from Waste:

1. CIWEM considers that energy recovery from waste has a legitimate role to play in the portfolio of sustainable waste management measures.
2. CIWEM supports wider use of combined heat and power (CHP), which represents the most efficient method of energy recovery from waste and encourages consideration of the role that it could play in reducing our reliance on conventional fossil fuels.
3. CIWEM considers that the Government should assess the current and likely future market for waste derived fuels that are still classified as waste – especially in high energy use industries where security and diversity of fuel supply could deliver a commercial advantage.
4. CIWEM urges the Government to support Europe-wide standard setting for waste derived fuels.
5. In the upcoming European negotiations on the Waste Framework Directive, CIWEM considers that there would be benefit in pressing for the de-classification as "waste" those refuse-derived fuels (RDFs) which are of sufficiently high quality. The Institution also considers that there is a need for greater research and development on RDFs in order to increase the proportion which may be co-fired without any reduction in emissions standards and we urge the Government to support this.
6. If EfW is to deliver real benefit to the UK then more should be done at a strategic and planning level to encourage the uptake of CHP which improves the efficiency of energy recovery considerably.
7. CIWEM considers that Energy from Waste (EfW) has a significant role to play in meeting the Landfill Directive targets for the diversion of biodegradable municipal waste from landfill.
8. CIWEM considers that the public perception of energy from waste is clouded by past performance and that stringent emissions standards which must now be adhered to are such that EfW should provide no greater air pollution than many common and widely accepted sources.

Context

Energy Recovery from Waste describes the process in which energy (in the form of heat) is recovered from the incineration of waste, and used to generate electricity which is then fed back into the national grid, or provide both electricity and heat (combined heat and power) to nearby communities or other uses. Waste may be in the form of an individual waste stream, generally from a commercial or industrial activity, which is used in existing plant as a fuel; it may be the residue once recyclables are separated from a general waste stream; or it may be a specially produced refuse-derived fuel (RDF) which must meet certain standards to be burnt in certain plant such as cement kilns or, potentially, power station furnaces.

There is a range of incinerator technology used, from mass-burn (generally the simplest approach) to fluidised bed combustion (utilising a moving bed of sand), pyrolysis and gasification (more novel technologies which produce gas from the waste by heating it in either a zero or low-oxygen environment, which is then burnt). Anaerobic digestion of waste is not covered in this PPS.

There are currently about 15 energy from waste (EfW) plants in the UK, which together incinerate over 3 million tonnes of municipal waste. To put this into context, in 2004/5, 67% of municipal waste was sent to landfill, 23.5% recycled or composted and 9% incinerated¹. Recently, waste incineration in the UK has been unpopular with the public,

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with fears over the health effects of emissions from EfW plants. Some of these fears are fuelled by the poor emissions performance of the previous generation of incinerators. Yet stringent restrictions imposed by the EC on the amount of waste which maybe be sent to landfill has led to the Government indicating in its Waste Strategy Review that EfW may have to play a bigger role, despite the current emphasis on recycling. The Government estimates that EfW could increase from its current 9% of MSW treated to around 25% if waste growth levels are high.

Expansion of EfW has also been set against the need to deliver reductions in the amount of greenhouse gas emissions. Waste has the potential to replace a small amount of conventional fossil fuels which are burnt to generate electricity, and consequently power generated in EfW plants has been exempted from the Climate Change Levy. There are also calls for a wider range of wastes to be permitted to be co-fired in industrial kilns and boilers and for EfW to be classified as a renewable source of energy. Increasing concerns about future security of energy supplies have also led to calls from some quarters for expansion of EfW as a secure source of energy for the UK.

Key Issues

EfW as a Sustainable Waste Management Tool

As a result of the EU Landfill Directive, improved rates of recycling by local authorities are being seen and targets exist to recycle or compost at least 33% of household waste by 2015. It may be reasonable to expect even better rates of recycling with time. Despite this, municipal waste (MSW) production is growing by approximately 2% per annum and there are targets under the Landfill Directive to reduce the amount of waste sent to landfill considerably. Even if Landfill Directive targets are met, half of all biodegradable municipal waste (BMW) could still be sent to landfill in 2013 and over a third in 2020.

There remains a significant gap between the amount of waste which will be able to be sent to landfill, and that which may be recycled. Elsewhere in Europe EfW is widely used as the mainstay of waste management strategies and though Defra has stated that EfW in the UK is unlikely to match the amounts combusted in Europe it could feasibly deal with up to 27% of MSW by 2020.

Public Opposition and Concern / Perception - Pollution

Public perception of waste incinerators / EfW plant in the UK is far from positive and there is generally significant opposition to proposals for their construction. This stems from fears over the health and environmental impacts of the pollutants emitted and is manifested in a typical 'not in my back yard' reaction. The primary pollutants of concern are dioxins, heavy metals, acid gases, nitrogen oxides and particulates. The presence of dioxins in particular has resulted in fear and opposition because of their carcinogenic properties and persistence in the food chain. Other pollutants can cause respiratory illness in susceptible individuals.

Waste incineration is highly regulated at a number of levels. The Environment Agency regulates releases to the environment in England and Wales (as does SEPA in Scotland and DOENI in Northern Ireland). The EU Waste Incineration Directive 2000 introduced tight emissions standards for waste incinerators. The Directive aims to minimise the impact of negative effects on the environment and human health resulting from emissions to air, soil, surface and ground water from the incineration and co-incineration of waste, and is implemented largely via the existing permitting requirements of the Pollution Prevention and Control (England and Wales) Regulations 2000. Consequently, levels of dioxins and other pollutants from incinerators are now amongst the lowest when compared to other common air pollution sources such as house or forest fires, or fireworks. This is supported by Defra commissioned research on environmental and health effects of waste management which has concluded that health risks posed by incineration of waste are small in comparison with other known risks faced by most people in their daily lives.

Energy

The Government's recent Energy Review has emphasized concerns over the future security and diversity of the energy resources which are used to generate power. EfW plants could play a limited, but increased role in generating electricity and providing heat to communities. With fossil fuel prices rising in recent years, the attractiveness of an EfW component of the portfolio is likely to grow.

CIWEM considers that wider utilization of the energy value of residual waste before final disposal would make a sensible and more sustainable contribution to our energy policy. Refuse derived fuels could, with the right development, provide energy at stable prices for industrial purposes.

The Government has emphasized the importance of the role combined heat and power (CHP) can play in the future energy mix. The UK Government and the Office of Gas and Electricity Markets (Ofgem) are to undertake a comprehensive review on distributed energy including CHP, which will report in 2007. The Renewables Obligation Order 2006 made EfW derived CHP eligible for Renewables Obligation Certificates (ROCs) and those which are compliant with Combined Heat and Power Quality Assurance are eligible for ROCs on all their biomass-generated energy. Government guidance states that Municipal waste management strategies should drive proposals for new EfW plant, within the context of diverting wastes further up the waste hierarchy, and seek to maximize the benefits of any new plant such as CHP for neighbouring communities. The Waste incineration Directive states that heat should be used 'as far as practicable'.

Climate Change / Greenhouse Gas Emissions

The UK Government has stated in its review of the Waste Strategy that EfW reduces emissions of greenhouse gases, through diversion of waste from landfill which would otherwise generate the powerful greenhouse gas methane during waste decomposition. Furthermore, emissions from the biomass fraction of waste are considered by the Government to be carbon neutral with the energy recovered displacing that otherwise likely to be produced from fossil fuels. The Government claims that "these advantages clearly make EfW a valid option for waste management towards the lower end of the waste hierarchy"².

Debate surrounds whether combustion emissions from biomass (biogenic or short-cycle carbon, which is contained in material such as paper and card, kitchen and green waste, residuals of which may still be present when incinerated) should be considered carbon neutral. The reasoning is that such carbon was taken up recently by the biomass when it grew, and if such materials are grown sustainably an equilibrium is reached between carbon taken up from and that released to the atmosphere. The waste fraction comprising materials originating from fossil fuels (e.g. plastics) is considered to produce non-biogenic, or long-cycle carbon, which prior to combustion was stored underground for a long time and hence is regarded as a net addition to the atmosphere and the key source of anthropogenically induced climate change.

A recent study by WRAP³ claims that even when the assumption is made that biogenic carbon from kitchen waste and paper is carbon-neutral, EfW without CHP produces significantly more CO₂ equivalent per kilowatt hour than gas fired power stations. Incinerators are also generally less efficient because energy is expended in removing moisture from the refuse and in scrubbing pollutants from flue gasses.

There have been two recent reports considering the impact of EfW on greenhouse gas emissions / climate change. The first, by ERM for Defra⁴ (to accompany the 2006 review of the Waste Strategy) investigates a range of scenarios and likely responses to the EU Landfill Directive. It estimates greenhouse gas emissions for these, and shows that scenarios with high levels of recycling, EfW, and MBT with RDF combustion show greater net greenhouse gas benefits. However, process emissions of carbon dioxide from EfW in the study were based on the non-biogenic component of the waste stream and did not count biogenic carbon.

The second report, by Eunomia⁵ for Friends of the Earth (FoE), challenges the view that energy recovery from waste will have beneficial effects on levels of greenhouse gas emissions. This view, it claims, is subject to a range of assumptions which can have a significant impact upon the outcome of studies. It claims that conventional life cycle assessment approaches are not necessarily appropriate, particularly how they consider the issue of the time profile of emissions. It also casts doubt on the appropriateness of removing biogenic carbon from the equation, stating that the climate responds no differently to biogenic or non-biogenic CO₂ and that much of the energy recovered in EfW is from non-biogenic carbon in plastic waste residuals. It states that under assumptions widely employed in work for Defra, EfW where only electricity is generated (as is the case in the UK) is only marginally better than landfilling.

Discussion

The UK must comply with European regulation to significantly reduce the amount of mainly biodegradable municipal waste disposed of to landfill. Even with good delivery against these requirements, additional ways of disposing of waste are likely to be required barring dramatic improvements in waste minimisation levels. Recovering energy from waste represents a practical way of treating it, and CIWEM considers that, particularly if combined with heat recovery through CHP, Energy from Waste does have a role to play. There is ample evidence from Europe that EfW can coincide happily with high levels of recycling and CIWEM does not consider that investment in improved and expanded EfW would hamper efforts to increase recycling rates or reduce waste production.

If CHP is to be more widely utilised with EfW, there will need to be greater emphasis on its encouragement at a strategic level. Planning bodies should consider new developments with a more favourable attitude towards their integration with CHP programmes both large and small. There would be benefits to be gained if new developments were planned in such a way that they could take advantage of CHP technology at an appropriate scale (power and heat is far more efficient than power only). There have been calls for fast-track planning of new EfW infrastructure, but CIWEM considers that any new facilities should be required to go through the full and proper planning process.

Issues of public health impacts are likely to remain contentious with opinion split. The Health Protection Agency's position is that the Waste Incineration Directive should ensure that health effects are unlikely, and that incineration of municipal waste accounts for less than 1% of UK dioxin emissions. At the other end of the scale, Friends of the Earth claim that much of the population are already exposed to unacceptable levels of dioxins, therefore new additions to such emissions should not be permitted.

CIWEM considers that the Government should work on developing greater public appreciation of the health risks posed by EfW in the context of other commonly occurring processes and pollutants (e.g. the fact that about 14% of UK dioxin emissions are produced on bonfire night is probably not widely appreciated). The measurement of the impact of combustion plant in terms of deaths brought forward does nothing to allay these

fears and is something of a risk perception gaffe. There is a need to measure the impact of all waste management facilities in the same way and to be somewhat more positive about communicating them to the public. CIWEM considers that the emissions from such plant are insignificant in comparison with conventional power plant, whose emissions are much less tightly controlled. Despite this it is likely that opposition will remain which will make planning for new facilities a long and drawn-out process.

There is an ongoing debate regarding the relative merits of EfW and landfill in terms of their contributions towards greenhouse gas emissions and therefore climate change. Nevertheless, CIWEM considers it a positive move that EfW with CHP may be eligible for ROCs and considers that a technology which diverts a proportion of waste from landfill and at the same time replaces conventional fossil fuel and generates electricity and usable heat should be supported.

CIWEM considers that the use of high quality RDFs is entirely prudent. Much can be gained through cooperation between industry and regulators in the agreement of protocols and quality criteria for RDFs on a Europe-wide level. High quality RDFs could provide a source of fuel which is cleaner than much of the coal burned in power stations and furnaces in the UK and therefore should be encouraged, when burnt in Waste Incineration Directive compliant plants. The Institution contends that if this approach is adopted, there will be negligible health impacts on the public, although perceptions may be hard to change.

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October 2006

Note: CIWEM Policy Position Statements (PPS) represent the Institution's views on issues at a particular point in time. It is accepted that situations change as research provides new evidence. It should be understood, therefore, that CIWEM PPS's are under constant review, that previously held views may alter and lead to revised PPS's.

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Energy from waste and health

There is significant public concern about the possible health risks of energy from waste (EfW) plant emissions.

Our role

We have a statutory role to safeguard the environment and human health from all processes and activities we regulate, including EfW plants.

We use information provided by the EfW plant applicant to consider the health effects of EfW plants. We do this by:

- comparing emissions with industry best practice and limits set by regulations. The Waste Incineration Directive has strict limits that should prevent any unacceptable impact;
- looking in detail at what the EfW plant will release and how this could impact on the local environment;
- considering expert scientific opinion and research reports on health effects due to emissions;
- seeking advice from specialist bodies like the Food Standards Agency and the local Primary Care Trust (England) or Local Health Board (Wales);
- involving local communities to listen to and take on board their concerns.

If we decide to issue a permit we make sure that the operator operates the EfW plant in line with the conditions of the environmental permit. We inspect the plant, review their monitoring data and carry out our own monitoring to audit their figures. If there is any breach of permit condition the operator must tell us. We can take enforcement action against any operator who fails to prevent or minimise harm to the environment or public health.

Expert opinion

The Health Protection Agency (HPA) provides authoritative advice to government, agencies and the public.

The HPA has published a position statement on incineration of municipal solid waste that states “Modern, well-managed waste incinerators will only make a very small contribution to background levels of air pollution”; “provided they comply with modern regulatory requirements, such as the Waste Incineration Directive, they should contribute little to the concentrations of monitored pollutants in ambient air”.

This opinion is based on comprehensive review of available research.

Research

A great deal of detailed research has been carried out, both at specific sites and nationally, to investigate whether EfW plants do, in fact, damage human health.

The majority of published studies concentrate on the health effects from the older generation of incinerators. But, modern, well-managed EfW plants must now meet much tighter emission standards under the European Waste Incineration Directive. They release far less chemicals than the old incinerators and, therefore, only make a small contribution to background levels of air pollution. Indeed, dioxin emissions have been reduced by 99.8 per cent since 1990.

The most recent independent review of evidence on the health effects of household waste treatment and disposal was published by the Department for Environment, Food and Rural Affairs (Defra) in 2004. The *“Review of the Environmental and Health Effects of Waste Management: Municipal Solid Waste and Similar Wastes”* considered 23 high quality studies of the patterns of disease around EfW plants and also four review papers looking at the health effects of EfW plants. It concluded that there is no convincing link between EfW plants and adverse effects on public health.

The report considered cancer, respiratory disease and birth defects and found no evidence for a link between the incidence of the disease and the current generation of incinerators. It concluded that present day practice for managing solid municipal waste has only a minor effect on human health and the environment.

This should be viewed in the light of the benefits of collection and disposal of the waste that we all generate. If waste were not collected, treated and disposed, it would cause disease, odour and litter.

An earlier report by the Medical Research Council’s Institute for Environment and Health *“Health Effects of Waste Combustion Products”* also concluded that epidemiological studies on people who work or live near incinerators have shown no consistent excess of any specific disease.’

The Government’s expert advisory Committee on the Carcinogenicity of Chemicals in Food, Consumer Products and the Environment reviewed a large study by the Small Area Health Statistics Unit that examined 14 million people living within 7.5km of 72 municipal solid waste incinerators, which operated up to 1987. The Committee concluded that, ‘any potential risk of cancer due to residency (for periods in excess of ten years) near to municipal solid waste incinerators was exceedingly low and probably not measurable by the most modern techniques.’

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MUNICIPAL SOLID WASTE INCINERATION

Introduction

The Health Protection Agency supports Primary Care Trusts and Local Health Boards in their role as 'Statutory Consultees' for the Pollution Prevention Control (PPC) regime. Statutory Consultees are considered to have special knowledge or expertise. Guidance is available at (<http://www.hpa.org.uk/hpa/chemicals/IPPC.htm>).

Municipal Solid Waste Incineration is subject to regulation under Pollution Prevention and Control (PPC sector 5.1) and is likely to be a source of considerable public concern. Consequently the Chemicals Hazards and Poisons Division have produced this position statement on the public health consequences of these processes in order to help inform the debate.

Waste Management

The introduction of the European Union Landfill Directive (1999/31/EEC) will fundamentally change the way waste is managed in the UK, with the most significant requirement being the progressive reduction in the amount of waste permitted in landfill. For example, by 2020 no more than 35% of the amount of biodegradable municipal solid waste produced in 1995 can be disposed of in landfill sites. This may place a greater emphasis on incineration as a means of waste disposal.

Pollution potential

The by-products of the incineration process may contain hazardous or toxic pollutants and emissions will contribute to background pollution levels. Since 1996 there have been significant cuts in emissions from incinerators in order to meet strict European Union legislation. This has led to the phasing out of the older, more polluting plants as new emission and operation standards were introduced. As a result contemporary facilities are substantially less polluting and modern abatement technology will help reduce the hazard from emissions provided that the facilities are properly operated at all times.

The European Union Waste Incineration Directive (often termed 'WID') 2000/76/EC will further reduce the potential to pollute. This was transposed into UK law on 28 December 2002 and all new incinerators already have to comply with the tighter provisions of this directive. Previous existing incinerators have until 28 December 2005 to meet these standards. This new Directive aims to reduce and/or prevent possible negative effects on the environment caused by emissions into air, soil, surface water and groundwater, and thus lessen the risks which these pose to human health. Compliance will mean further significant reductions in the emissions of key air pollutants (such as nitrogen oxides, sulphur dioxide and hydrogen chloride, as well as dioxins and furans). As well as stricter emissions limits, this Directive also requires better management systems and increased monitoring of emissions.



The Waste Incineration Directive will therefore impose stricter operating conditions and emissions standards and so further reduce the potential human health impact. This should ensure that public health effects are unlikely. Pollution Prevention and Control permits will require immediate reporting of breaches of emission standards and the stopping of the waste feed should the abatement technology fail. These requirements will further reduce the potential for incinerators to cause significant pollution.

The incineration process can result in three main sources of emissions, (1) gaseous to the atmosphere, (2) via solid ash residues, and (3) via cooling water. Provided that solid ash residues and cooling water are handled and disposed of appropriately, atmospheric emissions remain the only significant route of exposure to humans.

Public Health Impact

The general public can be exposed to atmospheric emissions associated with incinerators through a number of routes; by direct inhalation and/or by indirect entry via the food chain being of particular importance. (For many pollutants including some of the trace metals, and carcinogenic organic compounds (such as dioxins and furans), the major route of exposure is through the food chain.)

There is no doubt that air pollution (from all sources) can have an adverse effect on the health of susceptible people (i.e. young children, the elderly and particularly those with pre-existing respiratory disease). The adverse effects of airborne particles on health have been established through epidemiological studies and include increases in hospital admissions for both respiratory and cardiovascular disease, increased mortality and, when exposure is over long periods, reductions in life expectancy. There are also less severe but nonetheless important effects, such as increased symptoms in asthma sufferers. Other pollutants may have similar effects.

However, there is little evidence to suggest that incinerators are associated with increased prevalence of respiratory symptoms in the surrounding population. Modern, well-managed waste incinerators will only make a very small contribution to background levels of air pollution. Air-monitoring data demonstrate that emissions from the incinerators are not a major contributor to ambient air pollution. However, the contribution to local pollutant levels should be assessed on a site specific basis.

The Health Protection Agency recognises that there are particular concerns over emissions of dioxins and furans from incinerators. The following opinion on the health effects of these compounds, and of tolerable daily intakes, i.e. the amount that can be ingested daily over a lifetime without appreciable health risk, is informed by the advice of the independent expert advisory Committee on the Toxicity of Chemicals in Food, Consumer Products and the Environment¹. This Committee has recommended a tolerable daily intake of 2 picogrammes

¹ Available at <http://www.food.gov.uk/science/ouradvisors/toxicity/>



TEQ/kg body weight/day² based on a detailed consideration of the extensive toxicological data available on dioxins and identification of the most sensitive effect, namely, adverse effects on the developing fetus resulting from exposure *in utero*. As this was the most sensitive effect it will protect against the risks of other adverse effects including carcinogenicity. The advice of two other independent expert advisory committees, the Committee on the Carcinogenicity of Chemicals in Food, Consumer Products and the Environment³ and the Committee on Mutagenicity in Food, Consumer Products and the Environment⁴, informed the conclusion, namely that dioxins do not directly damage genetic material and that evidence on biological mechanisms suggested that a threshold based risk assessment was appropriate.

The majority (more than 90%) of non-occupational human exposure to dioxins occurs via the diet, with animal-based foodstuffs like meat, fish, eggs, and dairy products being particularly important. Limited exposure may also occur via inhalation of air or ingestion of soil depending on circumstances. Provided that strict emissions limits are adhered to, inhalation is not a significant source of exposure for the general public.

Atmospheric emissions are also important through deposition to growing crops and pasture grass from which they can be incorporated into foodstuffs, either directly into edible crops or, indirectly into animals that graze on the pastures. It is therefore possible that people who consume produce from local food-chains within the area affected by emissions from the incinerator could receive a relatively higher exposure. However, current levels of dioxins emissions from incinerators are unlikely to increase the human body burden appreciably as incineration of municipal solid waste accounts for less than 1% of UK emissions of dioxins.⁵

However, dioxins and furans are highly persistent pollutants and we strongly support the Government policy to reduce dioxin exposures further by all practicable means and welcome the stricter emission limits applied under Waste Incineration Directive.

Health studies

Studies in the UK have principally focused on the possible effects of living near to the older generation of incinerators, which were significantly more polluting than modern plant. The Agency has considered studies examining adverse health effects around incinerators and is not aware of any consistent or convincing evidence of a link with adverse health outcomes. However it is accepted that the lack of evidence of adverse effects might be due to the limitations regarding the available data.

² TEQ refers to Toxic Equivalents and is an internationally recognized method for considering the toxicity of mixtures of dioxins and furans based on considering their relative potencies compared to the most potent dioxin (tetrachlorodibenzodioxin, or TCDD)

³ Available at <http://www.advisorybodies.doh.gov.uk/coc/index.htm>

⁴ Available at <http://www.advisorybodies.doh.gov.uk/com/index.htm>

⁵ Available at <http://www.defra.gov.uk/corporate/consult/dioxins-two/report2.pdf>



A number of comprehensive reviews on incineration have been published. The Department for Environment, Food and Rural Affairs ⁶ have recently commissioned a review of the effects of waste management, which was peer reviewed by the Royal Society. Cancer, respiratory disease and birth defects were all considered, and no evidence was found for a link between the incidence of the disease and the current generation of incinerators. It concluded that although the information is incomplete and not ideal, the weight of evidence from studies so far indicates that present day practice for managing solid municipal waste has, at most, a minor effect on human health and the environment, particularly when compared to other everyday activities.

An earlier report by the Medical Research Council's Institute for Environment and Health on the "Health Effects of Waste Combustion Products"⁷ also concluded that 'epidemiological studies on people who work at or live near incinerators have shown no consistent excess of any specific disease'.

The Committee on the Carcinogenicity of Chemicals in Food, Consumer Products and the Environment ⁸ has reviewed a large study by the Small Area Health Statistics Unit that examined 14 million people living within 7.5 km of 72 municipal solid waste incinerators, which operated up to 1987. The Committee concluded that, 'any potential risk of cancer due to residency (for periods in excess of ten years) near to municipal solid waste incinerators was exceedingly low and probably not measurable by the most modern techniques'. We agree with this view.

Conclusion

Incinerators emit pollutants into the environment but provided they comply with modern regulatory requirements, such as the Waste Incineration Directive, they should contribute little to the concentrations of monitored pollutants in ambient air. Epidemiological studies, and risk estimates based on estimated exposures, indicate that the emissions from such incinerators have little effect on health. The Agency, not least through its role in advising Primary Care Trusts and Local Health Boards as statutory consultees for Pollution Prevention and Control (PPC), will continue to work with regulators to ensure that incinerators do not contribute significantly to ill-health.

⁶ Review of Environmental and Health Effects of Waste Management; Municipal Solid Waste and Similar Wastes, published May 2004. Available at <http://www.defra.gov.uk/environment/waste/research/health/>

⁷ Available at <http://www.le.ac.uk/ieh/pdf/R7.pdf>

⁸ The full statement can be found at <http://www.advisorybodies.doh.gov.uk/coc/munipwst.htm> .



Renewable energy

Key Issues

Renewable energy technologies (or 'renewables') – such as wind, wave, tidal, hydro, solar and biomass (crops grown for use as fuel and other organic materials) – can provide “low carbon” sources of energy. To tackle climate change we urgently need to reduce energy use, by adopting more efficient technologies, and to generate energy from sources that release much less, or no, carbon dioxide – one of the major greenhouse gases causing global warming.

In the UK there is increasing use of renewable energy. The Government has set a target of generating 15 per cent of electricity from renewable sources by 2015. To meet this target, and then go further to 20 per cent by 2020, there will have to be a dramatic increase from the current level of 2 - 3 per cent.

The Environment Agency supports this increase in renewables, but only if it happens in an environmentally sensitive way. All energy sources have impacts on the environment – of different scales and duration. Renewables can have impacts on biodiversity, landscape, transport and air quality. The challenge is to find practical ways that have less impact than the traditional fuels we currently depend on.

An advantage of renewables is their diversity and range of uses to meet different needs for heat, electricity and liquid fuels. We think that there needs to be more focus on technologies to complement windpower, such as solar and wave power, which can help meet targets for 2020 and 2050.

The growing use of renewables will decentralise energy supply, replacing large power stations with smaller local sources of heat and power. This can have benefits – for security of supply and improved transmission. More people will live close to a power station or plant for capturing renewables, which will impact on local communities.

The Environment Agency's role

The Environment Agency regulates a number of aspects of renewable energy. We are consulted on planning applications. We administer Pollution Prevention and Control for larger biomass power and biofuel (liquid fuel production) plants. We license water abstraction for hydro power and for cooling water. And we monitor impacts on soil, water quality and resources and biodiversity (for example from fuel crop planting).

As a regulator we seek to offer an evidence-based view in keeping with principles of sustainable development. We take a precautionary approach and look at each case on its merits but have to take a strategic view as well of risks and benefits to the environment and society. Not every technology will be suitable in every location.

We are seeking to ensure the appropriate development of hydropower in keeping with our duty to achieve good water quality and protect fisheries.

We are developing a tool to ensure that we can assess the whole life cycle impacts of biomass power developments to minimise the overall environmental impact and maximise the benefits.

We promote collecting the gas from decay in landfill sites (known as landfill gas) for power generation, and processes for turning organic wastes (from farming and food production) into biogas. Using landfill gas or biogas to generate power captures a valuable energy resource and also helps to prevent global warming. We support this through our regulatory work, as long as there are safeguards for the local environment. We do not believe that burning waste to produce power is the same as use of renewable energy, though advanced methods promise to be a valuable way to recover energy from waste that cannot be recycled.

We support the take up of renewable energy technologies at regional level by policy advice to regional strategies and in some cases through active support. We use renewable energy technologies in our own operations where practical.

Solutions we call for:

1. The major focus of future energy policy should be to reduce demand, and increase the use of renewable energy and other low carbon technologies. We will play our part, for instance, in enabling hydropower developments where this does not compromise other environmental obligations and in supporting sensitive biomass power developments.
2. There should be a more rapid but environmentally sensitive adoption of renewables to work towards the goal of 20 per cent of electricity generation by 2020 and large-scale reductions of greenhouse gas emissions of 60 per cent by 2050.
3. More effort is needed to encourage diversity of sources including technology development and commercialisation for buildings to convert sunlight to electricity (with solar photovoltaics), to capture energy in tidal currents, and to develop wave power to compete in the market to meet targets up to 2050.
4. The Government should also do more to recognise and support generating heat from renewable sources. For example they could implement the Royal Commission for Environmental Pollution's call for developers of new housing developments to use renewable heat and power.
5. Developers of new technologies need to know there will be long term consistency and certainty for investment to assist their financial planning and for making the business case for projects to sell power
6. We support an improved approach to planning for renewables, which cascades down from regional targets to community level with increased public participation
7. Timely energy grid upgrades will be critical to ensure targets are met.
8. The full environmental costs of all energy technologies need to be internalised to enable decision-making on a level playing field. Different schemes should be judged on the same basis for their costs, impacts and benefits. The planning system does not compare a proposal to its alternatives. Nor do investors always use the same criteria. Impacts of one technology are rarely compared to others on a like basis, especially ways of linking short term and long term, local and global impacts. That is why we need a system that brings in all these costs and 'externalities'.
9. The whole life of a development should be used as the basis for decision making. Commitments need to be made about decommissioning facilities after use, whether major power developments or small scale sites and equipment for local generation, at the same time as development.

Background

- The Government is committed to a target of generating 15 per cent of electricity from renewables by 2015; and has an “aspiration” of 20 per cent by 2020. Energy policy is committed to reducing 1990 greenhouse gas emissions by 60 per cent by 2050
- Under the Renewable Electricity Directive, the European Union states should reach a collective 22 per cent share of renewables in electricity consumption by 2010.
- The UK has the largest resources for wind, wave and tidal energy in Europe, but currently performs badly. Other European countries generate significantly more electricity from renewable sources – Denmark 20 per cent, Finland 26 per cent, Sweden 47 per cent, Germany 8 per cent, and Spain 16.2 per cent.
- Of the total amount of energy used in the UK, 34 per cent is by transport; 31 per cent in homes and 23 per cent by industry. Heating accounts for 85 per cent of domestic demand.
- Developing renewables can help foster employment and regeneration opportunities across the country. Most regions have potential for further development and there are national benefits from innovation in new technologies. Commercialisation of some renewables offers significant potential economic benefits and global mitigation of climate change through exports. Germany has shown new industries can be built rapidly by overtaking Denmark on wind power and now becoming a leader in photovoltaics. Now 120,000 people work in the renewable energy sector, with 400,000 jobs planned by 2020 - jobs increased by 52,000 between 1998 and 2002.
- The pace of development of technologies is rapid and costs are falling steadily for wind turbines, solar photovoltaics (though still high), and other technologies. Research and development of forms such as wave and tidal power is rapid and venture capital is being attracted to new technologies.
- The Environment Agency has already switched every one of its 2000 sites and facilities to 100 per cent renewable electricity, in some cases integrating renewable energy into new developments.
- Detailed policy on specific technologies is being developed separately by the Environment Agency.

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Landfilling of gypsum waste including plasterboard

Purpose of this note

This statement summarises how we will regulate the landfilling of waste containing or consisting of gypsum in England and Wales. If such wastes are disposed of with biodegradable wastes it can lead to the production of odorous and toxic hydrogen sulphide gas. To reduce the impact of this waste we want to ensure that it is managed properly. This position supersedes all previously issued regulatory positions connected with the landfill of gypsum waste. We are developing guidance with industry on the management of 'other high sulphate bearing waste' that will be available soon.

Background

The Landfill Directive sets out the general conditions for the landfilling of waste with the aim of minimising the impact of landfill on the environment and to encourage waste minimisation and recycling.

Regulations¹ set out the criteria for the acceptance of gypsum and other high sulphate bearing wastes at landfill:

'Non-hazardous gypsum-based and other high sulphate bearing materials should be disposed of only in landfills for non-hazardous waste in cells where no biodegradable waste is accepted'.

Limits apply to organic carbon in waste to be deposited in such cells.

Our position

The landfilling of gypsum and other high sulphate bearing wastes with biodegradable waste has been prohibited in England and Wales since July 2005².

We had been taking a pragmatic view that separate disposal is not necessary where construction waste contains small amounts (up to 10%) sulphate. This was a working guideline that we always planned to review in response to scientific research.

The results of this research will be available soon (Sulphate Bearing Waste: Determination of a Concentration Limit for Separate Disposal). It will confirm that the relationship between sulphate in waste and the production of hydrogen sulphide gas is complex, but will conclude that we cannot set a practicable limit for gypsum wastes. We are therefore revising our guidance to remove the 10% guideline value.

Our intention is to encourage the reuse and recycling of more gypsum and other high sulphate bearing waste while reducing the potential production of hydrogen sulphide gas at a landfill.

This position applies to loads of waste containing identifiable **gypsum-based materials** (e.g. plasterboard). This material **must not be landfilled** with biodegradable waste. Producers of gypsum waste should separate it for **recovery and recycling** wherever possible. Where a load of gypsum is sent to landfill it must be deposited in a separate cell with waste that does not have a biodegradable content that exceeds specified limits.

How do I manage my waste gypsum-based materials?

All waste destined for disposal to landfill must be treated. We have produced guidance that is available at: <http://www.environment-agency.gov.uk/business/1745440/444663/landfill/1789720/?version=1&lang=en>

The simplest method of treating gypsum waste is to separate it from other waste at the point of production. You could also send your waste to a contractor to sort it for you at a waste transfer facility. Separated gypsum waste can be recycled or reused, for example in the manufacture of plasterboard or for agricultural soil treatment. You can get more guidance on managing gypsum waste and alternative uses for it, from WRAP. See: www.wrap.org.uk

If you are a producer of construction and demolition waste, including a waste transfer facility:

- If you are in England and your construction project is worth more than £300,000 you must have a site waste management plan (SWMP). See the Netregs web site at: <http://www.netregs.gov.uk/netregs/legislation/380525/1555007/>
- You must try to separate the gypsum-based material from other wastes so that it can then be either recycled / reused or can be disposed of properly at a landfill.
- You must not deliberately mix gypsum waste with other construction and demolition waste at a waste transfer facility.
- You must comply with your Duty of Care and only pass your waste on to someone who is an authorised carrier.
- You must try to recycle and treat as much of your other wastes as possible, for example by separating at source or by passing it on to someone else to treat. You must provide your waste carrier with a full description of your waste and the treatment that it has received. He can give you a form to complete, or you can use our own treatment confirmation form. We have produced 'Guidance for waste destined for disposal in landfills': http://www.environment-agency.gov.uk/commondata/acrobat/wacv2_1006008.pdf,

If you are a landfill operator:

- You must adopt waste acceptance procedures that will identify whether a waste stream contains gypsum-based material.
- If you accept gypsum waste you must dispose of it in accordance with the waste acceptance criteria and in a separate cell that doesn't contain biodegradable waste.
- You must let us know about any non-compliant load and its producer so that we can take action.

What you can expect from us

- We will work with the construction sector, WRAP and the waste management industry to raise awareness of this revised position.
- We will publish this position that removes the 10% guideline value and encourages waste producers to find alternative management methods for their gypsum waste.
- After 1 April 2009, if gypsum waste is accepted for disposal in the same cell as biodegradable waste, we will take action in accordance with our enforcement and prosecution policy.
- We take a pragmatic and proportionate approach to enforcing the Regulations. If occasionally small amounts of gypsum are found in loads of waste being disposed of at landfills, we expect landfill site operators to remind their customers of the requirements. We will take enforcement action against those who deliberately abuse the rules.

customer service line

08708 506 506

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incident hotline

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floodline

0845 988 1188

References:

1. The Environmental Permitting (England and Wales) Regulations 2007, schedule 10, paragraph 5(1)(g).
2. The Landfill (England and Wales) Regulations 2002 (as amended), regulation 10(2) and schedule 1, paragraph 15 [now repealed].

Appendix C

Available Health and Waste-Resource Management Fact Sheets

Biological Treatments

Fact Sheet 4

This fact sheet focuses on biological treatments. The treatments displayed here all deal with the biological part of your rubbish; which is the garden waste and kitchen waste (also known as organic or biodegradable waste). The fact sheet details three different approaches to composting and a treatment called anaerobic digestion.

Composting

“Composting,” means the breaking down of garden and / or kitchen wastes (organic waste) by micro organisms (small organisms) such as bacteria in the presence of oxygen and water, this process is called biodegradation.

Depending upon whether non organic materials (e.g. plastics) are present in the garden and / or kitchen waste, the process can produce compost, soil enhancer or mulch, which all help to improve the condition of soil.

Home Composting

Many people have compost heaps or bins in their back gardens, these can either be made or bought at a discounted rate from your local authority.

The type of bin or heap you have determines what you can put into your bin but most compost bins or heaps can only use garden waste and only vegetable food waste (not meat or fish) as their ‘green’ ingredients.



Photo: Three different types of compost bin.

Some Local authorities collect garden and / or kitchen waste (including meat and fish) from the kerbside or at Reuse and Recycling Centres/Civic Amenity sites or from local businesses. This green waste is used to make compost on a large scale.

There are two main large-scale composting processes: **windrow composting** and **In-Vessel Composting**.

Home composting is very similar to windrow composting which is a method of composting on a large scale.

Windrow Composting



Photo: Windrow composting heaps

This form of composting has been used for many years and is only used for green and garden wastes. Windrow composting is a simple method that uses no special technology. It is suitable for large quantities of green waste.

The Process

The green waste material is shredded into small pieces, any material that shouldn't be there (such as plastic bags and large stones) is removed and the material is then heaped into long piles as shown in the photograph. The piles are turned over at set intervals (about every 2-3 weeks) to give air to (aerate) the waste, as the micro-organisms in the waste need air (oxygen) to work.

Windrows can be either passively aerated – allowing air to get into the compost by turning the piles, or forcefully aerated by forcing air into the piles of compost using pipes running through or under the piles.

Location

Windrow composting can take place inside a building or outdoors, usually in rural or farm locations. The process can take between 12 to 16 weeks to complete (times can vary depending upon uncontrolled factors, such as temperature). The size of a windrow facility can vary but usually they will be between 1 and 3 Ha.

End Use

Local Authorities can use the final product - compost, on their parks, gardens and reclamation schemes, or it can be sold back to local residents.

In Vessel Composting (IVC)

Garden wastes and kitchen wastes (as well as catering food waste), including meat and fish, can be mixed together in a closed vessel or tunnel for treatment.

The Process

As the waste arrives at the facility it is shredded and screened, this means that any material that shouldn't be there such as plastic bags or bricks is taken out and the remaining material is broken up into smaller sized pieces.

As the waste is enclosed the composting process can be speeded up by pumping air into the waste, by either increasing or decreasing the water content of the waste and by increasing or decreasing the temperature within the tunnel or vessel.

The amount of air or water that needs to be added to the waste during the composting process depends on the composition of the green waste going in to it. For example, if the waste load has a high content of food waste then less water will be needed during the process because the food itself will have a lot of water contained inside it.



Photo: Inside an In Vessel Composter

Regulation

All IVC plants are regulated by the State Veterinary Service this is because (due to foot and mouth) they fall under a regulation called ABPR or the Animal By-Products Regulations. This regulation is in place because the IVC process enables the composting of meat and fish. This means that an inspector from the state veterinary service will visit the plant regularly and take samples of the compost product for analysis. As meat and fish are part of the material going into the plant that high standards of plant hygiene and maintenance must be carried out.

Location

The process takes place inside a tunnel or vessel building; this means that it could be more visible than open windrow composting.

End Use

A higher grade (better quality) of compost is achieved using the IVC method rather than Windrows. Local Authorities can use the final product (compost) on their parks, gardens and reclamation schemes, or it can be sold back to local residents.

Anaerobic Digestion

Another way of treating the garden and kitchen waste part of your rubbish is by using a treatment process call Anaerobic Digestion.

“Anaerobic digestion” means the breaking down of garden and kitchen wastes (organic waste) by bacteria in the absence of air (anaerobic).

The Process

After collecting your garden and kitchen waste from your kerbside or from your local civic amenity site a local authority using this facility would transport it to the site for processing. On arrival at the facility the waste would be shredded and any material that shouldn't be in the waste (contaminants) such as plastics or other household waste is separated. The material is then fed into an enclosed vessel such as the ones displayed in the pictures below, and heated. As the material heats and breaks down a biogas (a green gas) is produced. This gas is made of a mixture of (mostly) methane and carbon dioxide. The gas is captured as part of the process and can be used to generate either heat or electricity. The 'digestion' process also produces a digestate which is a liquid which has some of the green waste (woody fragments) remaining in it. The digestate can be filtered so that the solid and liquid parts are separated and then either recycled back into the process or used as a soil improver or added to compost products, or composted to improve its quality. The end use of the digestate depends on what waste has been used in the process. If food waste containing meat and fish has been used then the digestate will need to be regulated under the Animal By-Products Regulations in the same way that the compost from an In Vessel composter is regulated.



Photo: Anaerobic Digester in Tel Aviv

End Use

The resulting compost like material can be used as soil conditioner and the biogas can be sold as fuel or combusted, e.g. in gas engines to generate electricity.

Location



Photo: Anaerobic Digester

There are currently many Anaerobic Digestion plants across the UK being used to treat sewage sludge by water companies. At the moment there are only two purpose built plants treating household waste – one in Devon and one in Leicester. The plants look no different to other industrial facilities and will be between 1 and 3 Ha in size.

Biological Treatments Impacts

Any new house or industrial facility constructed will have some impact on the environment. This section considers some of the potential environmental impacts that the biological treatments discussed in this fact sheet might have.

Environmental Impacts and Benefits

Disposing of green waste and kitchen waste (biodegradable waste) in a landfill site can cause methane, which is one of the most powerful greenhouse gases to be produced. This is why targets have been set by the EU (European Union) to help us to divert the biodegradable part of our household rubbish away from landfill. These technologies are LAS (Landfill Allowance Scheme) compliant. The compost and digestate produced from all of these processes (after being appropriately treated) can have lots of benefits for your soil, replacing lost nutrients and helping your plants to grow.

Odour

If the composting process is not controlled carefully the waste being treated could start to smell. Each process must be carefully monitored to make sure that they occur at the right temperature and speed. All waste treatment

facilities are strictly managed and will have systems in place to limit odour. The In Vessel and Anaerobic Digestion facilities are enclosed and would be fitted with ventilation and filter systems to prevent odour and dust from escaping. The Anaerobic Digestion process is what happens in a landfill site and needs careful control to stop gases from escaping.

Home composting and Windrow composting are similar as they are both open to the air. If the material that is going into the process is strictly monitored then unpleasant odours should not be produced. As with all waste treatment facilities the Environment Agency strictly monitors operation.

Noise

The main noise coming from these facilities will be produced from vehicle movements. As with all industrial facilities hours of operation will be limited to times of the day that will not cause a nuisance to the local community.

Vehicle Movements

The most environmentally friendly way to dispose of your green waste and kitchen waste is by using a compost bin in your back garden or at a personal or community allotment, this means that your waste requires no vehicle movements or limited vehicle movements to reach its final destination. Windrow composting, In Vessel composting and Anaerobic Digestion require some vehicle movements so that your waste can be collected either from the kerbside outside your house or from your local civic amenity site. All vehicle movements produce carbon dioxide, which is another greenhouse gas but is 21 times less strong than methane, so the treatment of organic waste is beneficial.

During the planning stages for the facility the number of proposed vehicle movements will be taken into consideration and the access to the site and its impact on the local community will also be considered.

Emissions & Health

Composting uses a natural process that goes on all around us in the environment. As such the emissions from composting processes are also emitted from natural processes (e.g. plant decay). Fungal spores are prevalent in the air that we breathe, and so, properly controlled in vessel composting plants will not significantly raise background levels of spores etc.

One of the emissions produced is carbon dioxide gas. This is released by vehicle movements needed to collect garden and kitchen waste from the kerbside and from civic amenity sites and businesses (catering waste) and take it to the facility. This can be reduced by using alternative fuel sources to power the collection vehicles.

Dust and Bio-aerosols (biological particles) could be produced as the waste is transferred from the collection vehicles into the facility and from movements within the facility. The impact of this is limited by staff working at the facility wearing the correct protective equipment and by the facility having enclosed collection areas and ventilation systems.

Gases (carbon dioxide and methane) are produced during the Anaerobic Digestion process. These gases are captured and can be used for energy and heat production.

Water run-off from composting processes is carefully monitored and facilities have special equipment to capture and treat it. The closeness to watercourses and underground water will be taken into consideration during the planning process. Again, this is closely monitored by the Environment Agency.

Visual Impact

As can be seen from the pictures these facilities look no different to other industrial facilities. Many of them are already in operation around the country. Planning conditions will suggest that any new facility that is built should be in keeping with the surrounding area whether that is an industrial estate or a rural setting to ensure that it does not stand out.

Costs

If the biodegradable fraction (green waste and kitchen waste) of our rubbish cannot be diverted from landfill then the EU will fine the UK for every tonne of organic waste it continues to send to landfill. To avoid the fines and to find more sustainable (reducing waste produced, recycling, composting and recovering energy from waste instead of disposing of it in Landfill) ways of dealing with our waste local authorities are considering a number of different options to treat their waste. There is no right or wrong combination of options and each local authority might have a different set of facilities depending on local circumstances. These facilities will cost a lot of money and it is important that all the options are evaluated when the decisions are made. The cheapest option is not necessarily the best and what seems like a good option for the present might not be a good choice for 10 or 20 years time.

The cost of a treatment facility can be dependant on many things – the cost of land, whether the current collection system that your local authority has will need changing, what other facilities your local authority is considering and whether this option will work well with them are just a few of the considerations.

Where does this fit in?

Biological treatments deal with one part of your rubbish – the green and kitchen waste. Other

technologies are still needed to treat the other materials that we throw away as part of our weekly rubbish. These treatment facilities can either be built on a site on their own or can be positioned next to each other on a larger site. The location and type of facility that your local authority chooses will be dependent on a number of factors including available land, transport access, how close the site is to local houses and how much it will cost.

What can I do?

You are producing the waste that your local authority has to deal with and treat. To help your local authority and the environment there are a number of ways you can make a difference. Firstly by thinking about the rubbish that you produce at the moment – how can you reduce it? Can you recycle or compost more of your waste? Secondly, take an interest in what your local authority is considering. They will be making some tough decisions soon and how your waste will be treated over the next 20 to 30 years. Take part in any consultation process, find out more about what they are considering and tell your neighbours! We all produce rubbish and we need to start taking responsibility for how we dispose of it. To find out more about what your local authority are considering get in touch with them or read their proposed waste strategy. Your opinion counts!



For additional information visit:
www.wasteawarenesswales.org.uk



Mechanical Biological and Mechanical Heat Treatment (MBT and MHT)

Fact Sheet 5

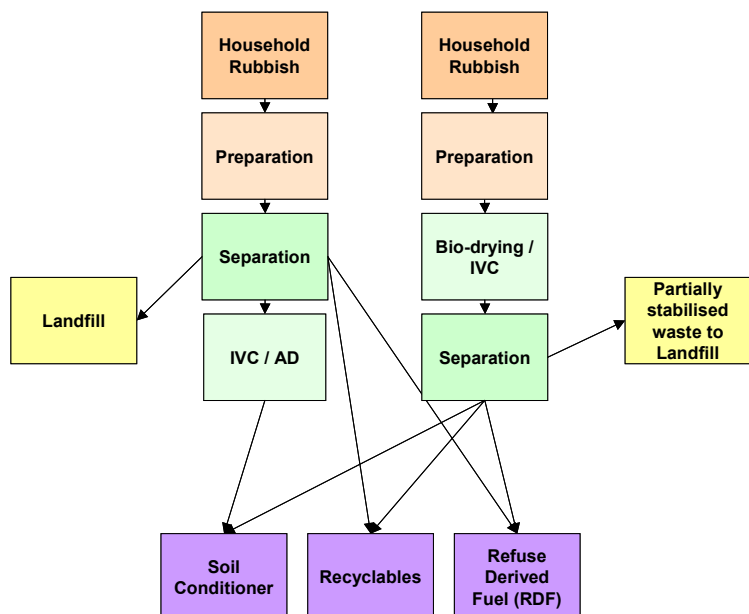
This fact sheet focuses on mechanical biological (MBT) and mechanical heat treatments (MHT). The treatments displayed are ways of separating your mixed rubbish or 'residual' waste, after household recycling has taken place. The waste is split into the biological parts (kitchen and garden waste) and the remaining parts (plastics, cans, glass etc.) and then treating them.

Your local authority might collect your garden (and perhaps kitchen waste) separately from your recyclables and residual waste (this is the name for the waste that hasn't been separated, it's often called 'black sack' rubbish). This collection system is good for separating recyclable and compostable material from your rubbish but it won't capture any materials that are left in your residual waste that might be potentially recyclable or compostable. Mechanical Biological Treatment (MBT) and Mechanical Heat Treatment (MHT) can capture and treat anything that's left in your rubbish bag.

Mechanical Biological Treatment

Mechanical Biological Treatment (MBT) is a term that is used to describe a number of different approaches to managing the residual waste. The main difference between the approaches is the stage at which the biological part of the waste (garden and kitchen waste) is treated – either before or after the mechanical separation of the waste.

The Process



Collection and Preparation

Your household rubbish will be collected from your kerbside and taken to the MBT plant. After being deposited in the facility it will be mixed and shredded (or similar) so that the waste is evenly mixed and of equal size.

Separation

The separation step can either come before the treatment of the biological part of the waste (mechanical biological treatment) or after (biological mechanical treatment). There are a number of different ways that the waste can be separated, here are a few of the more common methods:

- **Screens** can help to remove the larger pieces of waste,
- **Magnetic separation** can remove the ferrous metals (cans made of tin)
- **Eddy current separation** can remove the non ferrous metals (cans made of aluminium),
- **Optical separation** can separate certain types of plastics
- **Air classification** can help to separate light and heavy materials (paper for example).

Once separated some of the materials can go on for further recycling, for example the glass collected can go on to be used as low grade aggregate (a material often used in the construction of roads as a substitute for sand).

The materials recovered are of a lower quality than those materials collected separately as part of your kerbside recyclables collection and this can be a problem when looking for markets to sell the materials. It is always preferable in Wales that recyclables are collected separately from households, as this provides cleaner, better quality materials. These materials are more desirable and obtain a higher market value.



Photo: An MBT facility in Cologne

Biological Treatment

There are several biological treatment options for the biological (kitchen and garden) part of the waste, these include:

Biodrying/Biostabilisation

Air is forced through the waste to try and 'dry' it. This reduces the mass (weight and volume) of waste and starts to degrade (break down) the biological part of the waste. This process can make the waste easier to separate and can also give the waste a higher calorific value (energy content) as it removes nearly all of the non-combustible water, which means that it will produce more energy if it is burnt.

In Vessel Composting

The waste is enclosed in a vessel to be composted. As the process is enclosed the composting process can be speeded up by pumping air into the waste, by either increasing or decreasing the water content of the waste and by increasing or decreasing the temperature within vessel.

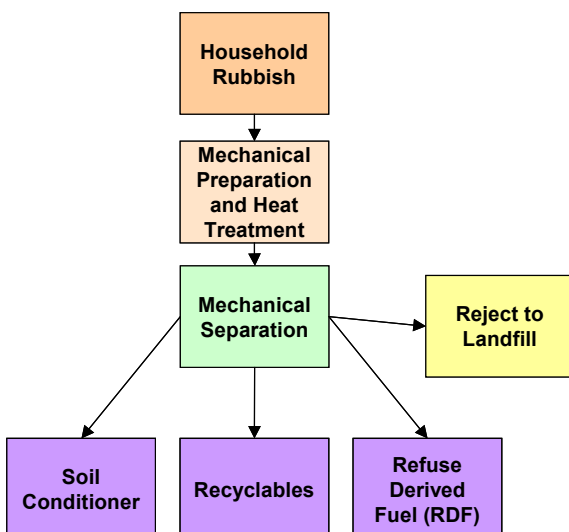
Anaerobic Digestion

The waste is fed into an enclosed vessel and heated. As the material heats and breaks down a biogas (a green gas) is produced. This gas is made of a mixture of (mostly) methane and carbon dioxide. The gas is captured as part of the process and can be used to generate either heat or electricity. The 'digestion' process also produces a digestate, which is a liquid with some of the green waste (woody fragments) remaining in it. The digestate can be filtered so that the solid and liquid parts are separated and then either recycled back into the process or used as a soil improver or added to compost.

Mechanical Heat Treatment

Mechanical Heat Treatment (MHT) is a term that is used to describe a number of different processes that involve the mechanical (separation) and thermal (heat) treatment of waste.

The Process



Collection and Preparation

Your household rubbish will be collected from your kerbside and taken to the MHT plant. After being deposited in the facility it will be mixed and shredded (or similar) so that the waste is evenly mixed and of equal size.

Heat Treatment

The most common method of heat treatment currently being used in this way is **Autoclaving**. This method is a steam treatment process that is often used for treating clinical (hospital) waste. Waste is processed for about an hour in a pressurised container to reduce the material to what is known as a 'flock'. Metals and glass will be partially cleaned by the process and can be removed and recycled. Plastics become deformed in the process and some types become suitable for recycling whereas others become very difficult to recycle. Once recyclables have been removed, the remaining material is used as fuel in a thermal heating process to produce energy & heat.

Separation

The separation step will follow a similar process to that described for MBT, which is a combination of screens, magnetic separation, eddy current separation, optical separation and air classification, all to allow recyclables to be extracted from the waste. The types of separation equipment used will be determined by the type of waste being accepted and the materials that are being targeted for extraction.

End Use

The MBT and MHT processes provide a number of end uses for the waste material that is processed. The quality of the end products will depend upon which process is used and in what order the stages are followed.

The biological material (e.g. soil conditioner) that can be recovered from the MBT and MHT process is of a lower quality compared to the products that would come from a separate biological treatment process, this is because it would be very difficult to remove a lot of the mixed waste material (plastics etc) from the product. As the material has been in contact with meat and fish while it was part of the mixed rubbish it would also have to be tested and approved under the Animal By-Products Regulations. The material could be used in landfill restoration or perhaps in engineering and in contaminated land clean-up.

The materials recovered from both MBT and MHT processes are of different quality. The material recovered from the MBT process is generally of poor quality and only some types can be recycled. MHT can produce some materials of better quality such as glass and tins and cans (metal), this is because they are steam cleaned as part of the

process which removes all the labels and glue that are usually stuck on them.

If material is of a very low quality or cannot be used as part of a fuel product (see below) it will have to go to landfill. However, this material will usually be stable and will not contribute to the landfill allowances.

Refuse Derived Fuel

Both MBT and MHT can be set up to produce a high energy (calorific value) fuel called RDF or Refuse (rubbish) Derived (made from) Fuel. This fuel must have a high amount of paper, plastics and card so that it is able to produce energy. The fuel can be burnt in regular combustion plants such as energy from waste facilities or cement kilns or in specially built facilities..

Location

Facilities of this type would again expect to have lots of vehicle movements (similar to a landfill site) both to and from the plant and so should be sited close to established road /rail infrastructure.



Photo: an MBT plant in Leicester

MBT and MHT Impacts

Any new house or industrial facility constructed will have some impact on the environment. This section considers some of the specific potential environmental impacts that the mechanical biological treatment and mechanical heat treatments discussed in this fact sheet might have.

Environmental Impacts and Benefits

Disposing of green waste and kitchen waste (biodegradable waste) in a landfill site can cause methane, which is one of the most powerful greenhouse gases. This is why targets have been set by the EU (European Union) that require us to divert the biodegradable part of our household rubbish away from landfill.

Odour / Dust / Litter

If the biological treatment process is not controlled carefully the waste being treated could smell as it is biodegrading (as with all biological treatment options).

All waste treatment facilities are strictly regulated and will have systems in place to limit odour. The MBT and MHT facilities are enclosed and would be fitted with ventilation and filter systems to prevent odour and dust from escaping.

The Environment Agency strictly monitors operation and good practise during operation. Good design of the plant during the planning stage can stop odour, dust and litter at the site.

Noise

The main noise coming from these facilities will be produced from vehicle movements and from the mechanical processing of the waste and air ventilation systems. As with all industrial facilities hours of operation will be limited to times of the day that will not cause a nuisance to the local community.

Vehicle Movements

Both MBT and MHT require some vehicle movements so that your waste can be collected either from the kerbside outside your house or from your local civic amenity site and taken to the site. All vehicle movements produce carbon dioxide, which is a greenhouse gas which is 21 times less potent than methane (produced in landfill sites as waste degrades anaerobically).

During the planning stages for the facility the number of proposed vehicle movements will be taken into consideration and the access to the site and its impact on the local community will also be assessed.

Vehicle movements from the site could be reduced if the facility was located with other waste management treatment facilities, or near to a rail line or canal. Alternatively, siting a manufacturing company next to such a facility would ensure a local demand for the products and limit onward transportation.

Emissions & Health

One of the emissions produced by all of these processes is carbon dioxide gas, released by vehicle movements needed to collect waste from the kerbside and from civic amenity sites. This can be reduced by using alternative fuel sources to power the collection vehicles.

Dust and Bio-aerosols (biological particles) could be produced as the waste is transferred from the collection vehicles into the facility and from movements within the facility. The impact of this is

limited by staff working at the facility wearing the correct protective equipment. The facilities are enclosed thus limiting emissions to the environment and have efficient ventilation systems.

Gases (carbon dioxide and methane) are produced during the Anaerobic Digestion process. These gases are captured and can be used for energy and heat production.

Emissions will be produced during the burning of the fuel, as with all thermal treatment options. The outputs will be controlled by existing legislation and emissions limits set in EU policy and monitored by the Environment Agency.

The Department for Environment, Food and Rural Affairs have recently commissioned a review of the effects of waste management. It concluded that although the information is incomplete and not ideal, the weight of evidence from studies so far indicates that present day practice for managing solid municipal waste has, at most, a minor effect on human health and the environment, particularly when compared to other everyday activities.

Visual Impact

As can be seen from the pictures these facilities look no different to other industrial facilities. The UK currently has a few MBT plants in operation and there are over 70 plants running in Europe, most of which are in Germany.

Planning conditions will suggest that any new facility built should be in keeping with the surrounding area whether that is an industrial estate or a rural setting.

Costs

If the biodegradable fraction (green waste and kitchen waste) of our rubbish cannot be diverted from landfill then the EU will fine the UK for every tonne of waste it continues to send to landfill. To avoid the fines and to find more sustainable ways of dealing with our waste local authorities are considering a number of different options to treat their waste.

There is no right or wrong combination of options and each local authority might have a different set of facilities depending on local circumstances. These facilities will cost a lot of money and it is important that all the options are evaluated when the decisions are made. The cheapest option is not necessarily the best and what seems like a good option for the present might not be a good choice for 10 or 20 years time.

The cost of a treatment facility can be dependant on many things: the cost of land, the current collection system, what other facilities your local

authority is considering and whether this option will work well with them are just a few of the considerations.

Where does this fit in?

This treatment will not act as a stand-alone treatment and will need other types of facilities to be able to treat its outputs. These treatment facilities can either be built on a site on their own or can be positioned next to each other on a larger site.

The location and type of facility that your local authority chooses will be dependent on a number of factors including available land, transport access, how close the site is to local houses and how much it will cost.

What can I do?

You are producing the waste that your local authority has to deal with and treat. To help your local authority and the environment there are a number of ways you can make a difference.

Firstly think about the rubbish that you produce at the moment, and consider how you could reduce it? Can you recycle or compost more of your waste?

Secondly, take an interest in what your local authority is considering. They will be making some tough decisions soon about how your waste will be treated over the next 20 to 30 years. Take part in any consultation process, find out more about what they are considering and tell your neighbours! We all produce rubbish and we need to start taking responsibility for how we dispose of it. To find out more about what your local authority are considering get in touch with them or read their proposed waste strategy. Your opinion counts!



Photo: Refuse Derived Fuel MBT plant in Italy

For additional information visit:
www.wasteawarenesswales.org.uk



Thermal Treatments

Fact Sheet 6

This fact sheet focuses on thermal (heat) treatments. The following treatments are described:

- **Energy from waste (EfW), Incineration and Combined Heat and Power (CHP)**
- **Advanced Thermal Treatments**
 - **Pyrolysis**
 - **Gasification**

The treatments displayed here all deal with ways of recovering energy (heat, electricity or fuel) from your rubbish. The table below shows an overview of the different energy forms that can be produced using each of the technologies.

Treatment	Oxygen Level	Energy Form
Energy from Waste (Incineration)	Excess of Oxygen	Heat, Electricity
Gasification	Limited Oxygen	Gas, Char
Pyrolysis	Absence of Oxygen	Gas, Char, Liquid (Oil)

After you have separated everything that you can recycle and compost from your rubbish the material that remains (your 'black sack' rubbish) needs to be treated. Thermal treatments are one of the ways of treating this rubbish.

Energy from Waste

Energy from Waste is a general description for all the technologies that can be used to gain (generate) energy from treating our rubbish. It is commonly used to describe the Incineration process where rubbish is burnt to produce heat and/or electricity. Incineration without energy recovery is no longer allowed under UK law. This section of the fact sheet will describe the energy from waste process.

The Process

The flow diagram below illustrates the general operation of an energy from waste facility.

Collection

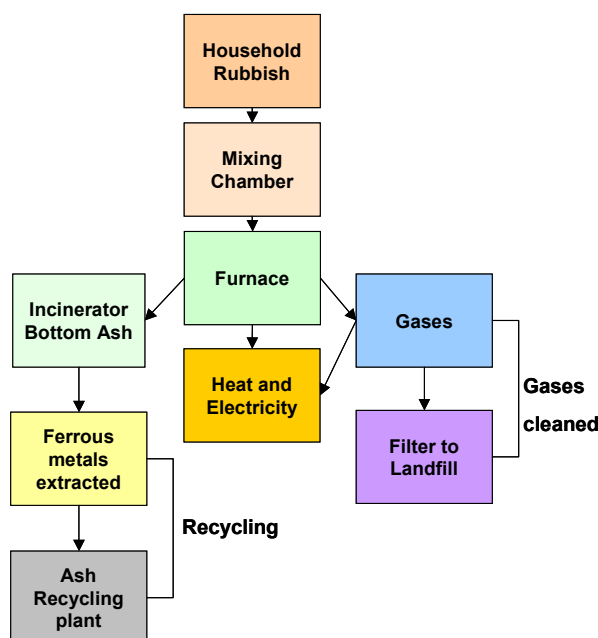
When your household rubbish (black sack rubbish) is collected from your kerbside there are several options as to where it can go next. It could either go straight to an EfW plant for treatment, or it could go to a Biological treatment plant (MBT/BMT/MHT) for pre-treatment facility (see fact sheet 4).

The route it takes depends on your local authority and what their current kerbside and household waste recycling centre (HWRC) recycling and composting collection schemes are. Some Local Authorities will use a biological treatment step before EfW so that any materials that are currently not separated from your rubbish for recycling are captured and recycled. Other local authorities have decided that they can collect enough good quality material for recycling through their kerbside collections and HWRCs that they do not need a pre-treatment step.

Your rubbish arrives at the EfW facility either directly from the kerbside as mixed rubbish ('black sack' rubbish), or as rubbish that has been pre-treated and might be in the form of either mixed rubbish (after some materials have been taken out) or as 'Refuse Derived Fuel' (RDF). This is a high energy fuel made from rubbish and can be burnt in the same way as mixed rubbish in an EfW facility to produce heat and/or electricity.

Preparation

When the rubbish arrives it is tipped into a large bunker and thoroughly mixed to help it to burn evenly when it reaches the furnace. In order for it to reach the furnace the rubbish must be put (by crane) into a feed hopper, this allows the facility to control how much rubbish is burnt at a time.



The Furnace

When the rubbish reaches the furnace a series of grate bars move the waste through the furnace where it is dried and burned at temperatures of around 1000°C. The rubbish stays in the furnace for 30 – 90mins during which time it (generally) goes through two stages.

During the first stage the rubbish is burnt at a very high temperature and in the presence of oxygen, so that as it burns it turns into gas (Carbon and Hydrogen present in the rubbish converts to Carbon Dioxide and Water). This stage lasts for almost as long as the rubbish is in the furnace for. The second stage lasts for only a couple of seconds. All the gas and particles released during the first stage are then burnt to make sure that complete burning (combustion) occurs.



Photo: The Marchwood Incinerator in Hampshire, one of three county incinerators

Incinerator Bottom Ash (IBA)

Even though the furnace in an incinerator reaches very high temperatures not everything in the rubbish will burn. The ash from the burned waste drops into a 'quench tank' then along a conveyor to a storage pit. Magnets above the conveyor attract the ferrous metals (iron) from the ash for recycling. The remaining IBA is sent to an Ash Recycling plant and can be used as a construction material for building roads (aggregates substitute).

Gases

Hot flue (chimney) gases produced by the furnace during the burning process travel through a boiler transferring the heat produced to water running through the boiler pipes. The hot water creates steam and the steam drives turbines (engines), which create electricity.

Gases from the burned waste are thoroughly cleaned by a flue gas cleaning system; some chemicals are added during this process to help the clean up. Lime is added into the gas stream to neutralise acid gases, this stops the gases from being acidic. Activated carbon is added to remove dioxins and heavy metals.

The gas passes through a gashouse filter (a filter made of fine fabric) that captures any particles before the now cleaned gas can be released through the chimney. Collected particles from the fabric filter are stored before being sent to a landfill site that can accept hazardous waste.

Location

Facilities of this type would again expect to have lots of vehicle movements both to and from the plant (similar to a landfill site) and so should be sited close to established road infrastructure.

Energy from Waste Impacts

Any new house or industrial facility constructed will have some impact on the environment. This section considers some of the potential environmental impacts that energy from waste facilities might have.



Photo: A Danish EFW Facility

Environmental Impacts and Benefits

Energy from waste facilities should be considered as one piece of the jigsaw when considering what to do with your rubbish. After everything that can be recycled or composted has been they provide a method of disposing of rubbish that is not in a landfill site and which can produce useful energy in the form of electricity and heat.

Odour / Dust / Litter

All waste treatment facilities are strictly regulated and will have systems in place to limit odour. Energy from waste facilities are enclosed and fitted with ventilation and filter systems to prevent odour and dust from escaping. As with all waste treatment facilities the Environment Agency strictly monitors operation and good practise during operation and good design of the plant during the planning stage can stop odour, dust and litter at the site.

Noise

The main noise coming from these facilities will be produced from vehicle movements and from the mechanical processing of the waste and air ventilation systems. As with all industrial facilities, hours of operation will be limited to times of the day that will not cause a nuisance to the local community.

Vehicle Movements

Energy from waste facilities require some vehicle movements so that your waste can be collected either from the kerbside outside your house or from your local civic amenity site and taken to the site. All vehicle movements produce carbon dioxide, which is another green house gas but is 21 times less potent than methane, which is produced when rubbish breaks down in a landfill site under anaerobic conditions.

During the planning stages for the facility the number of proposed vehicle movements will be taken into consideration and the access to the site and its impact on the local community will also be considered to minimise these impacts. Vehicle movements from the site could be reduced if the facility was located with other waste management treatment facilities or an operation that might be able to use one of the end products from its operation.

For an average sized plant that would accept 50,000 tonnes of waste per year Defra have estimated that up to 20 refuse collection vehicles per day would be anticipated.

Emissions & Health

Virtually all combustion processes produce hazardous or toxic emissions; they are an inevitable output of thermal processing. Such everyday combustion processes include smoking cigarettes, garden bonfires, BBQs, domestic coal fires etc, as well as industrial processes such as power generation. Only some of these combustion processes are subject to emission controls.

All energy from waste plants must comply with the Waste Incineration Directive (WID). This directive ensures that the gases (flue gases) produced by the facility and released into the air are thoroughly cleaned and constantly monitored. Emission levels allowed by the directive are a lot stricter than for coal fired power stations. The Environment Agency regularly checks that each facility has cleaning systems that are in good working order and that records are kept of all emissions.

Dust and Bio-aerosols (biological particles) could be produced as the waste is transferred from the collection vehicles into the facility and from movements within the facility. The impact of this is limited by staff working at the facility wearing the correct protective equipment and by the facility having enclosed collection areas and ventilation systems.

Compliance with modern regulatory requirements (such as WID), should mean that there will be little contribution to the concentrations of monitored pollutants in ambient air. Epidemiological studies, and risk estimates based on estimated exposures,

indicate that the emissions from such incinerators have little effect on health. The Environment Agency, not least through its role in advising Primary Care Trusts and Local Health Boards as statutory consultees for Pollution Prevention and Control (PPC), will continue to work with regulators to ensure that incinerators do not contribute significantly to ill-health.

The Health Protection Agency has considered studies examining adverse health effects around incinerators and is not aware of any consistent or convincing evidence of a link with adverse health outcomes. However, it is accepted that the lack of evidence of adverse effects might be due to the limitations regarding the available data.

The Department for Environment, Food and Rural Affairs have recently commissioned a review of the effects of waste management. Cancer, respiratory disease and birth defects were all considered, and no evidence was found for a link between the incidence of the diseases and the current generation of incinerators. It concluded that although the information is incomplete and not ideal, the weight of evidence from studies so far indicates that present day practice for managing solid municipal waste has, at most, a minor effect on human health and the environment, particularly when compared to other everyday activities.

Visual Impact

Large energy from waste facilities (over 200,000 tpa) can cover around 4Ha of land. The siting of these facilities will be carefully considered and will depend upon a number of factors. The site should have a good road network as refuse collection vehicles will need access everyday. The electricity and heat generated by the plant might be used locally, if so the plant should be fairly close to either a power plant or to an industrial facility that could take advantage of the energy produced.

Planning conditions will suggest that any new facility built should be in keeping with the surrounding area whether that is an industrial estate or a rural setting. Good design of plants can help to limit their visual impact. The largest stack (chimney) height a facility would have is around 70m high but as the picture of the Marchwood facility shows it can be made to blend in to the overall look of the facility.

Costs

If the biodegradable fraction (green waste and kitchen waste) of our rubbish cannot be diverted from landfill then the EU will fine the UK for every tonne of waste it continues to send to landfill. To avoid the fines and to find more sustainable ways of dealing with our waste local authorities are considering a number of different options to treat their waste. There is no right or wrong

combination of options and each local authority might have a different set of facilities depending on local circumstances. These facilities will cost a lot of money and it is important that all the options are evaluated when the decisions are made. The cheapest option is not necessarily the best and what seems like a good option for the present might not be a good choice for 10 or 20 years time.

The cost of a treatment facility can be dependant on many things: the cost of land, the current collection system, what other facilities your local authority is considering and whether this option will work well with them are just a few of the considerations.

Energy from waste facilities are expensive and have long operating life spans but are currently used in Europe in many high recycling countries.

Size

The size of an energy from waste facility will depend on the individual local authority and what facilities are already in place. A large authority or a group of authorities may decide that they would like one or two larger facility whereas a smaller authority may want a smaller facility. One size does not fit all though as an authority may decide that several smaller facility is the right option. Facilities will vary from around 1-4Ha in size. Current facilities in the UK accept anything from 60,000 tpa to over 500,000 tpa.

Where does this fit in?

This treatment will not act as a stand-alone treatment and will need other types of facilities such as recycling facilities to form part of the whole picture. These treatment facilities can either be built on a site on their own or can be positioned next to each other on a larger site.

The location and type of facility that your local authority chooses will be dependent on a number of factors including available land, transport access, how close the site is to local houses and how much it will cost.



Photo: Isle of Man EfW facility

Advanced Thermal Treatments

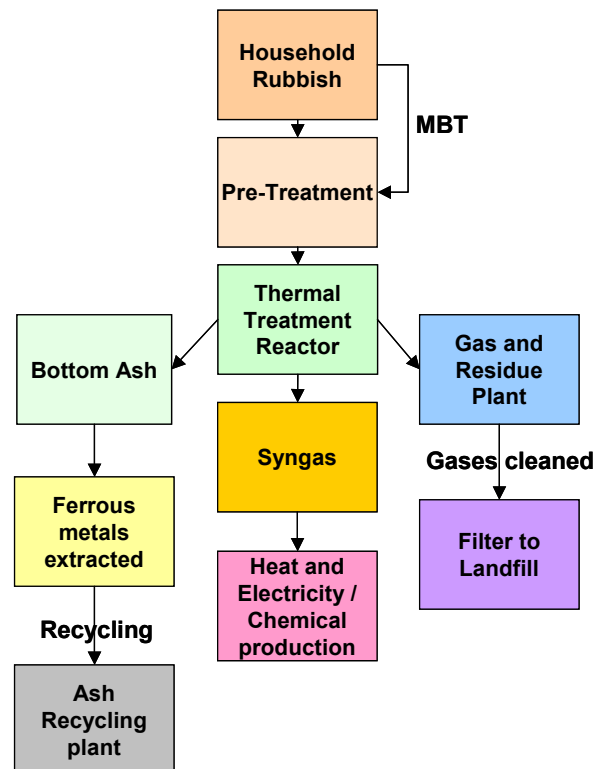
Advanced Thermal Treatments (ATT) are technologies that use heat to treat household rubbish. The two main types of treatment are called Gasification and Pyrolysis. These technologies have previously been used in the UK to produce fuels such as charcoal, coke and producer gas. Charcoal and coke are produced by pyrolysing wood and coal, and producer gas is a burnable (combustible) gas produced by the gasification of coke in the presence of air and steam.

Pyrolysis and Gasification

Pyrolysis and Gasification are very similar processes. The main difference between them is that Gasification occurs with a limited amount of oxygen and Pyrolysis occurs with no oxygen.

The Process

The flow diagram below illustrates the general operation of a Pyrolysis or Gasification facility.



Collection and Pre-Treatment

Both technologies prefer waste that has already been pre-treated so that all the non-burnable (combustible) materials such as metals and glass have been removed.

When your rubbish arrives at the Pyrolysis/Gasification facility it will be in the form of either mixed rubbish (after some materials have

been removed for recycling) or as 'Refuse Derived Fuel' (RDF) which had been pretreated. This is a high energy fuel made from rubbish and can be burnt in the same way as mixed rubbish in a Pyrolysis/Gasification facility to produce heat and/or electricity.

Preparation

When the rubbish arrives it is tipped into a thermal (heat) treatment reactor. In a Pyrolysis facility the rubbish is heated to around 500°C.

Gasification occurs at a higher temperature than Pyrolysis of around 1000-1200°C. Water is added to form hydrogen and oxygen (gases) which reacts further with the organic (carbon containing – green waste, plastics and paper/card) portion of the waste.

Products

Both processes produce Syngas, oils, and solid char and ash. The Syngas can either (after cleaning) be burnt to produce heat and power or can be used to produce some chemicals such as ammonia.

The oils produced can have different properties depending on what rubbish went into the plant. For example, higher levels of plastics will produce oils that have a higher heating value.

The ash produced comes from the solid material such as glass and stones that were not removed during pre-treatment. After treatment this can be used as aggregate for road building.

The carbon char is sand like, material that can be used as a coal replacement, or disposed of. The char often has a high heating value and can be subjected to gasification producing a fuel gas that can be mixed with the Syngas produced earlier in the process.

As part of the Defra demonstrator programme, a company called Novera are going to build a Gasification facility at the Ford motorcar plant in Dagenham, Essex. The plant will take 90,000 tonnes of refuse derived fuel (RDF) from the nearby MBT plant and will provide Ford with the equivalent of approximately £4 million per annum worth of electricity.

Gasification and Pyrolysis Impacts

Any new house or industrial facility constructed will have some impact on the environment. This section considers some of the potential environmental impacts that Gasification and Pyrolysis facilities might have.

Environmental Impacts and Benefits

Gasification and Pyrolysis facilities would be considered as one piece of the jigsaw when considering what to do with your rubbish. After everything that can be recycled and composted they provide a method of disposing of rubbish that is not in Landfill and that can produce useful energy in the form of electricity and heat and useful products such as Syngas that can be used in chemical production.

Odour / Dust / Litter

All waste treatment facilities are strictly regulated and will have systems in place to limit odour. Gasification and Pyrolysis facilities are enclosed and fitted with ventilation and filter systems to prevent odour and dust from escaping. As with all waste treatment facilities the Environment Agency strictly monitors operation and good practise during operation and good design of the plant during the planning stage can stop odour, dust and litter at the site.



Photo: A virtual image of an Advanced Thermal Treatment Plant

Noise

The main noise coming from these facilities will be produced from vehicle movements and from the mechanical processing of the waste and air ventilation systems. As with all industrial facilities hours of operation will be limited to times of the day that will not cause a nuisance to the local community.

Vehicle Movements

During the planning stages for the facility the number of proposed vehicle movements will be taken into consideration and the access to the site and its impact on the local community will also be considered. Vehicle movements from the site could be reduced if the facility was located with other waste management treatment facilities such as an MBT plant or an operation that might be able to use one of the end products from its operation such as a manufacturing plant. For an average sized plant that would accept 50,000 tonnes of waste per year Defra have estimated

that up to 20 refuse collection vehicles per day would be anticipated.

Emissions & Health

Virtually all combustion processes produce hazardous or toxic emissions; they are an inevitable output of thermal processing. Such everyday combustion processes include smoking cigarettes, garden bonfires, BBQs, domestic coal fires etc, as well as industrial processes such as power generation. Only some of these combustion processes are subject to emission controls.

All energy from waste plants must comply with the Waste Incineration Directive (WID). This directive ensures that the gases (flue gases) produced by the facility and released into the air are thoroughly cleaned and constantly monitored. Emission levels allowed by the directive are a lot stricter than for coal fired power stations. The Environment Agency regularly checks that each facility has cleaning systems that are in good working order and that records are kept of all emissions.

Dust and Bio-aerosols (biological particles) could be produced as the waste is transferred from the collection vehicles into the facility and from movements within the facility. The impact of this is limited by staff working at the facility wearing the correct protective equipment and by the facility having enclosed collection areas and ventilation systems.

Compliance with modern regulatory requirements (such as WID), should mean that there will be little contribution to the concentrations of monitored pollutants in ambient air. Epidemiological studies, and risk estimates based on estimated exposures, indicate that the emissions from such incinerators have little effect on health. The Environment Agency, not least through its role in advising Primary Care Trusts and Local Health Boards as statutory consultees for Pollution Prevention and Control (PPC), will continue to work with regulators to ensure that incinerators do not contribute significantly to ill-health.

The Health Protection Agency has considered studies examining adverse health effects around incinerators and is not aware of any consistent or convincing evidence of a link with adverse health outcomes. However, it is accepted that the lack of evidence of adverse effects might be due to the limitations regarding the available data.

The Department for Environment, Food and Rural Affairs have recently commissioned a review of the effects of waste management. Cancer, respiratory disease and birth defects were all considered, and no evidence was found for a link between the incidence of the diseases and the current generation of incinerators. It concluded

that although the information is incomplete and not ideal, the weight of evidence from studies so far indicates that present day practice for managing solid municipal waste has, at most, a minor effect on human health and the environment, particularly when compared to other everyday activities.



Photo: A Gasification pilot plant in Karlsruhe

Visual Impact

Large Gasification and Pyrolysis facilities can cover around 2Ha of land. The siting of these facilities will be carefully considered and will depend upon a number of factors. The site should have a good road network as refuse collection vehicles will need access everyday.

The electricity and heat generated by the plant might be used locally, if so the plant should be fairly close to either a power plant or to an industrial facility that could take advantage of the energy produced.

Planning conditions will suggest that any new facility built should be in keeping with the surrounding area whether that is an industrial estate or a rural setting. Good design of plants can help to limit their visual impact. The largest stack (chimney) height a facility would have is around 70m high but it can be made to blend in to the overall look of the facility.

Costs

If the biodegradable fraction (green waste and kitchen waste) of our rubbish cannot be diverted from landfill then the EU will fine the UK for every tonne of waste it continues to send to landfill. To avoid the fines and to find more sustainable ways of dealing with our waste local authorities are considering a number of different options to treat their waste. There is no right or wrong combination of options and each local authority might have a different set of facilities depending on local circumstances.

These facilities will cost a lot of money and it is important that all the options are evaluated when the decisions are made. The cheapest option is not necessarily the best and what seems like a

good option for the present might not be a good choice for 10 or 20 years time.

The cost of a treatment facility can be dependant on many things – the cost of land, whether the current collection system that your local authority has will need changing, what other facilities your local authority is considering and whether this option will work well with them are just a few of the considerations.

Gasification and Pyrolysis facilities are expensive and have long operating life spans but are currently used in Europe and Japan.

Size

The size of Gasification and Pyrolysis facilities will depend on the individual local authority and what facilities are already in place. A large authority or a group of authorities may decide that they would like one or two larger facility whereas a smaller authority may want a smaller facility. One size does not fit all though as an authority may decide that several smaller facility is the right option. Facilities will vary from around 0.9 -4Ha in size.

Where does this fit in?

This treatment will not act as a stand-alone treatment and will need other types of facilities such as recycling facilities to form part of the whole picture. These treatment facilities can either be built on a site on their own or better still can be positioned next to each other on a larger site. The location and type of facility that your local authority chooses will be dependent on a number of factors including available land, transport access, how close the site is to local houses and how much it will cost.



Photo: A Gasification plant, Norway

What can I do?

You are producing the waste that your local authority has to deal with and treat. To help your local authority and the environment there are a number of ways you can make a difference.

Firstly think about the rubbish that you produce at the moment, and consider how you could reduce

it? Can you recycle or compost more of your waste?

Secondly, take an interest in what your local authority is considering. They will be making some tough decisions soon about how your waste will be treated over the next 20 to 30 years. Take part in any consultation process, find out more about what they are considering and tell your neighbours!

We all produce rubbish and we need to start taking responsibility for how we dispose of it. To find out more about what your local authority are considering get in touch with them or read their proposed waste strategy. Your opinion counts!

For additional information visit:
www.wasteawarenesswales.org.uk



Materials Recovery Facilities and Transfer Stations

Fact Sheet 7

This fact sheet focuses on materials recovery facilities or MRFs and transfer stations.

Transfer Station

As the name suggests, a transfer station is a place where either waste or recyclables can be stored temporarily before it is moved on for treatment or disposal.

MRF

A Materials Recovery facility is a place where recyclables are separated from one another, prior to transportation to reprocessors. They enable mixed recyclables (from commingled collections) to be separated and segregated using a variety of machinery and manual handling,

Recycling is very important and all local authorities are now asking everyone to collect and separate lots of different materials for recycling. Different local authorities have different ways of collecting the materials it needs to recycle. The methods they use depend on what facilities are available in the local area to recycle and reprocess the materials you put out for collection. Some local authorities use bins, boxes or bags into which you can put lots of different materials for recycling. When these materials are collected together, they need to be separated so that the individual materials can go to the appropriate reprocessors.

The Process

The picture overleaf shows what can commonly happen inside an MRF. Each MRF is different and can accept different materials, for which it has been specifically designed. Some of the more common materials that can be separated from a mixed recyclables collection include:

- Paper
- Glass
- Plastic Bottles
- Tins and Cans
- Textiles

Collection and Preparation

Your household rubbish will be collected from your kerbside and taken to the MRF by recycling collection vehicles. The material will be tipped at a central point (the tipping floor) ready to be fed into the facility.

Separation

Once your recyclables have been deposited into a storage pit, they are slowly fed onto a series of conveyor belts to begin their trip around the facility. Each area in the plant helps to separate one type of recyclable material from another. There are a number of different ways in which this can happen. Here are a few of the more common methods:

- **Screens/Trommels** can help to remove the larger pieces of recyclables (cardboard, glass etc.)
- **Magnetic separation** can remove the ferrous metals (cans made of tin)
- **Eddy current separation** can remove the non ferrous metals (cans made of aluminium)
- **Optical separation** can separate certain types of plastics such as the different types of plastic bottles that can be collected, or glass.
- **Air classification** can help to separate light and heavy materials (paper for example)

Recycling and Reprocessing

Once separated, some of the materials can go on for further recycling. For example the glass collected can go on to a reprocessor where it be used as low grade aggregate (a material often used in the construction of roads as a substitute for sand).

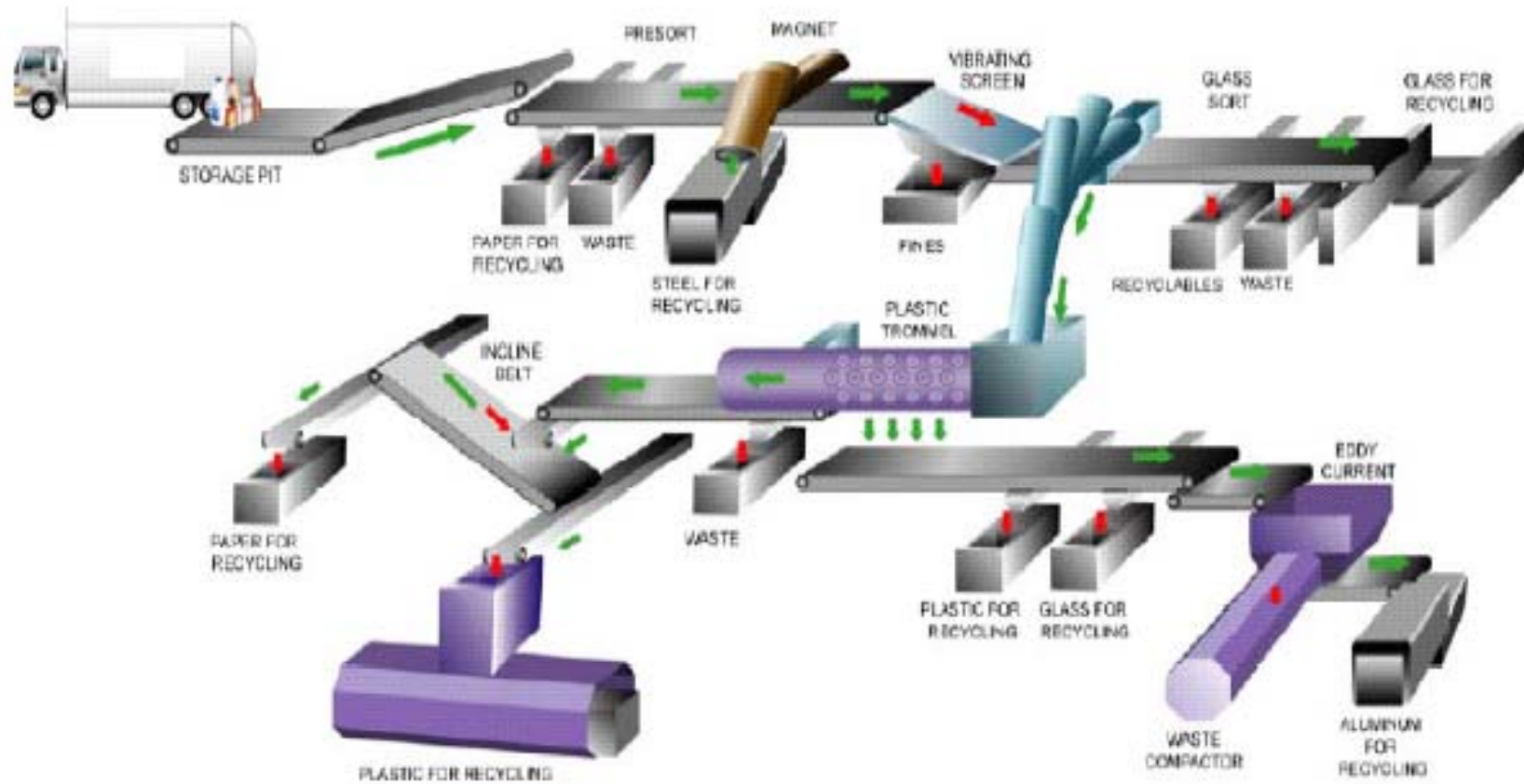
Each of the material streams are collected independently at the end of the MRF and can be compacted and baled. This way they can be transported easily and then taken to a reprocessing facility so that they can be turned into new products.

Any materials that have been collected with the recyclables by accident and cannot be recycled are separated and bulked together. These materials must be disposed of and can be sent to an energy from waste facility, or other treatment facility or to a landfill site. It is important to try and recycle the correct items in your kerbside collection bin box or bag so that there is limited material that has to be sent for treatment and disposal.

Location

Facilities of this type would again expect to have lots of vehicle movements (similar to a landfill site) both to and from the plant and so should be sited close to established road/rail infrastructure.

MRF Layout



MRF Impacts

Any new house or industrial facility constructed will have some impact on the environment. This section considers some of the specific potential environmental impacts that a Materials Recovery Facility, as discussed in this fact sheet, might have.

Environmental Impacts and Benefits

Disposing of green waste and kitchen waste (biodegradable waste) in a landfill site can cause the release of methane, which is one of the most powerful greenhouse gases. This is why targets have been set by the EU (European Union) that require us to divert the biodegradable part of our household rubbish away from landfill.

Odour/Dust/Litter

All waste treatment facilities are strictly regulated and will have systems in place to limit odour. MRFs are enclosed and would be fitted with ventilation and filter systems to prevent odour and dust from escaping.

The Environment Agency strictly monitors operation and good practise during operation. Good design of the plant during the planning stage can stop odour, dust and litter at the site.

Noise

The main noise coming from these facilities will be produced from vehicle movements and from the mechanical processing of the waste and air ventilation systems. As with all industrial facilities, hours of operation will be limited to times of the day that will not cause a nuisance to the local community.

Vehicle Movements

Vehicle movements are required so that your waste can be collected either from the kerbside outside your house or from your local civic amenity site and taken to the site. All vehicle movements produce carbon dioxide, which is a greenhouse gas 21 times less powerful than methane (produced in landfill sites as waste breaks down without the help of oxygen).

During the planning stages for the facility, the number of proposed vehicle movements will be taken into consideration and the access to the site and its impact on the local community will also be assessed.

Vehicle movements from the site could be reduced if the facility was located with other waste management treatment facilities, or near to a rail line or canal. Alternatively, siting a reprocessing facility such as a paper mill next to the MRF site would ensure a local demand for the products and limit onward transportation.

Emissions & Health

One of the emissions produced by this process is carbon dioxide gas. This is released by vehicle movements needed to collect waste from the kerbside and from civic amenity sites. This can be reduced by using alternative fuel sources to power the collection vehicles.

Dust and Bio-aerosols (biological particles) could be produced as the waste is transferred from the collection vehicles into the facility and from movements within the facility. The impact of this is limited by staff working at the facility wearing the correct protective equipment.

The facilities are enclosed thus limiting emissions to the environment and have efficient ventilation systems. Emissions are strictly regulated and controlled by the Environment Agency.

The Department for Environment, Food and Rural Affairs have recently commissioned a review of the effects of waste management. It concluded that although the information is incomplete and not ideal, the weight of evidence from studies so far indicates that present day practice for managing solid municipal waste has, at most, a minor effect on human health and the environment, particularly when compared to other everyday activities.

Visual Impact

As can be seen from the pictures, these facilities look no different to other industrial facilities. The UK currently has quite a few MRF facilities in operation and there are many more in Europe.

Planning conditions will suggest that any new facility built should be in keeping with the surrounding area whether that is an industrial estate or a rural setting.

Costs

If the biodegradable fraction (green waste and kitchen waste) of our rubbish cannot be diverted from landfill, then the EU will fine the UK for every tonne of waste it continues to send to landfill. To avoid the fines and to find more sustainable ways of dealing with our waste, local authorities are considering a number of different options to treat their waste.

There is no right or wrong combination of options and each local authority might have a different set of facilities depending on local circumstances. These facilities will cost a lot of money and it is important that all the options are evaluated when the decisions are made. The cheapest option is not necessarily the best and what seems like a good option for the present might not be a good choice in 10 or 20 years' time.

The cost of a treatment facility can be dependant on many things; the cost of land, the current collection system, what other facilities your local authority is considering and whether this option will work well with them are just a few of the considerations.

Where does this fit in?

This treatment will not act as a stand-alone treatment and will need other types of facilities to be able to treat its outputs. These treatment facilities can either be built on a site on their own or can be positioned next to each other on a larger site.

The location and type of facility that your local authority chooses will be dependent on a number of factors including available land, transport access, how close the site is to local houses and how much it will cost.

What can I do?

You are producing the waste that your local authority has to deal with and treat. To help your local authority and the environment, there are a number of ways you can make a difference.

Firstly, think about the rubbish that you produce at the moment, and consider how you could reduce it. Can you recycle or compost more of your waste?

Secondly, take an interest in what your local authority is considering. They will be making some tough decisions soon about how your waste will be treated over the next 20 to 30 years. Take part in any consultation process, find out more about what they are considering and tell your neighbours! We all produce rubbish and we need to start taking responsibility for how we dispose of it. To find out more about what your local authority are considering, get in touch with them or read their proposed waste strategy. Your opinion counts!



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RPS